Saturday Sept 16, 2006

Update on hardware

11:55 – 12:15

Varian V81M released July 2006
A replacement for the V70LP

V81M (not V81T)

- 50% reduction in power.
  - *lower bearing temperature.*
- Slightly higher pump speed.
- Higher tolerance to foreline pressure.

All future AMS systems will use the V81

Comparison of pumping speed for V70LP and V81M

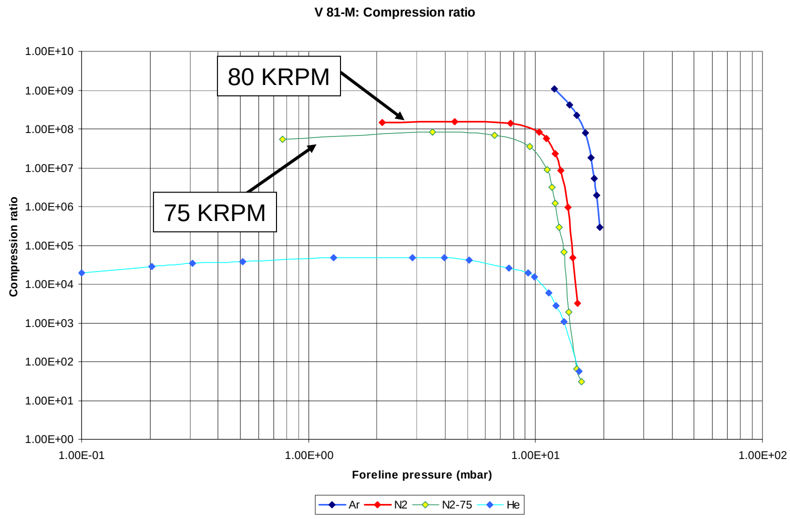
	Pump	Pin (mbar)	Power (W)	S (L/s)
N2	V70LP – 75k	7.52×10^{-3}	45	48.55
	V 81-M-75k	7.52×10^{-3}	22	48.55
	V 81-M-80k	6.98×10^{-3}	23	52.45
He	V70LP	9.71×10^{-3}	29	37.60
	V 81-M	7.84×10^{-3}	17	46.56
Ar	V 81-M	7.13×10^{-3}	28	51.20

Data from Varian

V81M Upgrade Issues

- Varian has an upgrade program to exchange a V70LP for a new V81M.
- New V70LP pumps are no longer available but rebuild/exchanges are still supported.
- Electrical and roughing port are the same style and location as V70LP.
- V81 does require a new cooling fan mounting bracket.
- The V81 PCB controller has the same electrical connections and mounting holes as the V70 PCB controller.
- The V70 PCB controller WILL drive the V81M pump at slightly reduced speed (75 KRPM vs 80 KRPM).

Operating with V70 controller will slightly reduce best performance



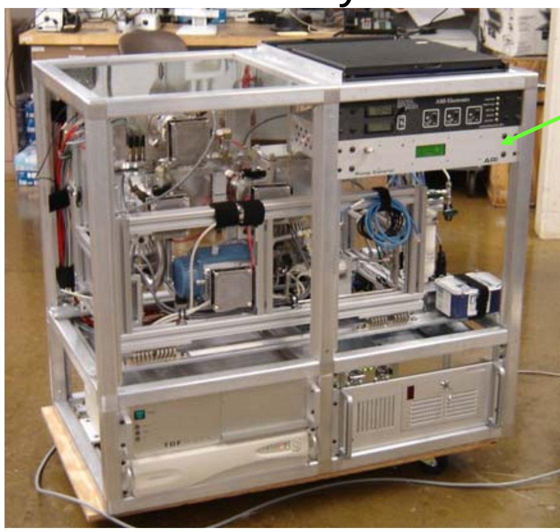
Data from Varian

New Pump Controller Interface

Improved control and diagnostics of the vacuum pump system

- Diaphragm pump
- Turbo Pumps
- Total DC current consumption
- Inlet pressure (auto start)
- PC control through USB with data logging capability
- Older systems are upgradeable

G1 aircraft cTOF with new pump control system



Controller has a 4x20 character LCD with a 3-fxn data entry knob and a USB port for PC control.

Successfully operated on G1 aircraft in MaxMex 2006

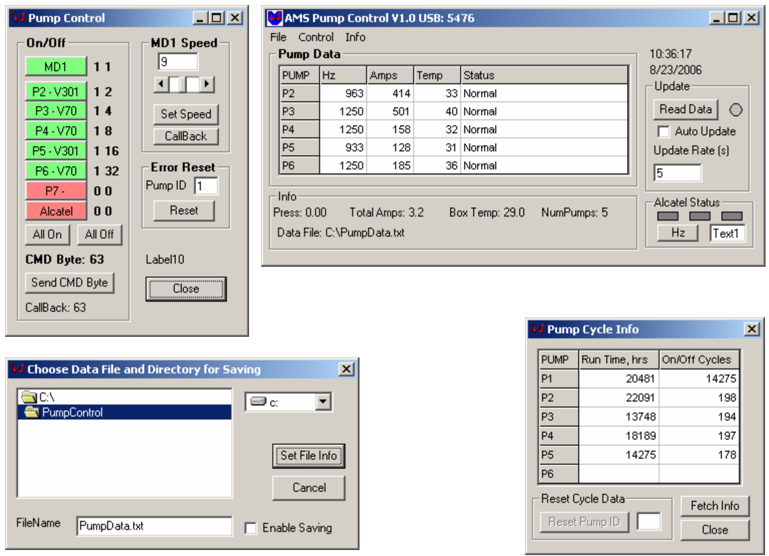
Turbo Pump Status and Error Messages

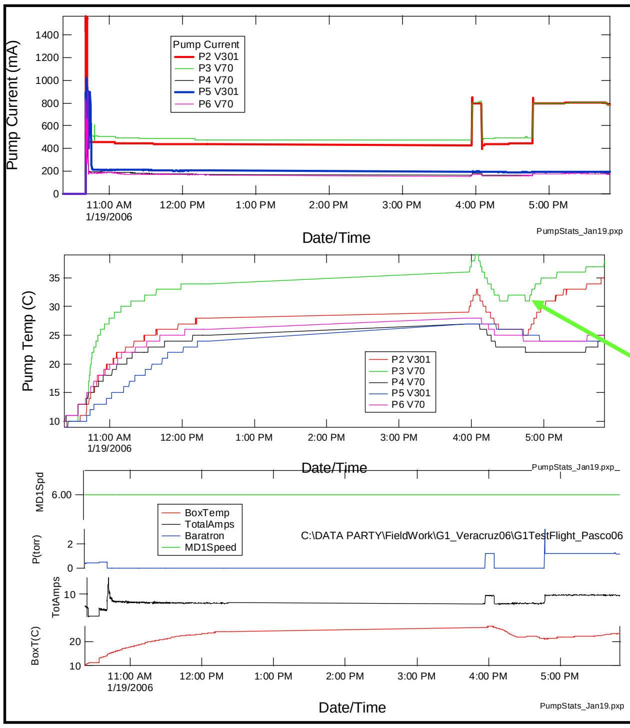
Pump status, pump speed, bearing temperature (and controller), and current are continuously updated.

Pumps Status
- Stopped
- Interlock
- Starting
- Auto Tune
- Braking
- Normal
- Error

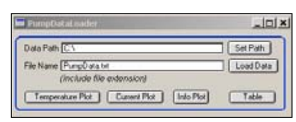
Pump Errors
- No connection
- Pump over temp
- Controller over temp
- Power fail
- Normal start fail
- Soft start fail
- Short circuit
- Too high load

PC Software interface for Pump Controller





Diagnostic plots



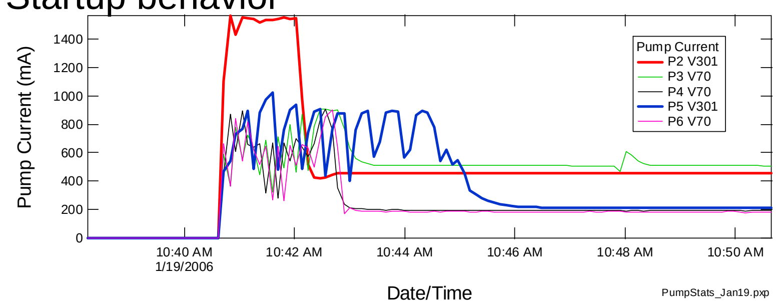
Pump 3 runs warmest

Pump 3 has highest failure rate…

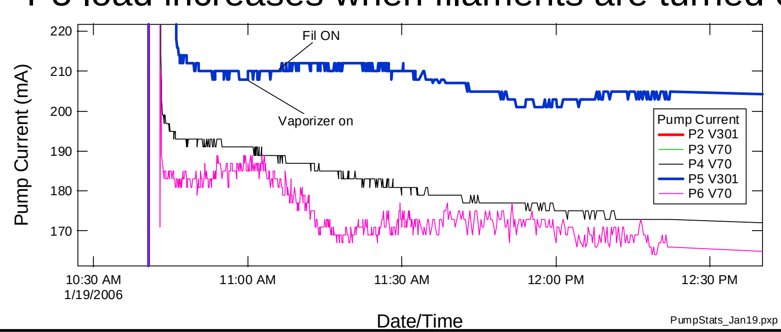
Consider Water Cooling Turbos in Warmer Operating Environments

- Since we now know that P2 (V301) and P3 (V70) run warmest water cooling these may be beneficial.
- Water cooling all turbos is probably not necessary.

Startup behavior



P5 load increases when filaments are turned on



Electronics needs to be redesigned for TOF systems

Only chopper, vaporizer and heater bias are need for TOF

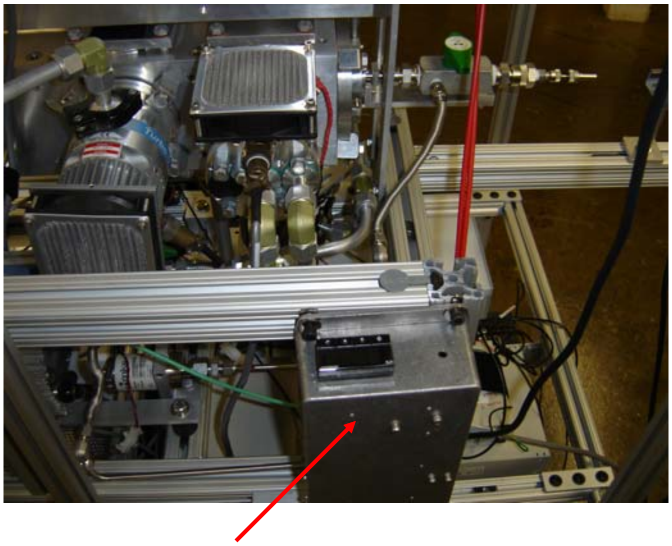
Power supply can be redesigned for TOF system

24 VDC supply (40A) in a 1U RM size

Constant Pressure Inlet System

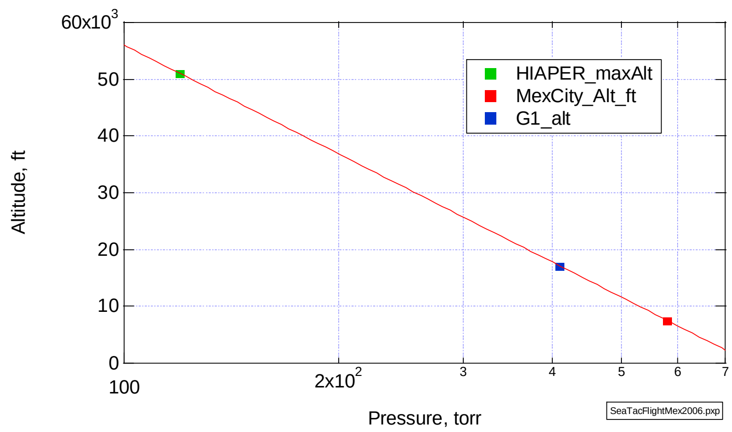
- Important for use on aircraft.
- Eliminates variation of particle velocity and particle transmission calibration as lens pressure changes with altitude.
- Past and current efforts have been made by
  - Ann Middlebrook (P3)
  - Jose Jimenez (C-130/HIAPER)
  - Jonny Crosier (BA 146)
  - J. Jayne (G1)

Compact pressure controller system



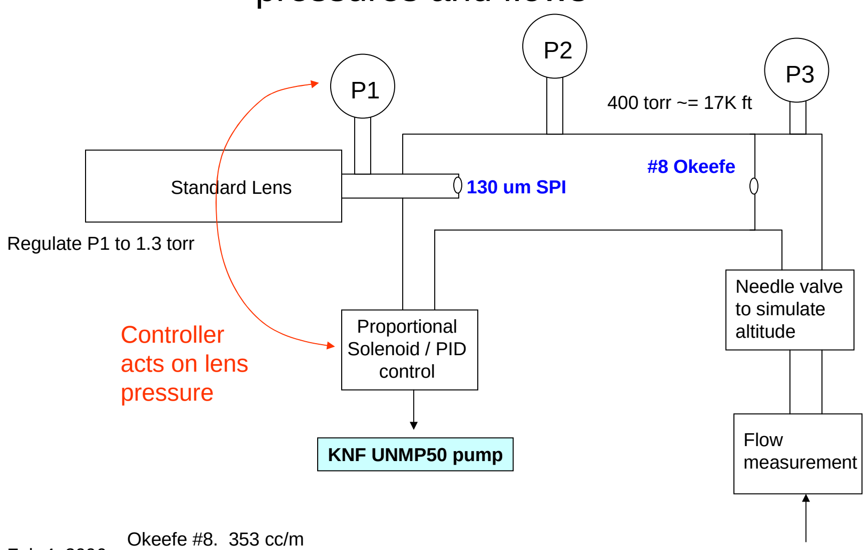
Houses small pump, electronic valve and PID controller

Calculated Pressure Altitude relationship



G1 Max. altitude 17,000 ft ~420 torr (for MaxMex)
HIAPER max. altitude 51,000 ft

Schematic of test setup to evaluate pinhole sizes, pressures and flows

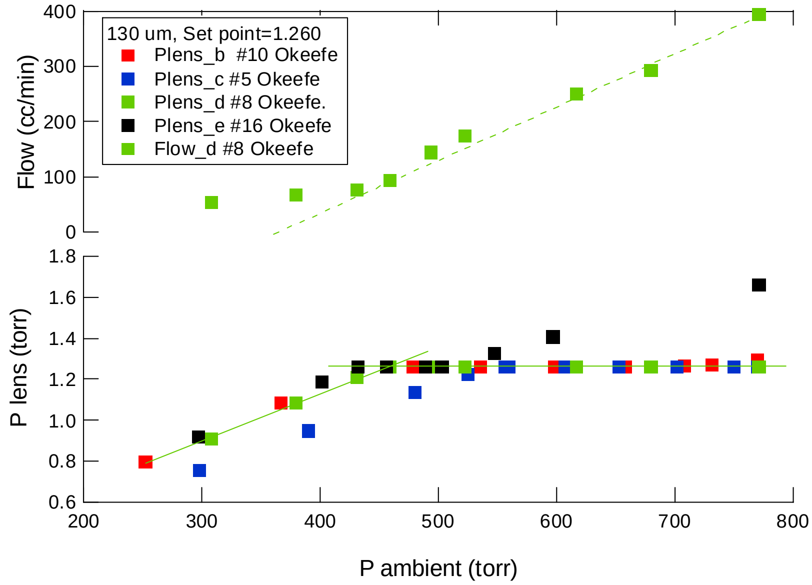


Feb 4, 2006

Okeefe #8. 353 cc/m measured under choke flow conditions

For Plens=1.28 torr (controller set point), P2 =420 torr.

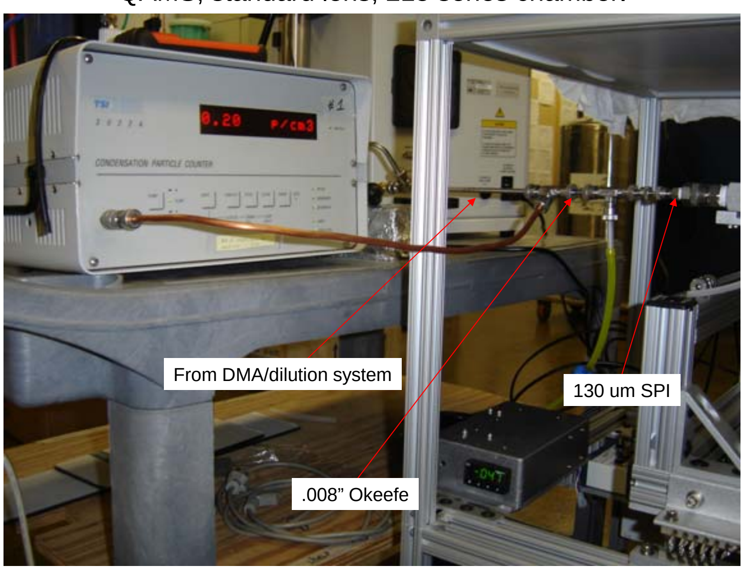
Evaluation of pressure regulation range



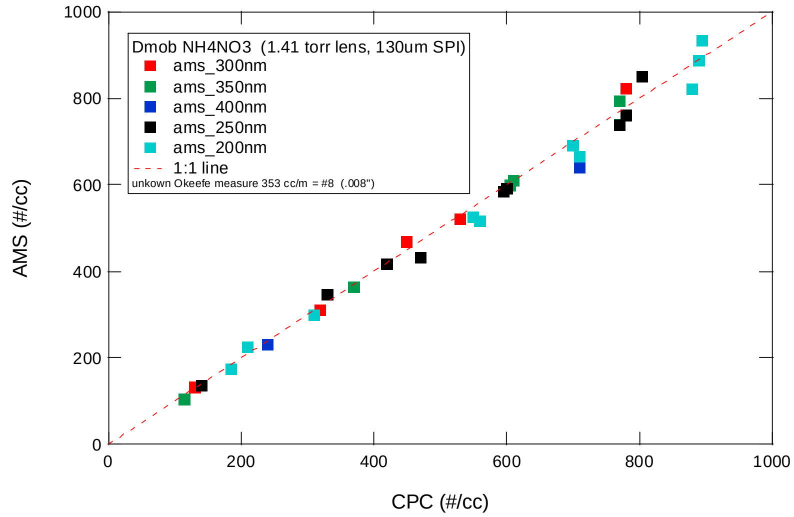
I choose the green points, Okeefe #8…

Aerosol transmission tests were performed using this plumbing arrangement.

QAMS, standard lens, 215 series chamber.



Collection efficiency measured by direct count method.



Used QAMS standard lens, 215 series chamber, Pressure Controlled inlet, Plens=1.41 torr.

Collection efficiency.

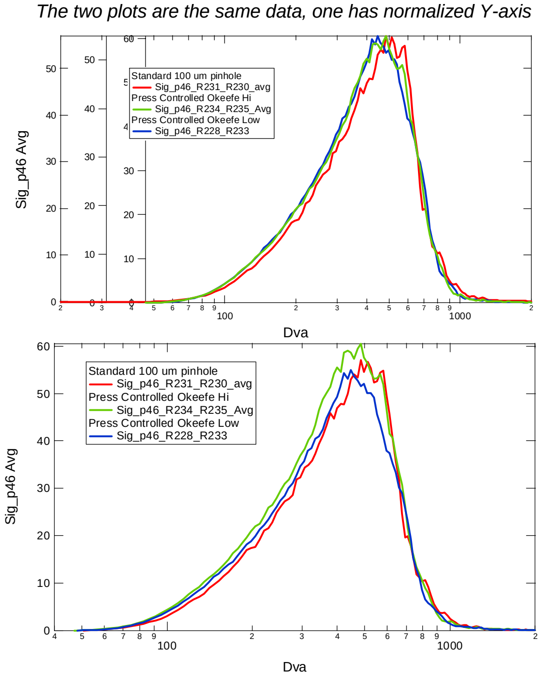
Measurement of polydisperrse NH4NO3 using standard 100um pin-hole assembly and pressure controlled inlet. Aerosol concentration kept ~constant at (3.5-4.0)e4/cc.

This figure suggests that there are no significant losses in PC inlet.

Polydisperse NH4NO3 sampled by 3 different configurations:

1) Standard 100um pinhole assembly
2) 130 um pinhole with Okeefe ¼" tube orifice at upstream end (high)
3) 130 um pinhole with Okeefe ¼" tube orifice at downstream end

The two plots are the same data, one has normalized Y-axis

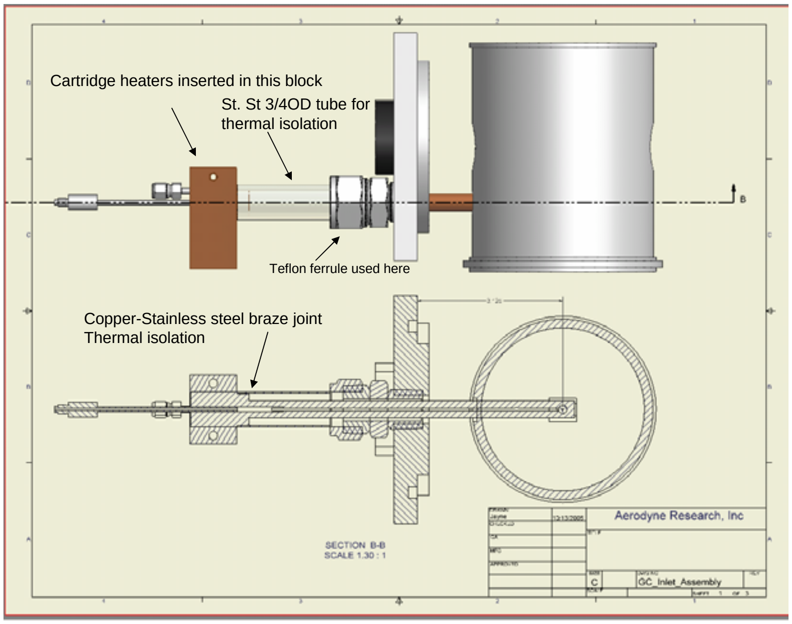


Pressure Controller Summary

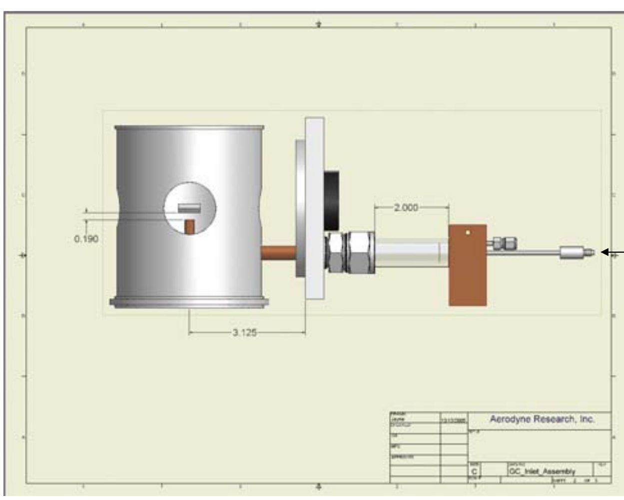
- Determine lowest pressure range for operation…select pinholes and pump.
- Use the lens pressure as the pressure to regulate.
  - Eliminates a second pressure gauge
- For sampling pressures >~400 torr losses seem to be small.
- For sampling pressures <~400 torr losses may be significant. Need to design better sampling interface to minimize losses.
- Application: tunable pressure lens

Direct Probe GC Inlet

- Designed for Dr. Akiama at Japanese Automobile Research Institute (JARI)
- Allows use of TOF spectrometer to measure effulents from GC capilary column



24 gauge (.016” ID x .022” OD) st. st. capillary tube extends from GC column connector thru the entire length of the copper rod, makes a 90 degree bend upwards to direct fused silica column effluent to ionizer.
The silica column is inserted into the st. st. column which provides ease of assembly, alignment and (good?) thermal contact with the heated copper pieces.

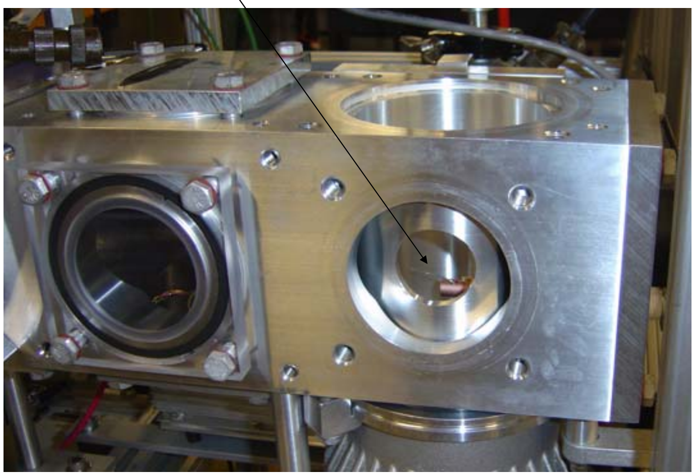


GC column connector

St. st. capillary column extends to the face of this connector

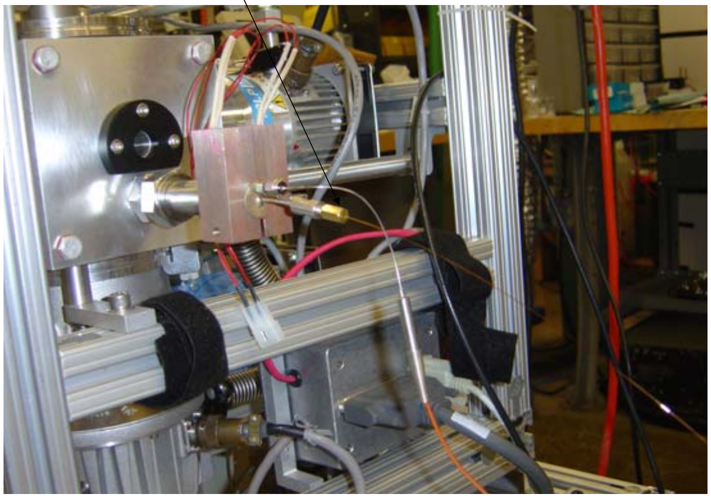
Two step insertion process.

Insert probe from the rear with vertical copper piece removed.
Vertical copper rod is installed after inserting probe. Note steel capillary tube is bent horizontal for insertion from rear of AMS.



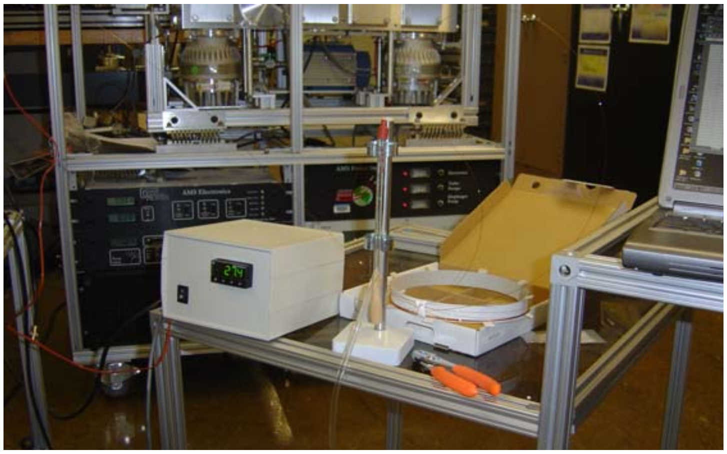
Vertical copper rod is installed from top of chamber, access thru VUV port is helpful. Note steel capillary tube is now vertical, directing gas to ionizer.

Slide GC column inside of steel capillary column until it won't go any further…this is where the st. st. column bends 90 deg. Upward into ionizer. Hand tightened brass nut with vespel ferrule for a leak tight seal.



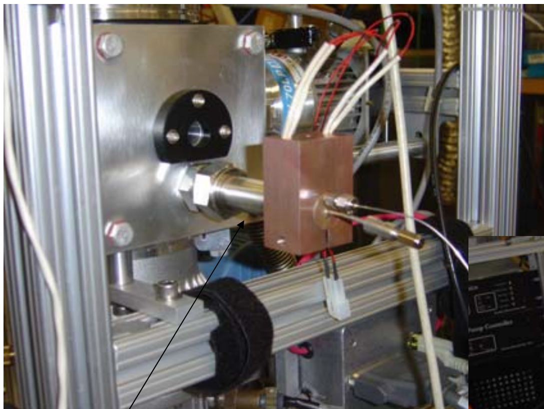
I used an RGA on detection chamber to test for leaks as the system was heated

Flow measures 17.6 cc/min at entrance end of column.
V301 at 0.88 amps…ok (0.34 amps no load)



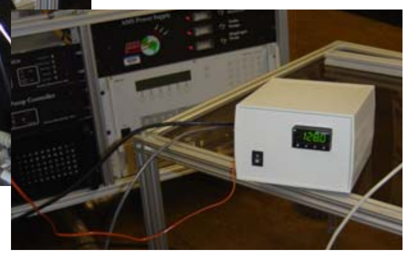
Heating scheme.
Two cartridge heaters (3/16 OD x 1.5 L 20 W 120 VAC) inserted into copper block. With insulation, achieved 180C. Need a bit more power will get new higher power heaters. No leaks…

These 20W heaters have been replaced with two 100W ¼" OD heaters….plenty of power



¾ OD St.St. tube thermally isolates from chamber.

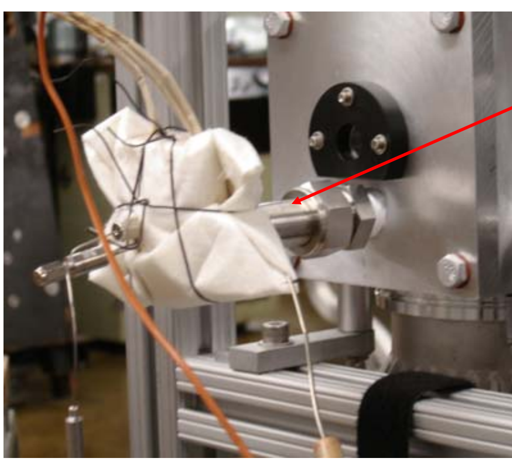
PID controller



Nov. 29, 2005

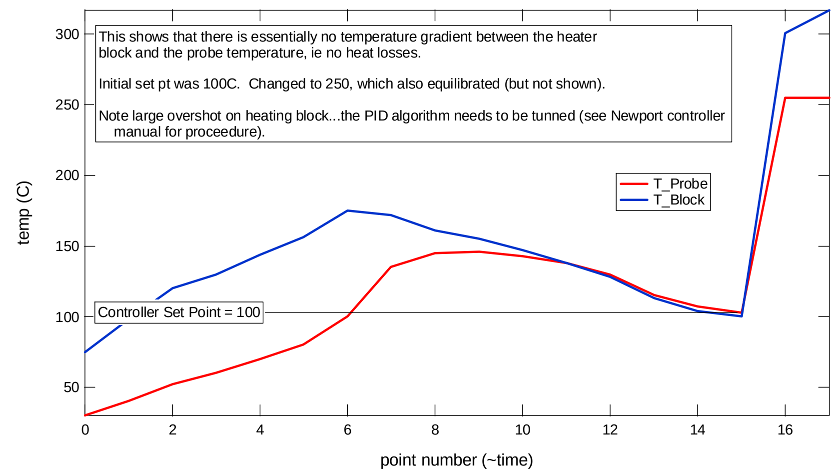
100W heaters tested…max temperature tested was 250C.

Measuring of temperature gradient between heater block and probe temperature.



For temperatures >200C you may need to cool the ¾" St. St. tube with either a heat sink or a small fan.

Minimal temperature losses



Dr. Akiama's Direct Probe results with VUV photo ionization