0.1 Vacuum Technology Laboratory

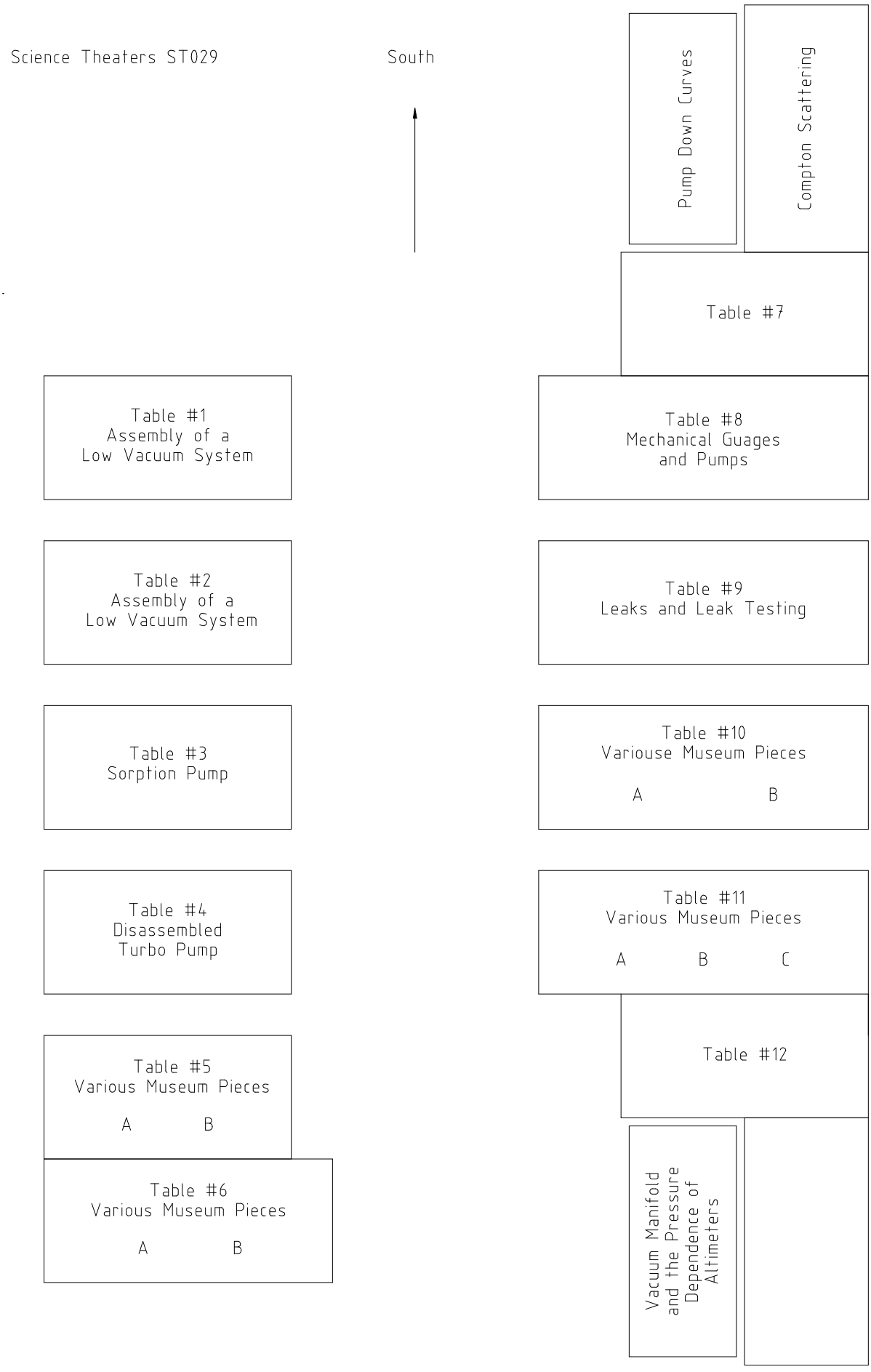
Note: This lab is designed to be done in Science Theaters 029

0.1.1 Experimental Setup

Equipmnent List:

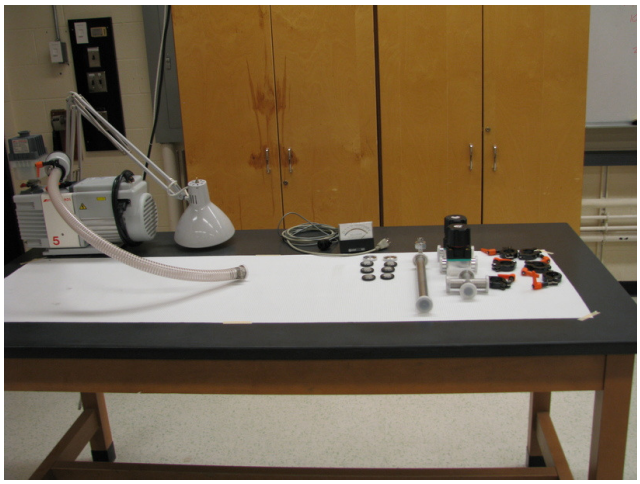
I) Hand operated vacuum pump, Edwards RV5 mechanical pump, schematic diagram of vacuum pumping principles, 5 board-mounted gauges.
II) Sorption pump, liquid nitrogen and dewar, thermocouple vacuum gauge, safety glasses, heat gun.
III) "Leaky weld" assembly, Edwards RV5 mechanical pump, helium bottle with regulator and bench clamp, 2 labs stands, 2 fork clamps, 2 right-angle clamps.
IV) Vacuum manifold cart, Edwards RV5 mechanical pump, 2 anatek power supplies, connecting leads.
V) Edwards RV5 mechanical pump, foreline trap, 2 isolation valves, vacuum hose, 25cm tube with NW25 terminations, four-way cross with NW25 flanges, thermocouple vacuum guage, assortment of NW25 O-rings and metal centering rings. assortment of NW25 clamps, rubber gloves.
VI) Vernier capable computer, Vernier intrumentation amplifier, pumpdown_template.cmbl Loggerpro file, pumpdown and leakout curve apparatus, stopwatch.
VII) Diffstak equipment cart, RG-83 ionization guage controller, Edwards RV5 mechanical vacuum pump. VIII) High Vacuum Turbo Molecular System.
Components of vacuum system museum that match labels available in "label" section.

0.1.2 Room Layout

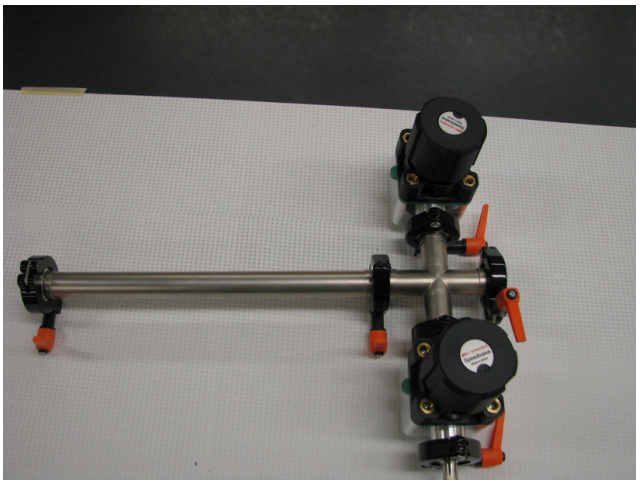


0.1.3 Table Layout

Table 1: Assembly of a Low Vacuum System



(a) Equimpent arranged for the student



(b) Equipment assembled for storage

Figure 2: Table 1 Contians: Edwards RV5 pump, foreline trap, 2 isolation valves, vacuum hose, 25 cm tube with NW25 terminations, four-way cross with NW25 flanges, Varian vacuum gauge and gauge head, assorment of NW25 rubber O-rings and metal centering rings, assortment of NW25 clamps, and rubber gloves.

Table 2: Assembly of a Low Vacuum System

Table 2 should be identical to Table 1

Table 3: Pumping with No Moving Parts

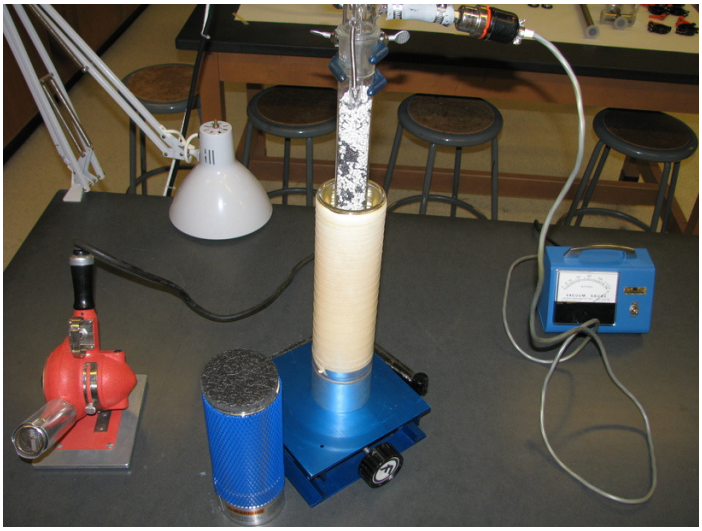


Figure 3: Table8 3 Contains: sorption pump, lab jack, tc gauge and guage head, tall liquid nitrogen dewer, second liquid nitrogen dewer, heat gun, and safety glasses (not shown).

Table 4: Dissasembled Turbo Pump

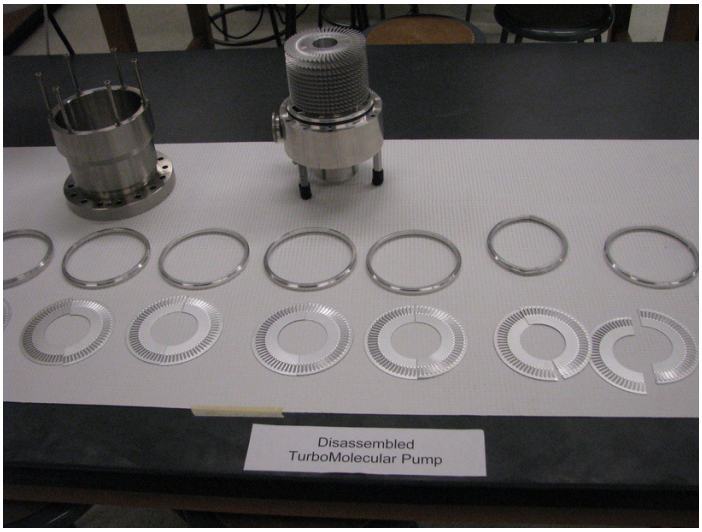


Figure 4: Table 4 Contains: dissasembled turbo pump.

Table 5: Various Museum Pieces

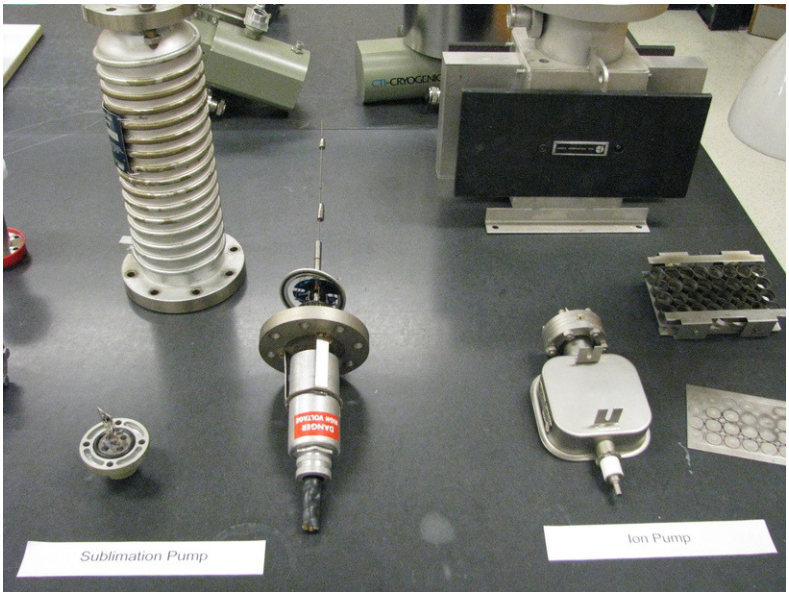


Figure 5: Table 5A Contains: sublimation pump and ion pump.

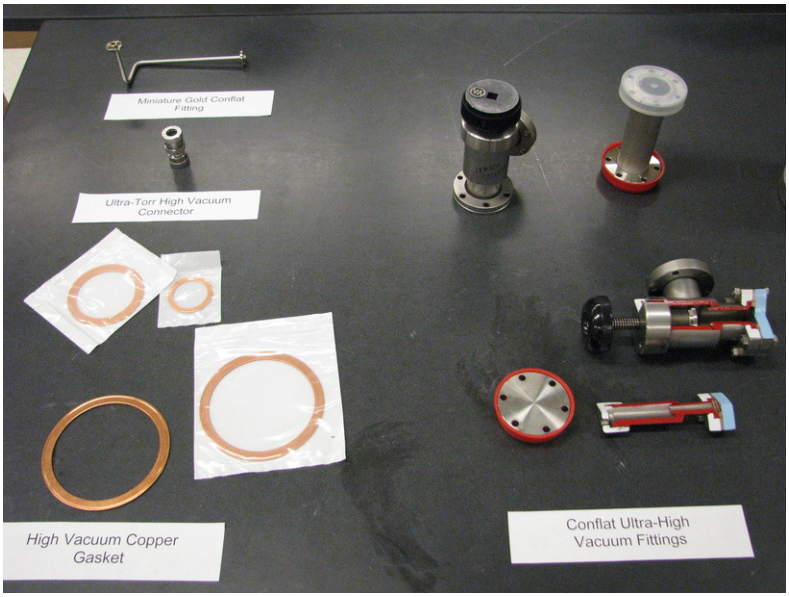


Figure 6: Tabel 5B Contains: miniature gold conflat fitting, ultra-torr high vacuum connector, high vacuum copper gasket, and conflat ultra-high vacuum fittings.

Table 6: Various Museum Pieces

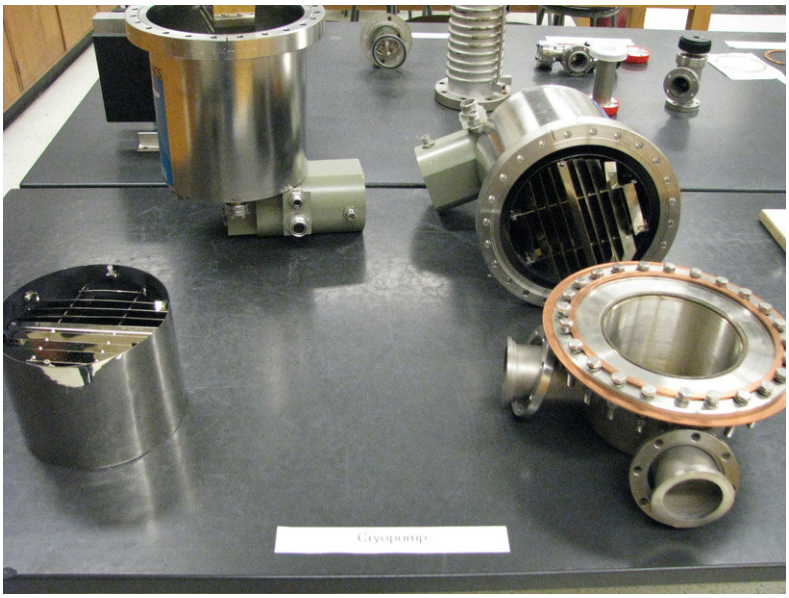


Figure 7: Table 6A Contains: cryopump.

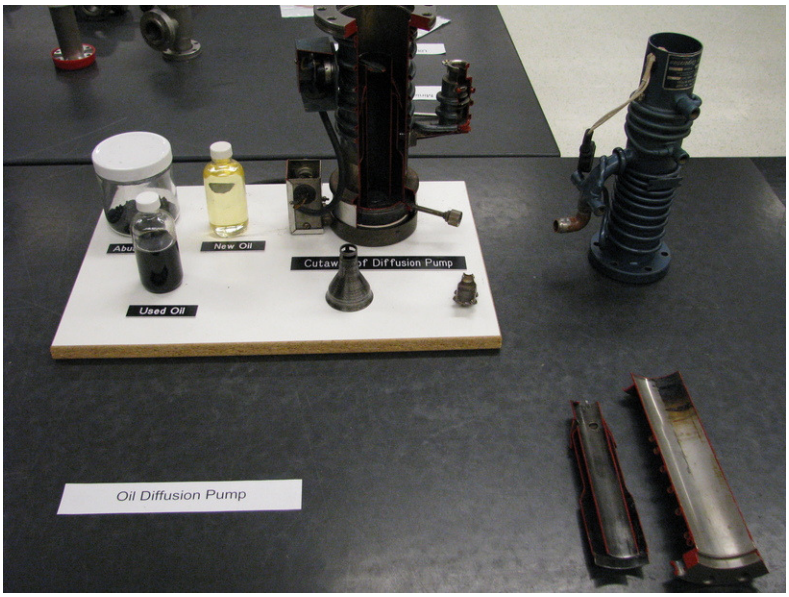


Figure 8: Table 6A Contains: oil diffusion pump.

Table 7: Empty

Table 7 should remain empty

Table 8: Mechanical Gauges and Pumps

Figure 9: Table 8 Contains: hand operated vacuum pump. Edwards RV5 mechanical pump, schematic diagram of vacuum pumping principles, and 5 board-mounted gauges.

Table 9: Leaks and Leak Testing

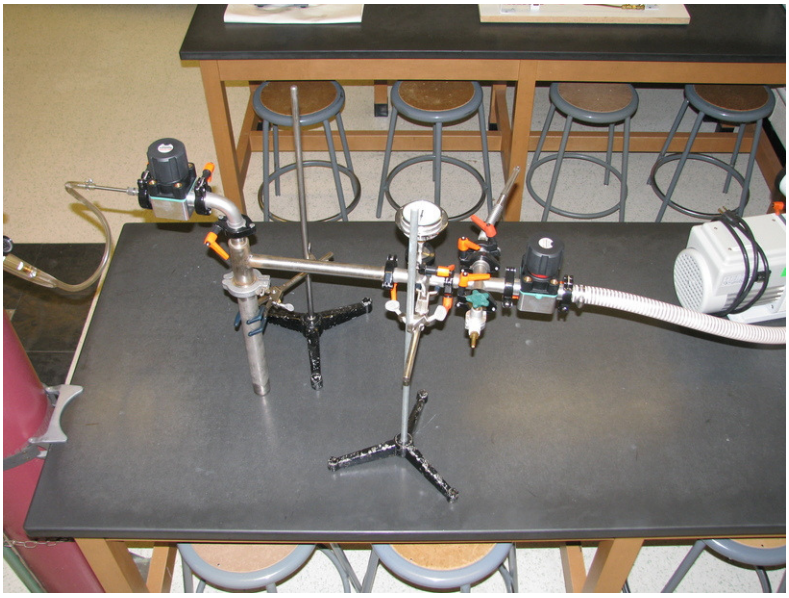


Figure 10: Table 9 Contains: "Leaky Weld" assembly, Edwards RV5 mechanical pump, helium bottle with regulator and bench clamp, 2 lab standss, 2 fork clamps, and 2 right-angle clamps.

Table 10: Various Museam Pieces

Figure 11: Table 10A Contains: Bourdon tube gauge, Bayard-Alpert ionization gauge, Aneroid mechanical vacuum gauge, cold cathode pressure sensor.

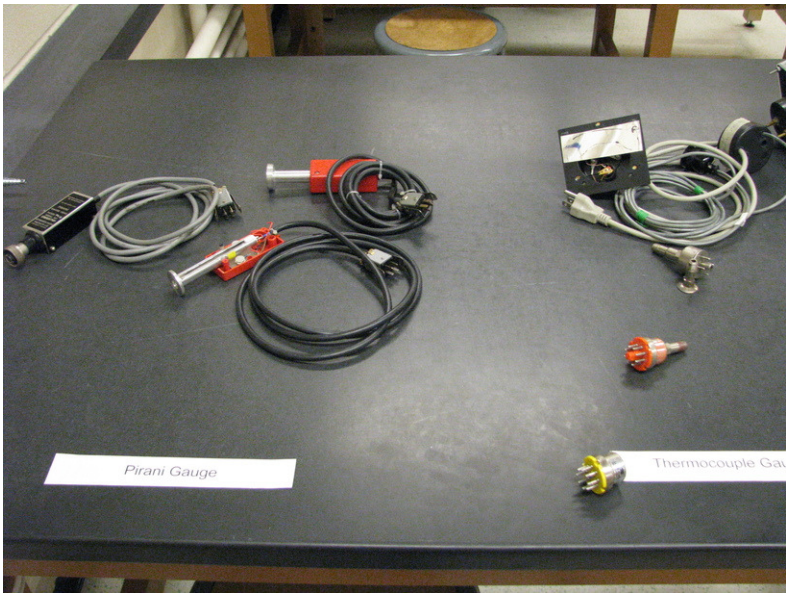


Figure 12: Table 10B Contains: Pirani gauge and thermocouple gauge.

Table 11: Various Museam Pieces

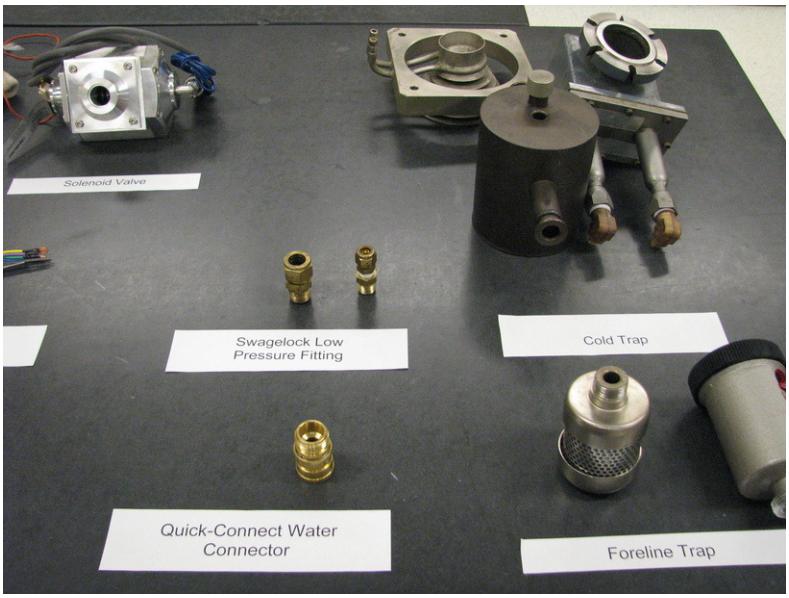


Figure 13: Table 11A Contains: swagelock low pressure fitting, cold trap, quick-connect water connector, and foreline trap.

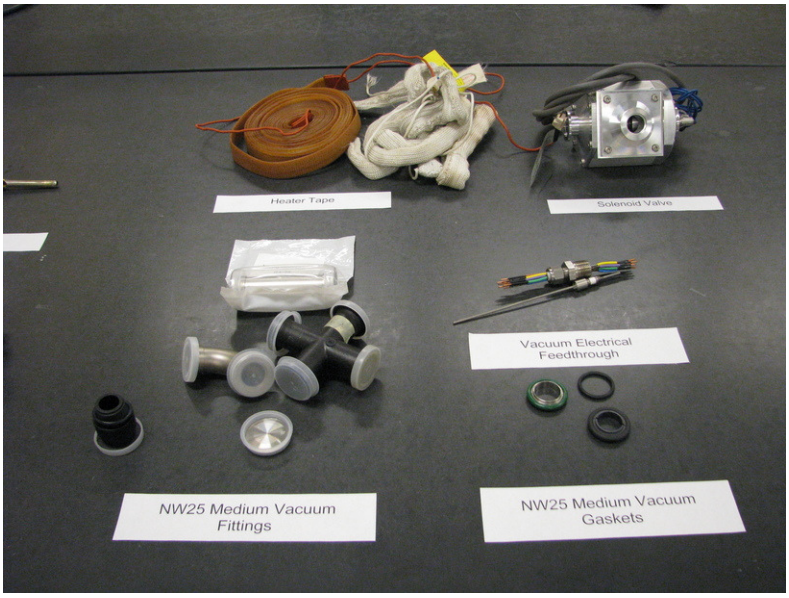


Figure 14: Table 11B Contains: heater tape, solenoid valve, NW25 medium vacuum fittings, NW25 medium Vacuum Gaskets, and vacuum electrical feedthrough.

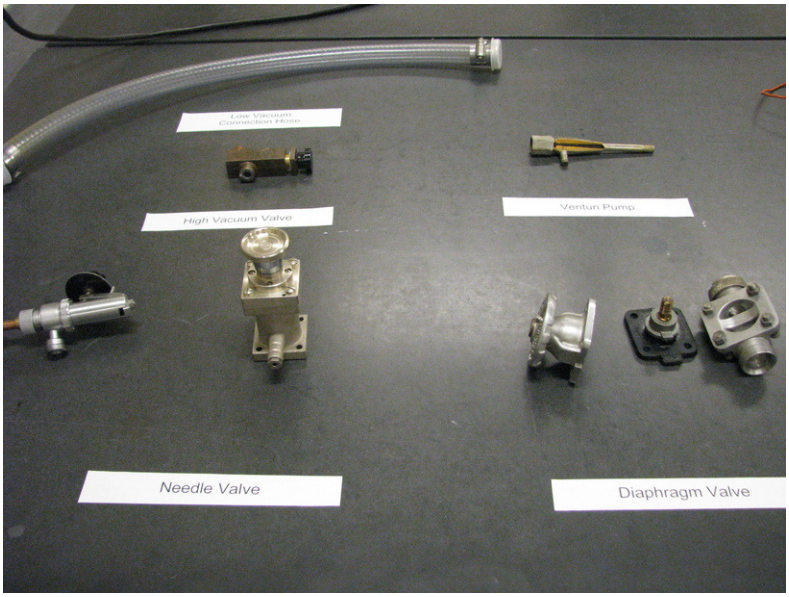


Figure 15: Table 11C Contains: low vacuum cnnection hose, high vacuum valve, venturi pump, needle valve, and diaphragm valve.

Pump Down Curves

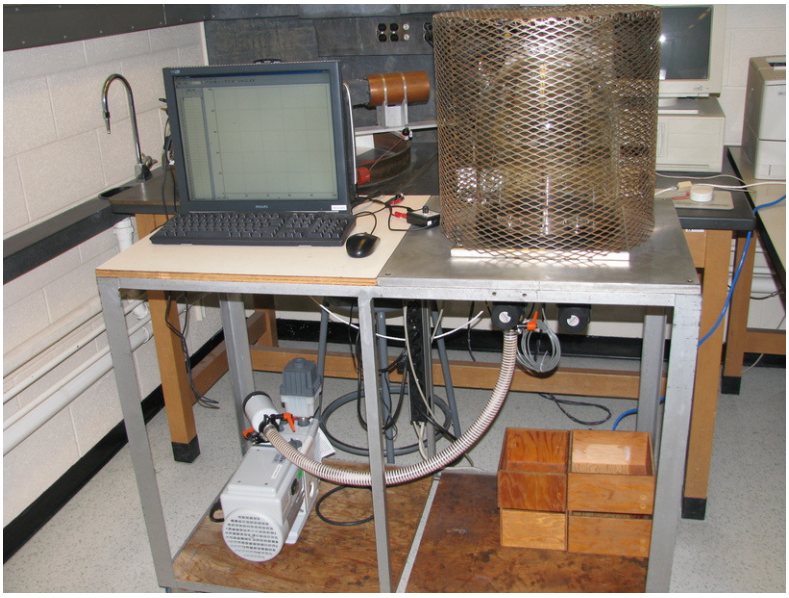


Figure 16: Contains: Vernier capable computer, Vernier instrument amplifier, pumpdown_template.cmbl file, pumpdown and leakout curve apparatus, and stopwatch

Vacuum Manifold and the Pressure Dependance of Altimeters

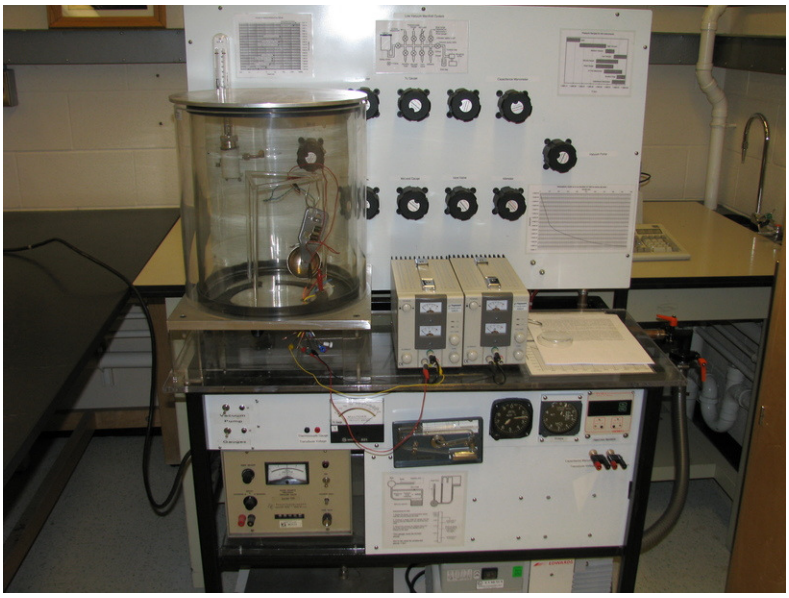


Figure 17: Contains: vacuum manifold cart, Edwards RV5 pump, 2DC power supplies, connecting leads.

0.1.4 Notes to the Instructor

Equipmnent Care:

Startup procedure for diffstak vacuum system.
A) Turn on water for cooling system
B) Close vent valve, main chamber valve, chamber backing valve, and backing valve.
C) Turn on mechanical pump, and guage controller.
D) Open backing valve and chamber backing valve, and pump on system until pressure in main chamber, and backing pipe have a pressure of less then 10mTorr.
E) Turn on diffusion pumb, and allow the oil to warm up for 10 minutes.
F) Open main chamber valve. If the backing pressure raises above 50mTorr close the main chamber valve and allow the mechanical pump or pump on the system for another 30 minutes. Continue this until the backing pressure remains below 50mTorr.
G) Turn on ion Guage.

Shutdown procedure for diffstak vacuum system.
A) Close main chamber valve, and turn off diffusion pump.
B) Allow water to run for 30 minutes.
C) Turn off water, mechanical pumb, and guages. Do not open vent valve.

Startup procedure for the Turbo Molecular Pump.
A) Turn on water for cooling system.
B) Turn on guages, and mechanical pump.
C) Pump on the backing side of the system until the backing pressure is less then 5mTorr.
D) Open the main chamber up to the mechanical pump and allow it to pump down on the whole system until the chamber is less then 5mTorre.
E) Turn on the turbo pump with high frequency and pump down on the whole system.
F) Turn on the ion gauge and keep an eye on the progress. The system should eventually bottom out the ion guage.
G) Once the pressure is in 10e-7 the ion pump can be turned on to help with pump down.
H) Once the load on the ion pump is low turn the frequency of the turbo pump to low.

Shutdown procedure for the Turbo Molecular Pump.
A) Close the main chamber valve.
B) Turn off ion pump and turbo molecular pump.
C) Alow system to cool for 30 minutes.
D) Turn of water, mechanical pump, and guages.

Common Errors made by Students: No notes on common errors made by students

Sample Data: No sample data.

0.1.5 Maintenance

A) If a pump has not been used for awhile it may need to be seasoned. An unseasoned pump can appear as a leak in the system. The pump may need to be ran for up to a week in order remove excess water and other contaminants from the system.
B) Check the colour and level of the oil in the mechanical pumps before each use.

C) Check vacuum log for further instruction on when to change the oil of the diffstack and turbo pumps.

0.1.6 Labels

Bourdon Tube Gauge

Sublimation Pump

Ion Pump

Cryopump

Oil Diffusion Pump

Solenoid Valve

Cold Trap

Foreline Trap

Heater Tape

High Vacuum Valve

Venturi Pump

Needle Valve

Diaphragm Valve

Pirani Gauge

Thermocouple Gauge

Bayard-Alpert Ionization Gauge

Aneroid Mechanical Vacuum Gauge

Cold Cathode Pressure Sensor

Disassembled TurboMolecular Pump

Miniature Gold Conflat Fitting

Ultra-Torr High Vacuum Connector

High Vacuum Copper Gasket

Conflat Ultra-High Vacuum Fittings

Swagelock Low Pressure Fitting

Quick-Connect Water Connector

NW25 Medium Vacuum Fittings

Vacuum Electrical Feedthrough

NW25 Medium Vacuum Gaskets

Low Vacuum Connection Hose