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Application Note Number 11: Atmospheric Pressure Sampling System

Abstract: It is often of interest to measure the composition of gases which are at pressures of 1 atmosphere or higher. The Extorr probe's vacuum environment for partial pressure measurements should be no greater than 10^{-5} torr. This note describes a simple pressure reduction system for this application.

If it is desired to make partial pressure measurements on the gases which are at pressures at or above atmospheric pressure, a pressure reduction system is required to bring the sample down to a pressure of 10^{-5} torr or below.

An example of a simple pressure reduction sampling system for the Extorr is shown in figure 1 below.

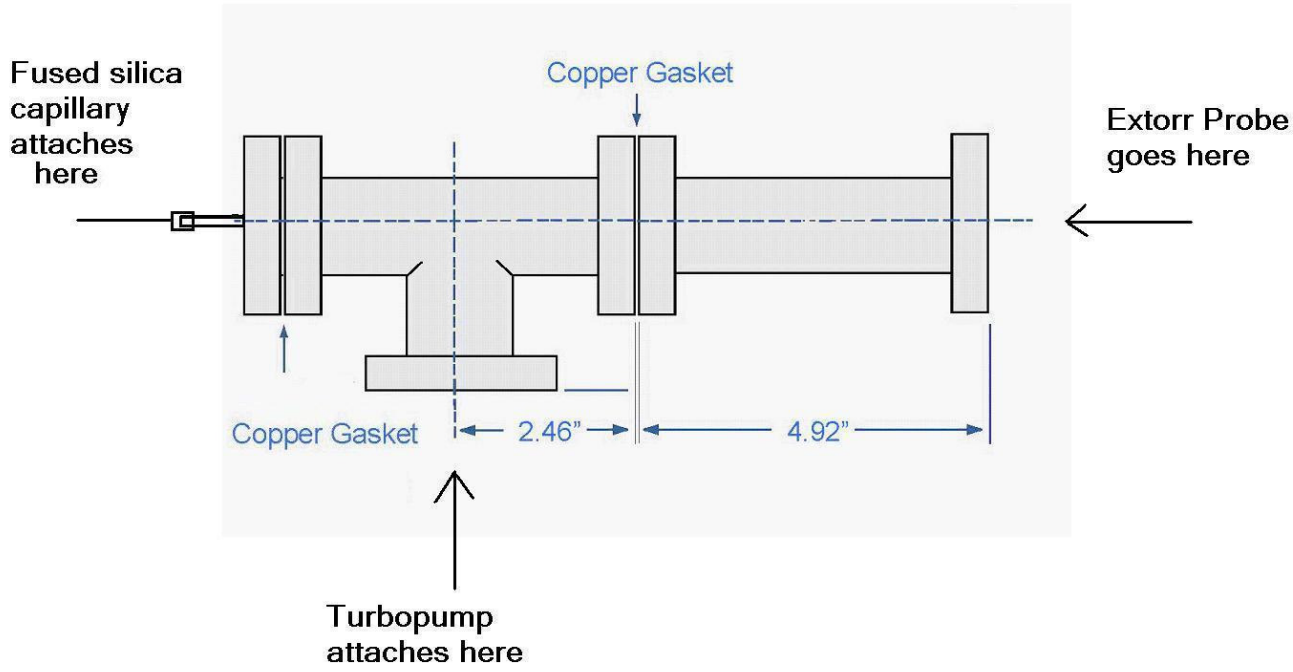

Figure 1 Pressure Reduction Plumbing

The vacuum system consists of a 2 ¾ inch CF vacuum nipple and T. These parts are produced by computer controlled equipment and have very tight tolerances. Most vacuum equipment suppliers carry these and your total bill will be less than $250. The turbo, of course, will be more expensive. A small 50 l/s necked to a 2 ¾ inch conflate will work well here. A roughing pump will be required to back the turbo. The actual pumping on the probe will be about 30 l/s.

The gas sampling is done by a very narrow inside diameter fused silica capillary. A number of vacuum supply companies offer 2 ¾ inch CF flanges with 1/8 inch ferrule sealed tube fittings. Gas chromatography supply houses offer both the plastic coated. Fused silica, capillaries and graphitized high temperature plastic ferrules. Properly sized, the ferrule will seal the capillary in the fitting on the 2 ¾ inch flange. The diameter and length of the capillary will depend on the sample.

The flow of gases through such a capillary is rather complex in that flow goes from a laminar pressure range to an intermediate and then to a molecular pressure range. Our experience has been that a meter of 80 micron id capillary will reduce the pressure from atmosphere to the 10^{-6} torr pressure range, in the vacuum system. The pressure reduction goes roughly linear with respect to the length of the capillary. The reduction goes, roughly, as the fourth power of the inside diameter of the capillary. That is, going from 80 to 40 microns means that the length may be reduced by 1/16 to get to the original pressure for the 80 micron length. The system response can be very rapid.

The advantage of the long capillary is that if it gets clogged, a short front section of the capillary can be cut off without changing the system significantly.

Heating the vacuum system and the capillary inlet can reduce some background spectra from the vacuum system and can help keep the system from suffering from problems with condensable gases.

The question, always asked, is “can you see gases which are in the single parts per million range?” The answer is, of course, yes and no.

If you are looking for a gas which produces an ion at a mass to charge ratio not shared by typical background gases, the answer is probably yes. If you are looking for gases which normally come from the chamber background or from the ionizer filament such as CO, CO2, or water vapor, the answer is no.