A Pressure-Controlled Inlet (PCI) for Airborne AMS Sampling

180 micron orifice  
260 cc/min

From Sampling Line  
Exhaust

80 Torr

Exhaust

Into the AMS

- The two exhaust lines are connected and have an MKS pressure control unit with a Baratron pressure sensor on the upstream side of the control valve.
- The pressure is maintained at 80 Torr (107 mbar), which is at least a factor of two lower than the lowest pressure we expected to encounter (225 Torr).
- We replaced the 100 micron AMS orifice in front of the standard aerodynamic focusing lens with a 300 micron orifice which has a flow rate of 1 sccs at 80 Torr.
Our PCI Design for NEAQS-ITCT 2k4

Note:
- Inlet will consist of a swageable VC8 fitting (MLV-U-VCR-28.4x39.4)
  brazed into hole in expansion chamber cap
- Exhaust ports will consist of
  male-to-female fittings (MLV-U-VCR-28.4x39.4) (v3)
  brazed into hole on either side of expansion chamber nozzle.
- Optional diffuser will be provided by a
  standard drilled gasket from Swiss Laser (MLV-U-VGR-2-200).

Scale 1:3
Laboratory Testing

• Used a separate pump on a section of inlet line with a pressure sensor (Baratron)
  – This doesn’t limit the flow rate into the system
• The reduced pressure volume was sampled with the PCI followed by the AMS with a 300 micron orifice
Lab Results: m/z=28 Signal w/ Varying Upstream Pressure

PCI pressure = 107 mbar
Slope of N2+ vs pressure is slightly lower with PCI.
Velocity Calibrations
w/ Varying Upstream Pressure

Neglecting the 50 nm points, the velocity calibration matches the previous 100 micron orifice calibration at Boulder ambient pressure (828 mbar) and did NOT change with upstream pressure.
• Ddma was 343 nm and Dva was 10% lower with the PCI.
• More particles in the smaller mode (more crystallization/breakup?)
• Caveat – these two runs were done 8 months apart.
• Recent field experiments are inconclusive.
• This needs to be repeated (along with particle transmission).
• Additionally we found the Nitrate IE remains constant w/ upstream pressure.
• Flow rate always decreased initially due to pump down.
• Despite large (20-30%) changes in pressure, the AMS flow rate remained fairly constant.
• Slight (<2%) changes in the flow rate occurred during ascents/descents, probably due to temperature fluctuations of the lens.
Field Results: \( m/z = 28 \) signal as \( f(\text{sampling pressure}) \)

PCI pressure = 107 mbar
Field data shows N2+ remained constant with pressure.
PCI Summary

• A constant pressure of 80 Torr (107 mbar) was maintained in the PCI.
• When the upstream pressure was varied from 270 to 830 mbar:
  – The AMS air signal remained constant
  – The particle velocity calibration remained constant
  – The particle beam profile (beam width probe data) remained constant
• Things to check again:
  – Particle Transmission
  – Ammonium Nitrate evaporation
  – Ammonium Nitrate crystallization/breakup
• Although it controlled the mass flow rate well during airborne sampling, we will probably redesign it to minimize residence time (currently 22 s).