Application Note

Particle Transport in Tubing

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Particle Transport in Tubing

by Morgan Polen - VP of Applications Technology, Lighthouse Worldwide Solution

Airborne Particle Counters (APC) are used for a variety of purposes such as:

- Filter testing
- Cleanroom certification and testing
- Isolator and minienvironment testing and certification.

Often the use of APCs requires the use of tubing for the sampling of the air as the APC may be located some distance from the actual air being sampled. Various factors impact the efficiency of particle transport in tubing. Factors such as sample air velocity, tubing length, tubing material, the number of bends, radius of such bends and tubing diameter need to be considered in selecting and using such tubing.

Lighthouse Worldwide Solutions has installed particle counters in many different applications throughout the world. This experience along with our application testing has provided us with the information needed to write this paper. Often overlooked is the real world application of installing and using particle counters in operating facilities. It is one thing to have tubing laying flat on the floor extended to 125 ft without any bends. It is another to have the tubing routed up the wall, across a false ceiling into a service chase, then into a cleanroom up through a raised floor.

Particle size, particle velocity and tubing diameter are the key factors in determining particle transport effectiveness in tubing. Tubing material is a secondary concern.

Materials used for this testing consisted of:

Bev-A-Line XX	Co-extruded tubing consisting of PVC exterior and Hytrel® interior. This material has been the particle transport material of choice for years due to the smoothness of the interior walls (Hytrel®).
Stainless Steel	Extremely clean, durable and conductive, stainless steel is an excellent material for particle transport. However, stainless steel tubing is inflexible and expensive to install.
Polyurethane	Smooth material that is chemically resistant and lower cost then either Bev-A-Line XX or Stainless Steel.

Particle counting is performed using several different flow rates:

- 1.0 CFM is the traditional flow rate used for testing filters and certifying cleanrooms. Additionally, some remote particle counters sample air at 1.0 CFM. Nominal transport tubing for this flow rate is ¼" ID.
- 0.1 CFM is the flow rate more closely associated with handheld particle counters and remote fixed particle counters for facility monitoring systems. Nominal transport tubing for this flow rate is ⅛" ID.
- 2.0 to 3.0 CFM is the flow rate associated with manifold sampling systems connected to particle counters. Though the manifold itself is designed to draw air at a higher velocity, the actual particle counter samples at 1.0 CFM. Nominal tubing for this flow rate is ½" ID.

Pharmaceutical Cleanrooms and Particle Transport

In pharmaceutical applications, 0.5 and 5.0 micron particles are often monitored. It should be noted that though 0.5 micron particles have a high transport efficacy both in discrete particle counter applications (1.0 CFM) and manifold applications (2.0 CFM), particles > 1.0 micron do not transport well in tubing, regardless of the flow rate and tubing diameter. With this in mind for applications where 5.0 micron particles are important, keeping tubing lengths as short as possible is recommended.

Figure 1 illustrates the effects of particle size on transport efficacy in a 1.0 CFM flow rate particle-counting test.

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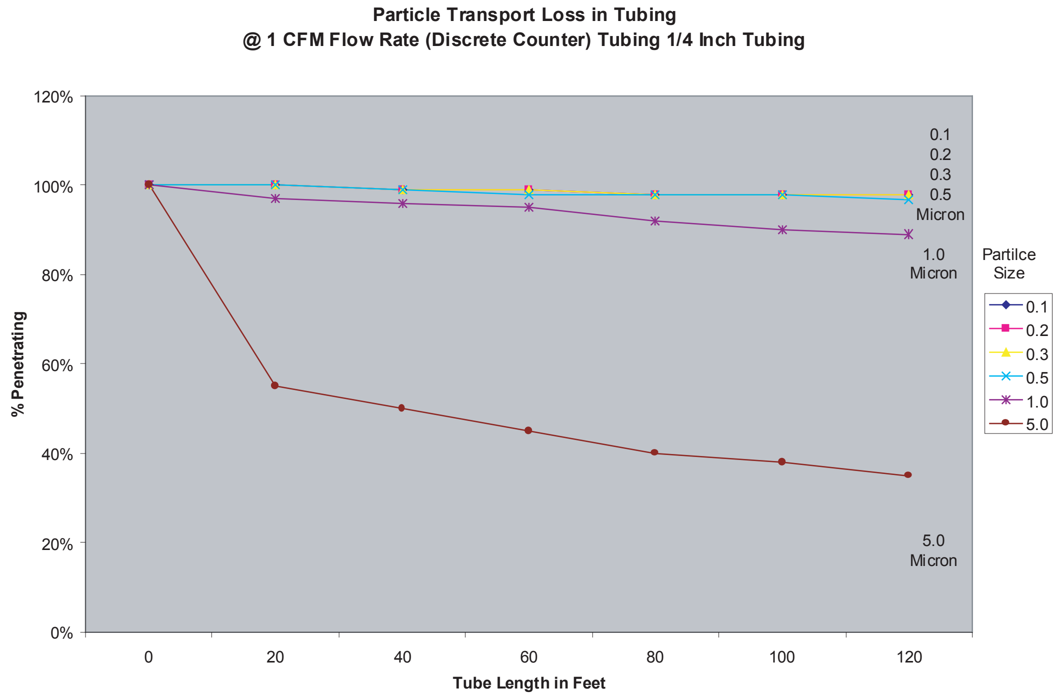
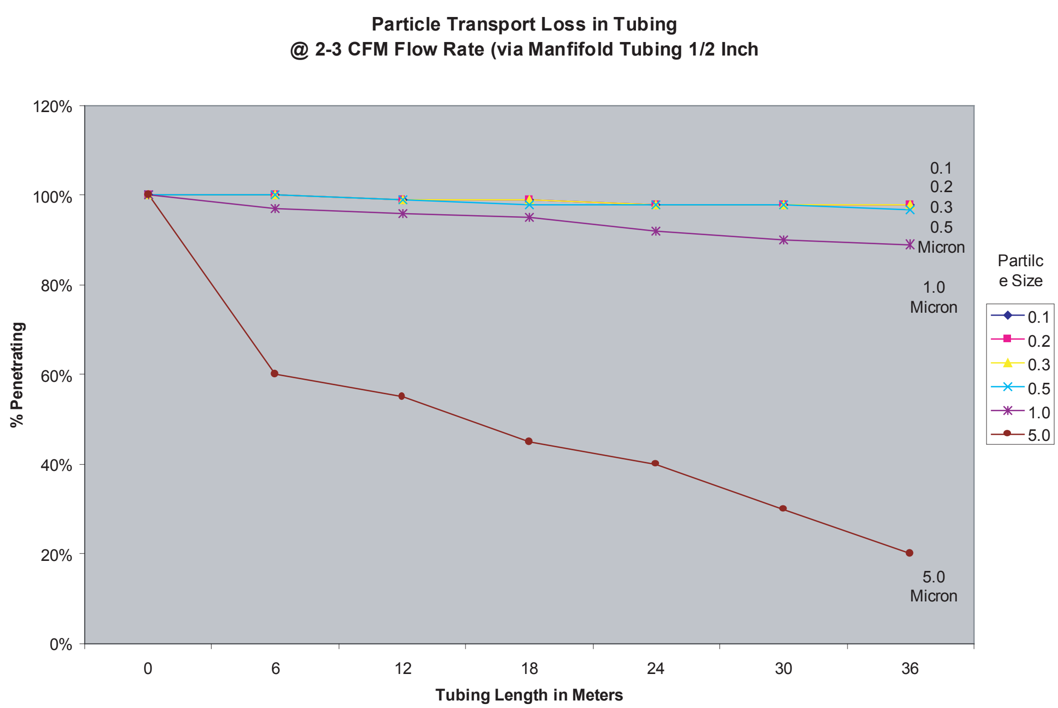


Table 1 shows FED-STD 209E table for particle concentration limits. Note there are two Class Names (S.I. and English). S.I. refers to System International. Particle concentration limits are expressed in either M^3 or FT^3.

Figure 2 illustrates the effects of particle size on transport via a manifold system with a 2 CFM flow rate



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