

before the exit 90° bend leading into the centrifugal blower. A flow constriction, across which a pressure drop gauge is connected, provides the sampling flow rate indication. For the flow rate of 2 liters/min, the indicated pressure drop was about 400 newtons/m² (1.6 in. H₂O). With the 2 liters/min flow rate and an inner duct diameter of 1.27 cm (1/2-inch), the axial flow velocity at the sensing volume is about 52.6 cm/sec (based on a fully developed laminar flow parabolic profile) which, combined with a sensing length of 2.54 cm, results in a fiber residence time of about 48 milliseconds. The detection volume of the FAM defined by the illuminating beam diameter is confined to a small fraction of the flow duct diameter for two principal reasons: (a) the need for a uniform laminar flow velocity within the illumination region to preclude variable residence times, and (b) the requirement of a nearly uniform electric field; i.e., the sensing diameter must be small with respect to the inter-electrode spacing.

The effective optical sensing volume is about 10^{-2} cm³, which results in a 1.6 percent coincidence probability for the simultaneous presence of two fibers within the detection volume at the maximum design objective concentration of 20 fibers/cm³.

Field Generation, Signal Processing and Display

The rotating field at the sensing region of the FAM is generated by two sinusoidal 400 Hz voltages, 90° -phase shifted with respect to each other, and applied to each of the opposing electrode pairs of the quadrupole. A quadrature generator produces these two 90° phase-shifted sinewaves