A particle counter samples air by extracting it from the surrounding environment.

Isokinetic sampling describes the special case where the velocity of the sample air entering the probe is equal to the velocity of the air in the main air flow stream (e.g. clean room directional flow) so that both the sample air and the main air flows are at the same fluid kinetic conditions.

When this happens, the probe captures all of the particles, which existed in the sample air while it was outside the particle counter, and a representative air-particle sample is captured.

If the flow is not isokinetic, the sample air and the surrounding air undergo rapid direction changes around the probe tip, convergent in the case of super-isokinetic capture and divergent in the case of sub-isokinetic capture. Since the particles have a much higher unit mass than does the air, they cannot make the rapid flow direction changes.

Under super-isokinetic capture conditions, particles that are in the sample air about to be captured cannot follow the air into the probe and pass by outside the probe.

Under sub-isokinetic capture conditions, particles that are in the air outside of the sample air to be captured cannot follow this external flow as it deflects around the probe, and enter into the probe, adding to the particles in the sample air captured.

Under these non-isokinetic conditions the number of particulates captured by the probe is not the same as existed in the sample of the air prior to capture by the probe and the particulate level in the sample air captured by the probe is biased away from the true air stream value.

If sampling in a directional flow the efficiency with which the particles are sampled is dependent on the ambient air velocity, the inlet geometry, size, and position, the particle counter flow rate, and the particle size.

Without going into too much detail a directional flow should always be sampled with the isokinetic probe aligned to the ambient airflow direction.

The following analysis is for environmental sampling when the air is calm. If the air is not calm, it's assumed that the airflow is non-directional and that the air velocity vector is zero on average.

Davies (1968) points out that in sampling from calm air with a small inlet tube at an arbitrary orientation, two conditions must be met for representative sampling.

1. An inertial condition to ensure that particles are drawn into the nozzle
2. A particle-settling velocity condition to ensure that the orientation of the nozzle has no influence on sampling.

These two conditions can be used to arrive at a range of acceptable inlet diameters for an isokinetic sampling probe[1].

Figure 1 shows the range of acceptable inlet diameters for representative sampling in calm air for particle sizes (diameters) in the range of 0.3µm – 10µm.

It was obtained with the following parameters:

- Normal temperature and pressure (20°C (293.15 K, 68°F) and 1 atm (101.325 kN/m2, 101.325 kPa, 14.7 psia, 0 psig, 30 in Hg, 760 torr).
- Particle density equal to 1.5g/cm^3
- Air viscosity equal to 182.03µP
- Volumetric flow rate
- Cunningham slip correction is applied

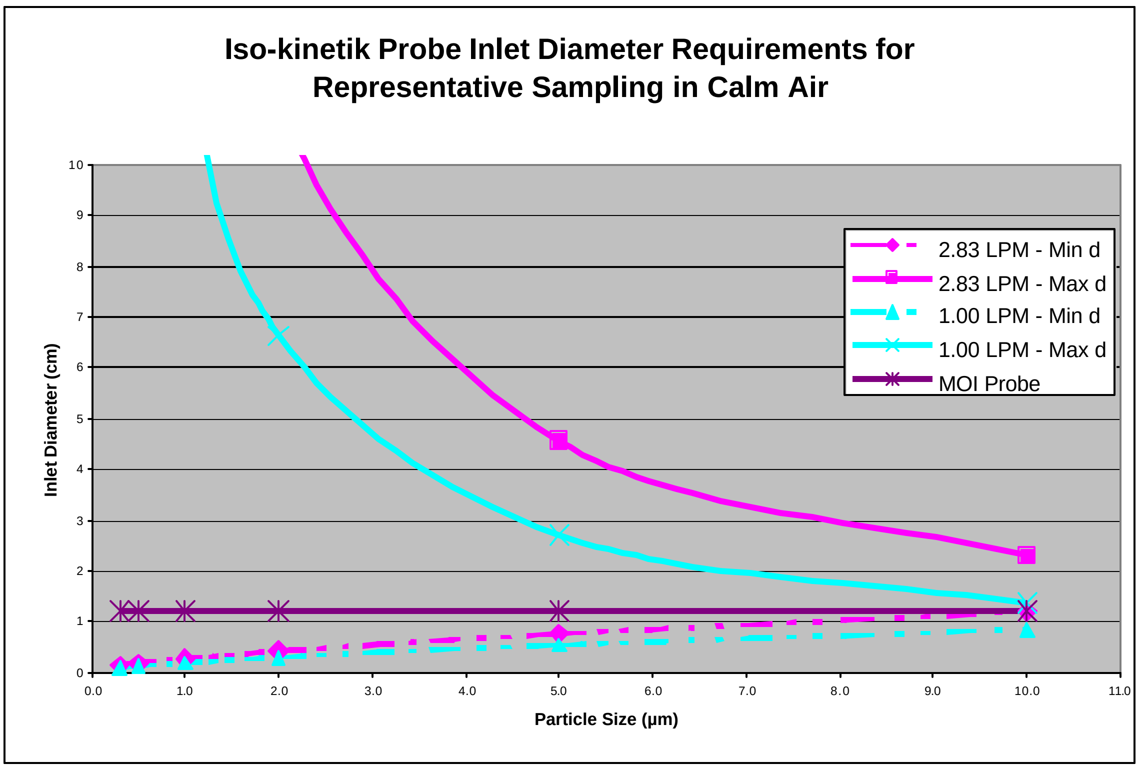

Figure 1

The Met One Instruments isokinetic probe (P/N: 8428) has an inlet diameter of 0.48in (1.22cm). As can be seen in Figure 1 it ensures representative sampling over the particle size range 0.3µm – 10µm for 1.0 LPM flow rate and 2.83 LPM (0.1CFM) flow rate.

[1] See Aerosol Measurement, Principles, Techniques and Applications, Klaus Willeke & Paul Baron, Van Nostrand Reinhold, 1993, pg 83-94