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FRACTIONAL PENETRATION OF PAINT OVERSPRAY ARRESTORS

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FOREWORD

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Fractional Penetration of Paint Overspray Arrestors

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Testing was conducted by James T. Hanley and Daryl D. Smith of the Research Triangle Institute, Research Triangle Park, NC, under Cooperative Agreement CR-817083.

Various members of the filter manufacturing industry also provided assistance in reviewing the technical effort and providing examples of arrestor systems used during the testing.

Executive Summary

Introduction

A request for technical assistance was received by EPA's Control Technology Center (CTC) from the City of Philadelphia, PA, to evaluate the relative emissions from various dry paint arrestors. A study was initiated by the CTC to develop the requested data. The results of the initial study indicated that most dry arrestors operate at 90 to 99+ percent arrestance based on a total weight capture basis. However, it was also determined from these studies that the capture of particles less than 10 µm (PM10) varied significantly for different designs. This suggested that, although the efficiency in terms of total weight captured is high, the capture efficiency for fine particulate could be vastly different. This is because fine particulate comprise only a small percentage of the total mass of paint overspray, and thus their capture is not significant in the total weight method.

Based on these findings, additional study was commissioned by the CTC to evaluate the fine particulate emissions (fractional penetrations) of the various dry paint overspray arrestor designs.

Fractional Penetration

A test protocol was developed to measure the fractional penetration of aerosol droplets emitted (penetrating) through paint overspray arrestors. Fractional penetration is defined as the fraction of particles or droplets of a given size which avoid capture when challenging an air cleaning device, e.g., a filter or separator. Fractional penetration is equal to one minus capture efficiency of the arrestor. Capture efficiency and fractional penetration are both functions of the particle or droplet diameter.

The droplet diameter at which 50% of the droplets penetrate the device (the remaining 50% are captured) is termed the "cut off diameter." The "cut off diameter" is only one of many descriptive criteria for separation devices and is deemed appropriate to define paint overspray arrestor efficiency in the fine particulate PM10 range.

Research Test

The research was performed in a specially outfitted single pass wind tunnel which allowed for spraying paint onto the paint overspray arrestors. The air flow was controlled to provide a face velocity at the filter of 120 fpm. The procedure measured the droplets in discrete size ranges both upstream and downstream

of the paint arrestor. The ratio of downstream concentration to upstream concentration for each size range was determined as the fractional penetration for that specific range of particle or droplet diameter. The fractional penetration of each paint overspray arrestor design tested for this program was initially measured in a clean condition, and then measured again after being coated with a high solids baking enamel.

The data quality objective (DQO) of the project was quantification of fractional penetration to within 0.1 at the 90 percent confidence level over the particle size range from 0.3 µm to 10 µm, and to resolve the particle or droplet diameter plus or minus 20%, in an air flow velocity of 120 fpm at the filter face. This DQO was met for 98.5% of the data.

The test procedure used during this program was developed to permit an assessment of the fine particulate capture capability of paint overspray arrestors. It was specifically developed to avoid the measurement interference presented by a weight efficiency method. This report gives the procedure for performing the tests and the results of testing five types of paint overspray arrestors.

Results

The five different paint overspray arrestors that were tested exhibited a range of "cut off diameters" from 3µm to 7µm.

The measurement of fractional penetration indicated that the PM10 penetration varied widely between different designs. The two stage polyester bag paint arrestor showed the smallest cut off diameter of all systems tested. This system achieved a 50% fractional penetration at the 3µm droplet diameter.

Fiber-filter-based designs tended to maintain their fractional penetration after loading with paint. The inertial-separator-based designs tended to increase their fractional penetration after loading with paint, resulting in cut off diameters of greater than 6µm.

Abstract

Fine particulate are defined as particles with diameters of 10µm and less. Fractional penetration curves for liquid droplet penetration of overspray arrestors were developed for discrete droplet diameters from 0.3µm to 10µm. These data points were obtained for two conditions, 1) for a clean arrestor and 2) for an arrestor coated with paint. The paint was applied to the arrestor by spraying high solids baking enamel from a spray gun directed at the paint overspray arrestor with the air flowing at a face velocity of 120 fpm.

Paint overspray arrestors were tested that can be grouped into three generic designs. This work demonstrated that for the conditions of the tests the behavior of the paint overspray arrestor is peculiar to the design of the arrestor. The program also defines the efficiency of the test method used to define the fractional penetration.

The results indicated that with the five different arrestor systems tested the 50 percent cut-off diameter ranged from 3µm to 7µm. The 50 percent cut-off value is defined as that diameter where at least 50 percent of the particles will be captured by the arrestor. The two stage polyester bag system showed the smallest cut-off diameter at approximately 3µm. The inertial separator system designs tended to exhibit the greatest cut-off level at approximately 7µm.

Preface

This research task was undertaken by EPA's Control Technology Center (CTC) at the request of the City of Philadelphia to determine whether different paint overspray arrestor designs allowed measurably different amounts of paint to be emitted from painting operations. The initial research study was completed in 1993 which defined the penetration of aerosols through different arrestors. This preliminary work used solid potassium chloride particles and an arrestor coated with oleic acid.

Although the use of solid potassium chloride and oleic acid overestimates the fractional penetration of liquid aerosols for the larger particle sizes, it did indicate that the transition of fractional penetration from near 1.0 to near 0.0 occurs under 10µm. It also indicated the suitability of the measurement technique when an appropriate liquid could be properly atomized. The research project reported here is a follow-up to that study, based on the development of a technique to generate liquid aerosols with a droplet size distribution having a statistically sufficient number of 10 µm droplets.

Past work indicated that to characterize and measure emissions from paint overspray arrestors it is important to understand the penetration of fine particles (or droplets) through the arrestor, and not just the percent of gross weight captured. The fractional penetration is the measure of the aerosol which passes through (or penetrates) the arrestor media. Fractional penetration is a function of droplet size, and is a property of the particular paint overspray arrestor design. It is independent of droplet size distribution.

The project evaluated fractional penetration for five different paint arrestor designs as a function of droplet size and loading conditions. The tested arrestor designs were provided by various vendors.

This research measured the capabilities of paint overspray arrestors to reduce emissions of both dry particulate and liquid aerosol droplets from paint spray booths. The testing for this study was performed by the Research Triangle Institute (RTI) under Cooperative Agreement No. CR-817083 with the U.S. Environmental Protection Agency. Writing the report was a cooperative effort between RTI, a Senior Environmental Employee serving as technical consultant to the project, and the EPA project officer.

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Abbreviations

ASHRAE	American Society of Heating, Refrigerating and Air-Conditioning Engineers
cm	centimeter, 0.01 meter, 0.3937 inch
CTC	Control Technology Center
DQO	Data Quality Objectives
EPA	Environmental Protection Agency
fpm	feet per minute, 0.3048 meter per minute
HEPA	High Efficiency Particle Air
NFPA	National Fire Protection Association
OPC	Optical Particle Counter
OSHA	Occupational Safety and Health Administration
PM10	Particulate Matter Less Than 10 Micrometers in Diameter
POA	Paint Overspray Arrestor
PSL	Polystyrene Latex
RTI	Research Triangle Institute
VOC	Volatile Organic Compound

Conversion Factors

1 meter = 3.281 feet = 39.374 inches
1 micrometer = 1 micron = 0.00003937 inch
1 inch of water (60 °F) = 2.488×10^2 pascal
°C = 0.56 (°F-32)
1 gal. = 3.79 liters = 3785 cm^3

1.0 Introduction

Professionally applied coatings are typically applied by spraying in a spray painting booth or hooded area. The air is filtered and exhausted from the booth or hood to 1) prevent dust from accumulating on the coated part before the coating dries, 2) carry the overspray away from the sprayed object to protect both the coated surface and the operator, and 3) dilute the volatile organic compounds (VOCs) and prevent the accumulation of vapors to toxic, flammable, or explosive concentrations in a painting area.

Over the past 20 years, "dry" or "replaceable" paint overspray arrestors (POA) or "filters" for the purpose of this study have come into common use to remove overspray from the air exhausted from paint spray booths. These POAs are replacing the waterfall booth air cleaning system. The present industry standard measurement technique for rating POAs is based upon simulated-use weight arrestance. This method uses a POA and a backup high efficiency particle air (HEPA) filter, to capture the penetrating aerosol. The arrestors are subjected to a paint aerosol generated by a spray gun, while air is flowing through them at over 100 fpm. The arrestance is calculated as the weight gain of the POA divided by the sum of that weight plus the weight of penetrating aerosol. The simulated-use test gives a single number for arrestance. This number, however, gives only a partial picture of the emissions. It is insensitive to the PM10 fraction of the total mass, because the PM10 fraction is an insignificant portion of the total mass of emissions.

The objective of this study was to characterize the penetration of paint aerosols with droplet diameters of less than 10 µm. In order to do this, it was necessary to develop a procedure whereby the fractional penetration through dry POAs could be measured in the range between 0.3 µm and 10 µm. Oleic acid, which is a low volatility, oily liquid was used as the test aerosol to simulate paint. In addition, during the study an actual paint was used to coat the arrestors to simulate a loaded condition.

Research conducted by the EPA and others indicated that PM10 is the size range of potentially high fractional penetration. The tests conducted in this study focused on droplets in discrete ranges from 0.3 µm to 10 µm in diameter.

Fractional penetration is defined as that portion of the aerosol of a given size that penetrates the filter (is not captured) and is a function of particle diameter. Fractional penetration is a property of the arrestor design. It is important that droplet diameter be stated when an aerosol fractional penetration value is reported, because the same arrestor that allows less than 10% of 10 µm droplets to penetrate might allow more than 90% of 1 µm droplets to penetrate the filter.

The work of Chan, D'Arcy, and Schreck[1] showed that measurable quantities of high solids paint exist as aerosols with droplet diameters below 10 µm for real paint droplet size distributions having 20 and 30 µm mean diameters.

William Hinds[2] gives an understanding of the filter and separator mechanisms for aerosol droplets, with equations that show that the region of high penetration extends above 0.3 µm. Results expressed in fractional penetration give the emission potential of the POA, and have the additional benefit of providing information on the emission of PM10 particles or droplets which can be inhaled. Thus, while the total emitted mass is an environmental concern, the mass in the particle diameters from 0.3 µm to 10 µm is of particular concern.

Fractional penetration is not a function of the droplet size distribution rather, but a function of the droplet size. This factor can be used to estimate of potential emissions versus droplet size over the droplet diameter range of 0.3 µm to 10 µm.

2.0 POA Design Considerations

The dominant filtration mechanisms for paint arrestors are interception, inertial impaction, and diffusion. Interception occurs when the flow lines of the fluid come within 1 droplet radius of a fiber or a bounding surface. Inertial impaction occurs when the mobility of the droplet allows it to move across flow lines under inertial forces to come within 1 radius of a fiber or a bounding surface. The paint arrestor designs based on inertial separation use this mobility to accomplish impact capture on the walls of the flow channels. Diffusion occurs when the droplet departs from the flow lines as a result of molecular impacts (Brownian movement) and comes within 1 radius of a fiber or a bounding surface. Due to the interaction of these filtration mechanisms, POAs (as with other air filtration devices) usually have their highest fractional penetration at droplet diameters around 0.3 µm.

The design for a POA is a tradeoff between the various filtration mechanisms that govern capture of droplet diameters having at least a 50% fractional penetration, a filter with a low pressure drop, and a filter with high holding capacity. Thus, due to the tradeoffs made in the filter design the overall capability and efficiency of the system is a compromise between the filtration mechanisms.

Figure 1 shows the general fractional penetration curve of an arrestor composed of a 1 cm bed with fibers of 70 µm diameter and which have a solidity of 8% in an air flow rate of 100 fpm. This curve indicates the fractional penetration transitions from a high value (near 1.0) to a low value (near 0.0), passing through 0.5 (50%) at between 3 and 4 µm droplet diameter. The fractional penetration also decreases below about 0.3 µm. This same characteristic is present in filter-based designs of POAs.

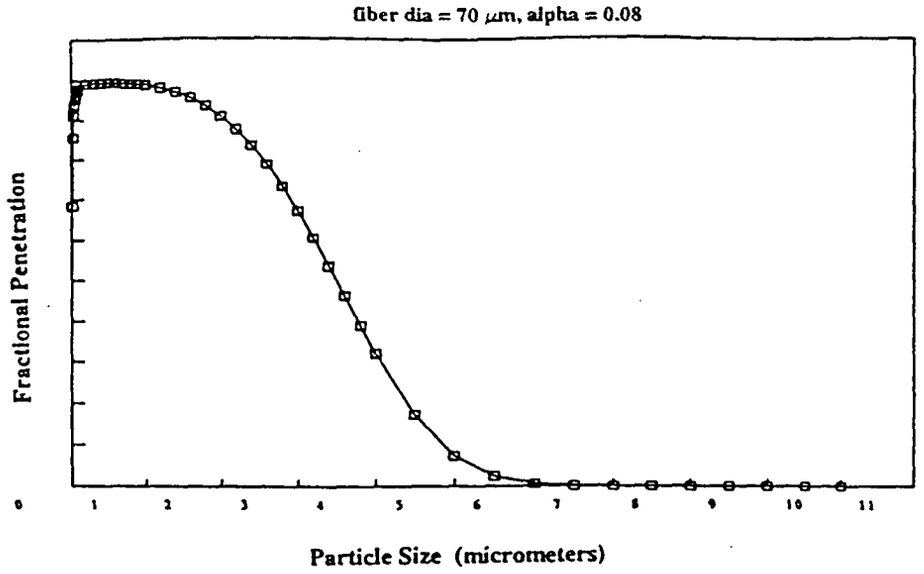

Figure 1: Characteristic of Fractional Penetration

With air cleaners which rely upon inertial separation of aerosols the diameter having a 50% penetration is also referred to as the "cut-off size". It is useful to think of this 50% penetration as a "cut-off size" for POAs.

Traditionally, paint arrestors are designed to remove a high percentage (e.g., 90 to 99%) of the mass of the paint sprayed before discharging the exhaust air flow into the ducts and then to the atmosphere. Since there is a wide size distribution in the overspray, and the droplet mass is proportional to the cube of the droplet diameter[2], the vast majority of the mass (often >99%) of paint spray is contained in droplets larger than 10 μm in diameter.

The PM10 droplets usually make up less than 1% of the weight of paint sprayed. Larger droplets usually fall out of the air flow, but those that reach the POA are captured with high efficiency.

Pressure drop across the arrestor is intended to remain as low as possible since it affects the cost of pumping air through the spray booth. The pressure drop across some paint arrestors does not vary greatly with loading. However, some of these arrestors also allow penetration of the larger PM10 droplets. Arrestors that remove the smaller PM10 droplets tend to have a shorter life because pressure drop increases with loading. Various design practices are used to reduce the effect of paint droplet capture on the pressure drop. Although pressure drop is a competitive area, some paint arrestor media have a pressure drop when clean that is greater than the pressure drop of others when fully loaded.

Several manufacturers offer multistage systems to remove PM10 overspray at relatively high efficiency. The arrestors selected for this study were chosen to span different operating principles and designs.

3.0 Standardized Air Cleaner Test Methods

When an object is coated by spraying, not all of the coating material (e.g., paint or enamel) attaches to objects. That which fails to attach to objects is by definition overspray. Spray painting transfer efficiency studies conducted by the EPA[3] have shown that from 10 to 90 percent of the total mass of coating material can be lost to overspray. The amount of overspray is dependent on a number of parameters, including but not limited to the size and shape of the object being sprayed, its orientation relative to the spray, and the velocity of air flow in the booth. Overspray is carried away by the paint spray booth air flow and must be removed from this air to avoid deposition of solids and combustible materials in the ducts and to protect the environment.

Depending upon design, POAs emphasize one or another of the performance characteristics for air filtration as found in the American Society of Heating, Refrigerating and Air-conditioning Engineers (ASHRAE) Standard 52-76[4]. These performance characteristics are as follows:

- The ability to remove particles (or droplets) from the air stream
- The resistance that is presented to the air flow (i.e., pressure drop across the filter)
- The operating time before replacement is required

The standard ASHRAE test methods for measuring filter efficiency were not used for this program since they cannot define PM-10 emissions. The two ASHRAE Standard 52-76 test methods for measuring the ability of an air cleaner to remove particles from the airstream are: 1) the Atmospheric Dust Spot Test, and 2) the Weight Arrestance Test. The Atmospheric Dust Spot Test uses unaltered ambient air for the challenge aerosol and evaluates particle removal based on the relative discoloration of glass fiber filter papers capturing this aerosol from samples drawn upstream and downstream of the air cleaner. Since ambient aerosol is mainly of submicrometer size, this test was not applicable for the objectives of this project. The Weight Arrestance Test injects a known weight of relatively coarse artificial test dust into the air upstream of the air cleaner. All of the test dust that passes through the air cleaner is collected by a HEPA filter downstream of the air cleaner. By measuring the weight increase of the test filter and dividing that weight by the sum of that weight increase plus the weight increase of the HEPA filter the arrestance of the filter can be computed. These ASHRAE tests are not sensitive to PM-10 emissions and provide only an overall capture efficiency of the total emissions stream.

The common industry modification of the ASHRAE Weight Arrestance Test for testing POAs is to use an actual paint spray

instead of the artificial test dust. However, while the ASHRAE test dust is standardized, the type of paint and the size distribution of the droplets are not standardized, but are representative of the intended use. Thus, the test is actually a simulated-use test, with the arrestance being dependent upon the paint and the particular droplet size distribution of the spray.

When the simulated-use arrestance of the POA media is measured by industry laboratories, all of the spray from the spray gun reaches the POA or filter and that which is removed is measured as one mass. The particular choice of paint and the spraying process also produces a droplet size distribution, which is a variable that is not easily quantified. Therefore the simulated-use test, although useful for determining total arrestance, does not give the necessary information to estimate emissions of fine particulate in the PM10 size range.

4.0 Test Program

4.1 Test Facility

The POA test facility used during testing is shown schematically in Figure 2. The test section and attached transition sections were constructed of stainless steel. The ducting was polyvinyl chloride tube with an internal diameter of 20 cm (8 in). Aerosol samples were taken both upstream and downstream of the test section to obtain the challenge and penetrating aerosol

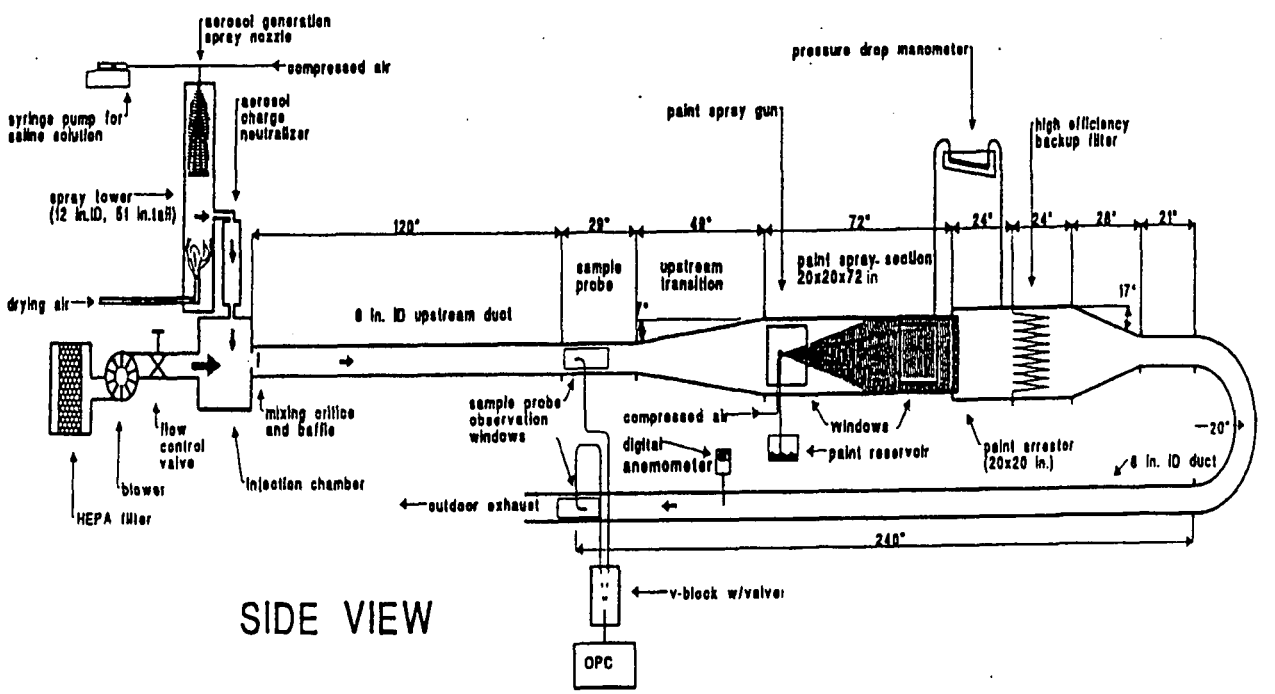

Figure 2. Paint Arrestor Test Apparatus.

concentrations. The aerosol sample taps were located a sufficient distance, both upstream and downstream, from the test section to allow for thorough mixing of the test aerosol with the air flow. Since the ducting runs back under the test section, both the challenge and the penetrating aerosol taps are located near each other, thereby facilitating aerosol sampling with a single optical particle counter (OPC) and reducing sample line length.

The test section also contained the paint loading section. It included a remote control Binks Model 61 spray gun (with a model 66X66R fluid and air cap set) mounted within the duct. A spray gun was used to load the POAs and was adjusted and operated in accordance with the manufacturer's instructions. Proper operation requires that atomized paint is discharged from the spray gun as a cone of droplets and is not over-atomized. When over-atomized the paint comes from the gun as a cloud which has a strong tendency to disperse.

A high efficiency (ASHRAE 95%) filter was placed in the test section downstream of the POA to capture any penetrating droplets in the air flow. This filter was used instead of a HEPA filter, to protect the downstream duct and instrumentation from fouling in the test facility.

Table 1 lists the five generic types of POAs which were tested in this study. Samples of each generic type of filter were obtained from filter vendors. Each filter used during the testing measured 508 x 508 mm (20 x 20 in.). The filter was mounted in a specially designed mounting frame and was designed to mount the filter media per the manufacturer's recommendations. The frame was then mounted on a 610 x 610 mm (24 x 24 in.) mounting plate to match the test section housing. Room temperature vulcanizing silicone rubber was used to prevent air leakage around the edges. The mounted media are shown in Figures 3 through 7.

Table 1. Types of POAs Tested

Type of Arrestor	Description
Cardboard Cyclone	Folded cardboard, 5 cm deep
Fiberglass Panel	Spun fiberglass, 8 cm deep with 0.5 cm dense fiber backing
Paper Mesh	Paper mesh with spun fiber backing, depth 0.5 cm
Polyester Bag	Bag filter, 38 cm deep with 1 cm spun fiber prefilter
Styrofoam Baffle	Molded styrofoam, 5 cm deep Two piece assembly

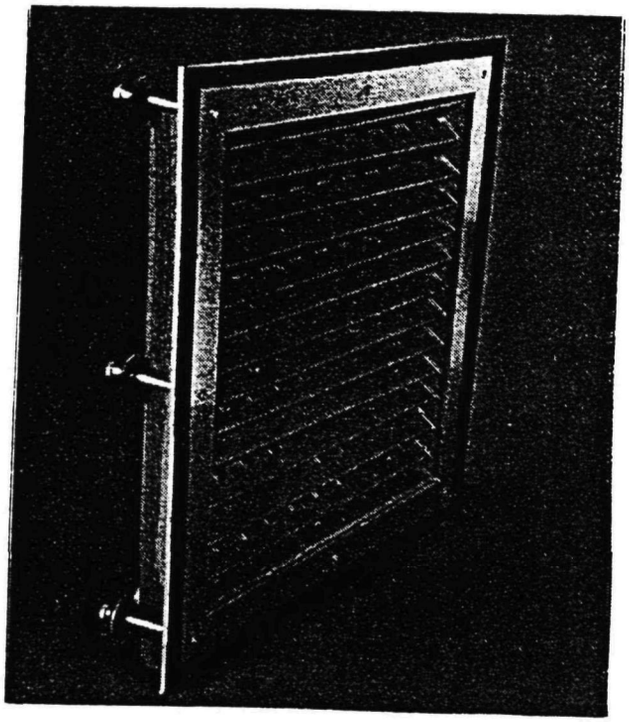

Figure 3. Cardboard Cyclone Arrestor in Frame

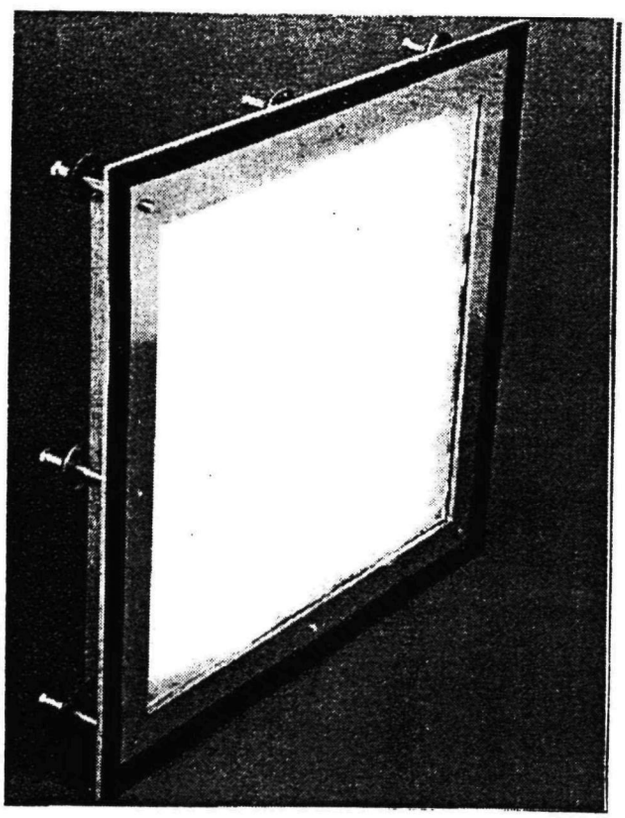

Figure 4. Fiberglass Panel Arrestor in Frame

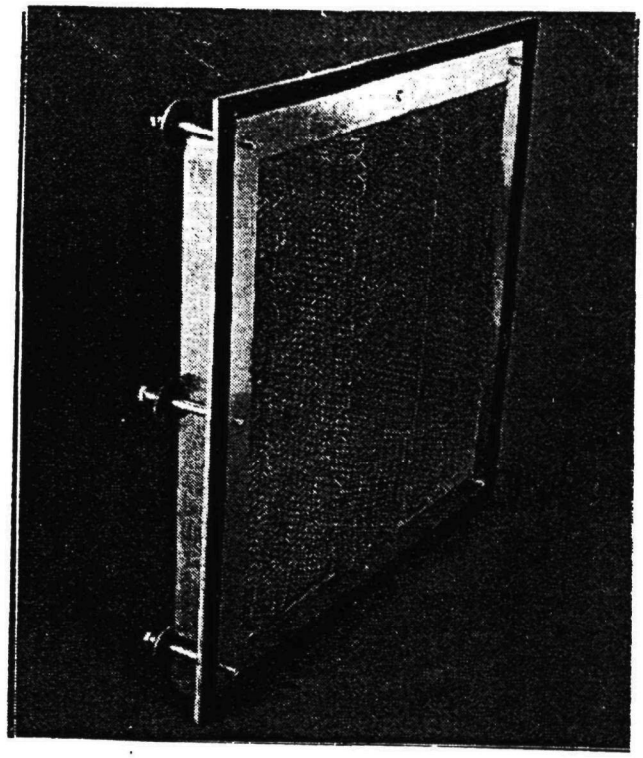

Figure 5. Paper Mesh Arrestor in Frame

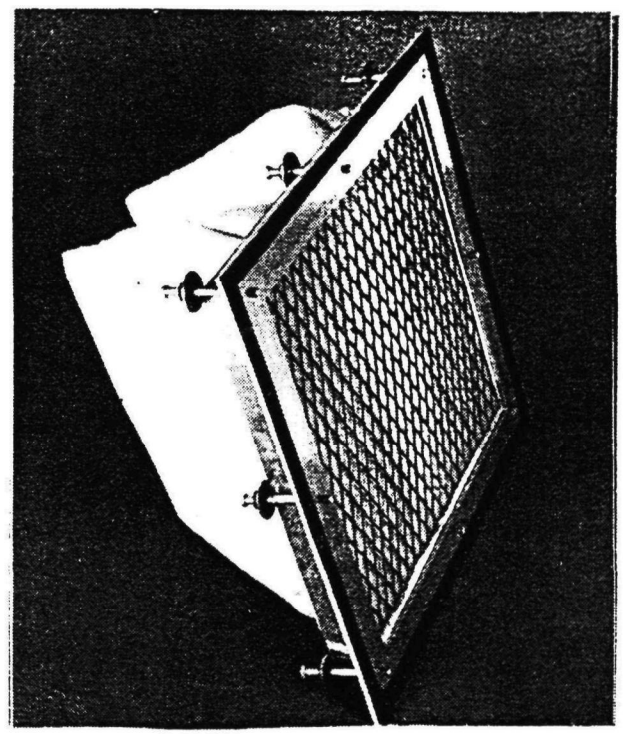

Figure 6. Polyester Bag Arrestor in Frame

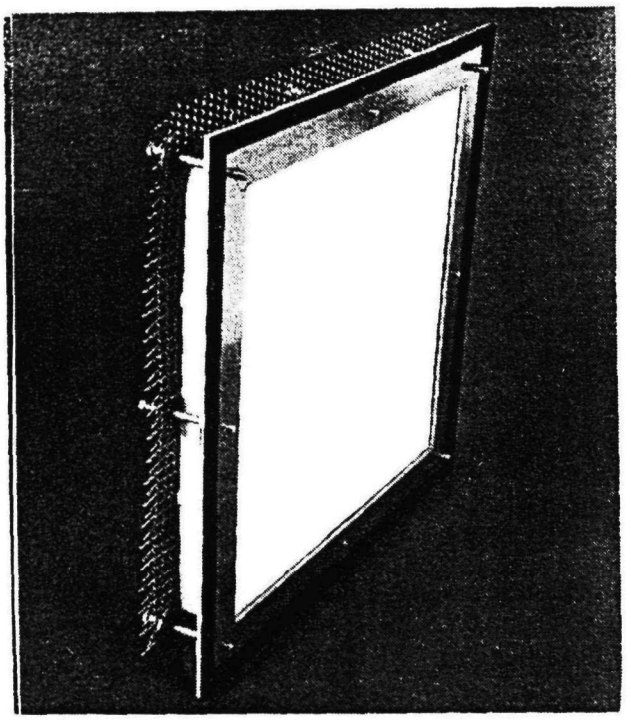

Figure 7. Styrofoam Baffle Arrestor in Frame

4.2 Instrumentation

A Climet 226/8040 high resolution Optical Particle Counter (OPC) was used to measure the concentration of particles in each of 15 discrete size ranges. This OPC measures the light that is scattered from the droplet over a wide angular range. The wide angular range minimizes diffraction effects of droplet size. The readings of this instrument correlate scattering intensity to droplet surface diameter and is dependent on the index of refraction of the droplets. The index of refraction of polystyrene is 1.546, and that of oleic acid is 1.458.[5] The calibration for this range of indexes of refraction is single valued. Prior to the testing, the factory calibration was verified with 0.451 µm, 0.720 µm, and 3.70 µm monodisperse polystyrene latex (PSL). Each day during the testing, the OPC calibration was verified by challenging the instrument with 0.720 µm PSL. The OPC was factory calibrated to cover the size range of 0.3 µm to 10 µm in 15 channels.

The upstream and downstream samples were directed to a solenoid-operated sampling valve, which was designed to give symmetry of flow to each sample. The sampling valve selects either the upstream or downstream sample flow to the OPC. The inlet nozzles of the OPC's upstream and downstream sample lines were sized to provide isokinetic sampling at the test flow rate.

Air flow through the test apparatus was monitored with an Alnor Model 8500D-11 Digital Thermal Anemometer probe placed in the center of the duct. Prior to the testing, traverses were performed which verified that the centerline air flow measurement was 5% above the average for total duct air flow. System air

flow was controlled by a valve between the blower and the test section, as shown in Figure 2.

Pressure drop across the POA under test was measured with a Dwyer Instruments Co. model 424-5 inclined manometer.

4.3 The Test Aerosol

The test aerosol used to simulate paint was composed of oleic acid in air. Oleic acid is a low volatility, oily liquid. It was selected because it is not a hazardous air pollutant, is miscible with paint, is transparent, and has a suitable index of refraction. The low volatility of oleic acid ensured that droplets would not significantly change size between upstream and downstream measurements. In addition, oleic acid is a liquid, and miscible with the paint which was to be used for loading the arrestors. The liquid oleic acid droplets have similar aerodynamic and physical properties to liquid paint droplets of the same aerodynamic size.

The test aerosol was generated by spraying metered amounts of oleic acid into an aerosol generating section. The oleic acid was delivered by a Scientific Systems Inc. model SSI350 metering pump through a Spraying Systems Co. model 44J-SS nozzle. A Dwyer Series RM Rate-Master flowmeter controlled the air flow through the generating section. This air flow carries the aerosol from the generating section to the main air flow passing through the test section. A TSI Inc. model 3054 neutralizer was used to eliminate electrostatic charge on the aerosol droplets.

It was not required to match the droplet size distribution of the generated aerosol to the droplet size distribution from a paint spray gun since fractional penetration is not dependent on droplet size distribution. The only requirement is that the test aerosol has to contain statistically acceptable quantities of droplets in the discrete size ranges being measured by the OPC. Therefore, the test aerosol was controlled to produce a minimum of droplets significantly larger than 10 µm.

The aerodynamic diameter was chosen to report droplet diameter because oleic acid has a density of 0.89, which is significantly less than that of paint. However, the relationship of surface diameter to aerodynamic diameter is given[2] by:

$$d_a = d_s\sqrt{sg_a} \qquad \textbf{(4-1)}$$

where

d_a = aerodynamic diameter of droplet (µm)
d_s = surface diameter of droplet (µm)
sg_a = specific gravity of the atomized liquid

Surface diameter is used since it is the property that the OPC measured. The surface diameter for a spherical droplet is the same as the physical diameter.

Note that the aerodynamic diameter of the oleic acid droplets will always be smaller than the surface (or physical) diameter, but the aerodynamic diameter of paint droplets will always be larger than the physical diameter. Oleic acid (specific gravity = 0.89) is somewhat less dense than a paint droplet (specific gravity between 2.0 and 2.5). Therefore, the oleic acid droplet will behave aerodynamically as though it were of a smaller diameter than a paint droplet of the same physical diameter. This results in a more conservative estimate of penetration than with actual paint.

The aerodynamic diameter versus the surface diameter (measured by the OPC) is given in Table 2 for oleic acid.

Table 2. Surface and Aerodynamic Diameters of Oleic Acid Droplets for Each OPC Channel

OPC Channel No.	Droplet Surface Diameter (µm)	Droplet Aerodynamic Diameter (µm)
1	0.33-0.40	0.31-0.37
2	0.4-0.5	0.37-0.47
3	0.5-0.6	0.47-0.56
4	0.6-0.8	0.56-0.75
5	0.8-1.0	0.75-0.94
6	1.0-1.5	0.94-1.41
7	1.5-2.0	1.41-1.88
8	2.0-3.0	1.88-2.83
9	3.0-3.92	2.83-3.69
10	3.92-5.0	3.69-4.71
11	5.0-5.42	4.71-5.11
12	5.42-6.54	5.11-6.17
13	6.54-7.74	6.17-7.30
14	7.74-8.82	7.30-8.32
15	8.82-10.0	8.32-9.43

4.4 The Approach

The design and operation of a spray booth is governed by the National Fire Protection Association (NFPA) and Occupational Safety and Health Administration (OSHA) codes and are basically the same. Therefore, when taking into account accepted industry practices, the test conditions and approach were based on their operational requirements.

The OSHA code requires that air must flow through the face of the paint filter at a minimum of 100 feet per minute (fpm) for conventional spray guns, and 60 fpm for electrostatic spray guns[6]. The overspray is carried by the air flow to the filter at the exhaust of the paint spray booth. Typically, operators of spray painting booths normally set air flow through the booth above this value, so that the air flow does not decrease to below the required minimum flow rate when the pressure drop increases as a result of paint loading. Therefore, because the various media have different pressure drops, the flow during testing was set and maintained at 120 fpm face velocity for all of the paint filters tested.

The fractional penetration was measured as the downstream droplet count divided by the upstream droplet count within droplet diameter ranges and after correction for losses to walls and sample lines. This was based on the equation[7]:

$$P = \frac{[\,(D_{avg} - D_b) / (U_{avg} - U_b)\,]}{P_{100}} \qquad \textbf{(4-2)}$$

Where

D_{avg} is the downstream average concentration (#/m^3)
D_b is the downstream background concentration (#/m^3)
U_{avg} is the upstream average concentration (#/m^3)
U_b is the upstream background concentration (#/m^3)
P_{100} is the average of the no-filter measurements (or "blanks")

The number of droplets within a diameter range was measured by an OPC, which provided particle counts digitally within 15 discrete diameter ranges.

4.5 Test Procedure

The OPC zero was checked at the beginning and end of each test run by sampling HEPA-filtered air. The sizing accuracy was checked using 0.451 µm, 0.720 µm, and 3.40 µm spheres of polystyrene latex (PSL), monodisperse. On a daily basis, only the 0.720 µm PSL was used to ensure that the calibration remained valid.

The aerosol generator was adjusted to produce satisfactory droplet counts in all channels. Satisfactory droplet counts were

between a minimum of 50 counts per minute, and a maximum of 0.1 times the manufacturer's recommended maximum.

The thermal anemometer bias was compared to the same value at the beginning of testing. A pitot tube near the same location was checked by a manometer to ensure that there was no substantial difference in measured air flow.

Once the aerosol generator had been prepared, and the filter installed in the test section, the OPC was allowed to warm up for at least 20 minutes, before each experiment was started.

The following steps were carried out for each experiment:

1. The system air velocity was set to 0.61 meter per second (120 fpm) and given time to stabilize.

2. With the aerosol generator turned off, the test duct background was measured by sampling air from the duct. The number of counts was recorded. It was observed that 15 seconds was ample time for sample lines to reach equilibrium.

3. The aerosol generator was turned on and adjusted to provide a sufficient challenge aerosol concentration (i.e., a minimum of 50 counts per minute per channel) for each of the size ranges being measured. It should be noted that the amount of oleic acid deposited on the filter during a fractional penetration measurement is miniscule. Therefore, the amount of oleic acid loading does not significantly change the loading condition of the POA during subsequent fractional penetration measurements.

4. The magnitude of the highest aerosol concentration measurements was then observed to ensure that they were below (by at least a factor of 10) the manufacturer's specified upper concentration limit for the OPC of 230 particles/cm^3. If the concentration was too high, the air pressure to the aerosol generator was reduced to lower the aerosol concentration to acceptable levels, and steps 3 and 4 repeated.

5. The following procedure (steps 5a and 5b) was then repeated 10 times for each POA being tested.

   5a. The sampling valve was switched to the upstream sampling position. After allowing 15 seconds for equilibration, the upstream aerosol concentration was measured.

   5b. The sampling valve was switched to the downstream sampling position. After 15 seconds to allow equilibration, the downstream aerosol concentration was measured.

6. The aerosol generator was turned off.

7. Step 2 was repeated.

8. The spray gun was turned on to load the arrestor with paint. The spray gun was turned off when 1240 grams of paint was consumed.

9. After loading, steps 2 through 6 were repeated to measure the fractional penetration of the coated POA.

The paint used was Sherwin-Williams Kem-Clad F73W82 High Solids Baking Enamel, which cures above 315 °F. Viscosity was adjusted per the manufacturer's instructions by addition of xylol (Sherwin-Williams R2K4). The paint was contained in a Speedair model 485169 2.5 gallon tank, which was located on an A&D electronic digital balance, model EP20KA. The weight of the paint container was monitored continuously to ensure that the spray gun would be turned off when 1240 grams of paint had been sprayed. The use a high solids baking enamel ensured that a minimal amount of drying would occur during the transport between upstream and downstream sampling points.

The resistance to air flow was measured at the beginning and end of this operation (i.e., one clean and one loaded measurement per arrestor). The POAs were weighed during the second round of testing to determine how much paint had been retained. The downstream high efficiency filter was weighed on the third round. These weight gains are reported in Table 3.

Table 3. Weight Gains and Pressure Drops (Δp) Across Arrestors for Clean and Loaded Conditions

Type of Arrestor	Round No.	Start Δp in.H_2O	End Δp in. H_2O	Average Δp in.H_2O	Arrestor Weight gain (g)	Backup Filter Weight Gain (g)
Cardboard Cyclone	1	0.22	0.22			
	2	0.22	0.22		498	
	3	0.20	0.20	0.21		38.5
Fiberglass Panel	1	0.03	0.04			
	2	0.03	0.05		643	
	3	0.03	0.05	0.03		11.8
Paper Mesh	1	0.07	0.11			
	2	0.07	0.11		449	
	3	0.075	0.12	0.07		3.2
Polyester Bag	1	0.16	0.17			
	2	0.13	0.17		731	
	3	0.12	0.16	0.14		1.4
Styrofoam Baffle	1	0.26	0.29			
	2	0.28	0.31		528	
	3	0.26	0.29	0.27		30.0

Fractional penetration was computed as the ratio of the average aerosol concentration downstream of the POA to the average aerosol concentration upstream of the POA for each channel of the OPC, corrected for wall and sample line losses. The alternate upstream-downstream sampling sequence was used so the average of the values would not have a bias in the event of drift of the generated droplet concentration. The sampling duration was held constant (1 minute) for both the upstream and downstream samples.

5.0 Test Matrix

All arrestors were first tested in their new and clean condition. It was expected that the fractional penetration would change as a result of loading. Since a change was expected, tests were conducted in both clean and loaded conditions.

The equations[2] governing fractional penetration indicate a sensitivity to both fiber diameter and flow channel size. Paint coating the filter fibers will change their effective capture diameters and also affect the filter's solidity. Paint depositing on the flow channel walls would also change geometrical ratios of inertial separators. The testing therefore consisted of fractional penetration measurements taken in the clean and the loaded condition. These conditions gave the fractional penetration through the filter under two loading conditions.

The test procedure, given in section 4.5, was repeated with each of the filter types and conditions according to the test matrix shown in Table 4. The test matrix guaranteed that the same type of paint filter was not used on consecutive tests. This eliminated the possibility that changes in the apparatus would result in systemic measurement errors for any filter. Testing of each type of filter was completed in each of three rounds. Each test started with a fresh, clean paint overspray filter.

Table 4. Test Matrix

Round No.	Test No.	Arrestor Type
1	1	No Filter
1	2	HEPA Filter
1	3	Cardboard Cyclone
1	4	Styrofoam Baffle
1	5	Fiberglass Panel
1	6	Paper Mesh
1	7	Polyester Bag
1	8	No Filter
2	9	No Filter
2	10	HEPA Filter
2	11	Cardboard Cyclone
2	12	Styrofoam Panel
2	13	Fiberglass Panel
2	14	Paper Mesh
2	15	Polyester Bag
2	16	No Filter
3	17	No Filter
3	18	HEPA Filter
3	19	Cardboard Cyclone
3	20	Styrofoam Baffle
3	21	Fiberglass Panel
3	22	Paper Mesh
3	23	Polyester Bag
3	24	No Filter

6.0 Data Analysis

The fractional penetration data for each size fraction are presented in Table 5 and are derived from equation 4.2. The percentage of particle penetration for each of the 15 OPC channels for the two loading conditions tested was determined for

each of the five arrestor designs tested. Each channel measured a distinct size range between approximately 0.3μm and 10.0μm.

From the three replicated tests of each arrestor, the experimental standard deviation (S) of the fractional penetration measurements at each droplet size fraction was computed using Equation 6.1.

$$S=\left[\Sigma_1^n \frac{\left(P_i-P_{avg}\right)^2}{(n-1)}\right]^{1/2} \qquad \textbf{(6-1)}$$

where:

P_i = the fractional penetration of an individual test
P_{avg} = the mean of the three fractional penetrations
n = number of samples

The 90 percent confidence limit of the measured fractional penetration was computed by the following equations.

Upper 90% limit = Mean + 1.69 (S)
Lower 90% limit = Mean - 1.69 (S)

7.0 Results

The reduced digital data for each filter are presented in Tables 3 and 5, and are shown graphically in Figures 8 through 30. They show the fractional penetration results after correction for background and no-filter measurements for each of the 15 data channels.

Weighing of the primary and backup filters was completed to show the normality of the measurements. Therefore, the measurement of weight gain of the arrestor was measured only in Round 2 of the testing, and the weight gain of the downstream filter was measured during Round 3. The pressure drop for each of the arrestors before and after loading is given in Table 3 as well as the average value of initial and loaded pressure drops. The changes indicated by the pressure drops were not large enough to indicate significant loading. Therefore, all of the testing was assumed to be done early in the equivalent service life of the arrestor.

The total weight captured is the sum of the arrestor weight gain and the backup filter weight gain. This weight captured ranged from 452.2 grams to 732.4 grams. The difference between 1240 grams and the weight captured can only be accounted for as the paint which coated the walls upstream of the test section and the paint which ran off the POA.

Figure 8 shows the no-filter (100% penetration) test values for fractional penetration measurements (runs 1, 8, 9, 16, 17, 24). The mean of these six curves was taken, for the appropriate

channel, as the P_{100} value in equation 4.2. This represented wall and sample line losses. The fractional penetration computation included this value.

The mean value of fractional penetration for each of the five types of paint arrestors is shown in Figures 9 and 10. Figures 9 and 10 are for the clean and loaded conditions, respectively. They show a small but distinct difference in fractional penetration, yet there is a definite similarity for each type of arrestor.

The fractional penetration for each type of POA is shown for each round of measurements under clean and loaded conditions in Figures 11 through 16. These plot fractional penetration versus aerodynamic diameter. Fractional penetration is a dimension less parameter ranging between 0.0 an 1.0. The fractional penetration for the arrestors remained over 0.1 throughout much of the measurement range. This shows that the particle size range was appropriate in all cases.

Figures 17 through 26 give the fractional penetration curves for each round that were measured for each of the five different types of POAs for the two conditions. Plots from the three rounds for the cardboard cyclone are shown in Figure 17 for clean, and Figure 18 for loaded conditions. Similarly, Figures 19 through 26 plot the data for clean and loaded fiberglass panels, Figures 21 and 22 for the paper mesh, Figures 23 and 24 for the polyester bag, and Figures 25 and 26 for the styrofoam baffle. Figures 27 through 31 present the respective systems' fractional penetrations in the clean and loaded condition. The smallness of variance for test results is clearly visible and indicated the repeatability of the test results for the various filters tested.

An example calculation for the determination of fractional penetration can be found in the Appendix A. Results of upstream and downstream particle counts for each test run can be found in Appendix B. These can be converted into fractional penetration results as defined in Appendix A.

Table 5. Fractional Penetration Measurements for Each OPC Channel

OPC Channel Number			1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
Min. Diam. (um)			0.31	0.38	0.47	0.57	0.75	0.94	1.42	1.89	2.83	3.70	4.72	5.11	6.17	7.30	8.32
Max. Diam. (um)			0.38	0.47	0.57	0.75	0.94	1.42	1.89	2.83	3.70	4.72	5.11	6.17	7.30	8.32	9.43
Geo. Mean Diam (um)			0.34	0.42	0.52	0.65	0.84	1.16	1.63	2.31	3.24	4.18	4.91	5.62	6.71	7.79	8.86
Round 1	1	No-Filter	1.00	1.00	1.00	1.00	0.99	1.00	1.00	0.99	0.98	0.98	1.02	0.95	0.94	0.82	0.79
	2	HEPA	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	3	Cardboard	1.01	1.00	1.02	1.00	1.00	1.00	0.99	0.98	0.94	0.80	0.68	0.55	0.46	0.31	0.26
	3L	Cardboard	1.00	1.00	1.00	1.00	0.99	1.00	0.99	0.95	0.91	0.83	0.70	0.63	0.49	0.41	0.27
	4	Styrofoam	1.01	1.00	1.00	0.99	1.00	0.99	0.99	0.98	0.92	0.77	0.61	0.55	0.46	0.35	0.32
	4L	Styrofoam	1.00	1.00	1.00	0.99	1.00	0.99	0.99	0.99	0.96	0.85	0.71	0.61	0.47	0.35	0.27
	5	Fiberglass	1.01	1.01	1.01	1.01	1.00	1.00	0.99	0.95	0.80	0.56	0.38	0.36	0.26	0.27	0.22
	5L	Fiberglass	1.01	1.00	1.00	1.00	0.99	1.00	0.99	0.95	0.78	0.48	0.29	0.24	0.19	0.15	0.13
	6	Paper Mesh	1.02	1.01	1.00	1.00	0.99	0.98	0.94	0.78	0.50	0.26	0.15	0.11	0.07	0.05	0.04
	6L	Paper Mesh	1.02	1.01	1.01	1.00	0.99	0.99	0.93	0.71	0.37	0.13	0.06	0.04	0.02	0.02	0.01
	7	Polyester Bag	0.99	0.97	0.97	0.98	0.96	0.94	0.89	0.69	0.35	0.08	0.02	0.01	0.00	0.00	0.00
	7L	Polyester Bag	0.98	0.97	0.98	0.97	0.96	0.94	0.90	0.73	0.37	0.08	0.02	0.01	0.00	0.00	0.00
	8	No-Filter	1.00	0.99	0.99	0.99	1.00	0.99	1.00	1.00	0.99	0.96	0.97	0.95	0.96	0.93	0.87
Round 2	9	No-Filter	1.00	1.00	1.00	1.00	1.00	1.00	1.01	1.00	1.01	1.01	1.05	1.04	1.07	1.03	1.01
	10	HEPA	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	11	Cardboard	1.00	1.00	1.01	1.01	1.00	1.00	1.00	0.97	0.94	0.83	0.68	0.59	0.45	0.36	0.32
	11L	Cardboard	1.01	1.00	0.99	1.00	1.00	1.00	1.00	1.00	0.98	0.93	0.81	0.75	0.60	0.52	0.44
	12	Styrofoam	1.00	1.00	1.00	1.00	1.00	1.00	1.00	0.98	0.93	0.76	0.63	0.56	0.49	0.41	0.37
	12L	Styrofoam	1.00	1.00	1.01	1.00	1.00	1.00	0.99	0.99	0.96	0.85	0.69	0.63	0.55	0.49	0.46
	13	Fiberglass	1.01	1.00	1.01	1.01	1.00	0.99	0.99	0.92	0.75	0.51	0.36	0.28	0.23	0.19	0.16
	13L	Fiberglass	1.02	1.00	1.01	1.00	1.00	0.99	0.99	0.91	0.70	0.44	0.27	0.22	0.15	0.11	0.09
	14	Paper Mesh	1.01	1.00	1.00	0.99	0.99	0.98	0.94	0.79	0.52	0.26	0.14	0.11	0.07	0.05	0.04
	14L	Paper Mesh	1.02	1.00	1.00	1.00	0.99	0.99	0.94	0.76	0.43	0.17	0.08	0.04	0.02	0.01	0.01
	15	Polyester Bag	1.00	0.98	0.99	0.98	0.97	0.95	0.90	0.74	0.44	0.14	0.04	0.02	0.01	0.01	0.00
	15L	Polyester Bag	0.97	0.96	0.96	0.96	0.95	0.93	0.89	0.72	0.39	0.10	0.04	0.03	0.02	0.02	.01
	16	No Filter	0.99	1.00	1.00	1.00	1.00	1.00	0.99	1.00	0.97	0.98	1.01	0.97	0.94	0.94	0.88

(Continued)

Table 5 (Continued)

OPC Channel Number			1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
Min. Diam. (μm)			0.31	0.38	0.47	0.57	0.75	0.94	1.42	1.89	2.83	3.70	4.72	5.11	6.17	7.30	8.32
Max Diam. (μm)			0.38	0.47	0.57	0.75	0.94	1.42	1.89	2.83	3.70	4.72	5.11	6.17	7.30	8.32	9.43
Geo. Mean Diam. (μm)			0.34	0.42	0.52	0.65	0.84	1.16	1.63	2.31	3.24	4.18	4.91	5.62	6.71	7.79	8.86
Round 3	17	No-Filter	0.99	0.99	0.99	0.99	0.99	0.99	0.99	0.99	0.98	0.99	0.98	1.01	0.97	0.87	0.87
	18	HEPA	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	19	Cardboard	1.01	1.00	0.99	1.00	0.99	0.99	0.99	0.97	0.92	0.80	0.63	0.60	0.49	0.40	0.42
	19L	Cardboard	1.01	1.00	1.00	0.99	0.99	1.00	0.98	0.99	0.96	0.88	0.73	0.71	0.61	0.53	0.47
	20	Styrofoam	1.00	0.99	0.99	0.99	0.99	0.99	1.00	0.97	0.90	0.72	0.57	0.55	0.42	0.42	0.38
	20L	Styrofoam	1.00	1.00	1.00	1.00	1.00	1.01	1.00	0.99	0.96	0.83	0.68	0.61	0.52	0.44	0.42
	21	Fiberglass	1.00	1.00	1.00	1.00	1.00	0.99	0.99	0.92	0.76	0.54	0.37	0.31	0.24	0.19	0.19
	21L	Fiberglass	1.01	1.00	1.01	1.01	1.00	1.00	0.99	0.93	0.76	0.48	0.31	0.25	0.19	0.14	0.10
	22	Paper Mesh	1.02	1.00	0.99	1.00	0.99	0.98	0.94	0.77	0.49	0.24	0.13	0.11	0.07	0.05	0.04
	22L	Paper Mesh	1.02	1.01	1.00	1.01	0.99	0.98	0.93	0.68	0.33	0.11	0.04	0.02	0.02	0.01	0.00
	23	Polyester Bag	0.98	0.97	0.98	0.98	0.96	0.94	0.91	0.77	0.46	0.15	0.05	0.02	0.01	0.00	0.00
	23L	Polyester Bag	0.99	0.98	0.98	0.97	0.96	0.95	0.91	0.76	0.44	0.11	0.02	0.01	0.00	0.00	0.00
	24	No-Filter	1.00	1.00	1.00	1.00	1.00	0.99	1.00	1.00	1.00	1.01	1.04	1.01	1.03	1.03	1.01
	Average No-Filter		0.99	1.00	1.00	1.00	1.00	1.00	1.00	1.00	0.99	0.99	1.01	0.99	0.99	0.94	0.91
	Average HEPA		0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Clean	Avg Cardboard		1.01	1.00	1.01	1.00	1.00	1.00	0.99	0.97	0.93	0.81	0.66	0.58	0.46	0.36	0.34
Clean	Avg Styrofoam		1.01	1.00	1.00	1.00	1.00	1.00	1.00	0.98	0.91	0.75	0.60	0.56	0.46	0.39	0.36
Clean	Avg Fiberglass		1.01	1.00	1.00	1.01	1.00	1.00	0.99	0.93	0.77	0.54	0.37	0.32	0.24	0.21	0.19
Clean	Avg Paper Mesh		1.02	1.00	1.00	1.00	0.99	0.98	0.94	0.78	0.51	0.25	0.14	0.11	0.07	0.05	0.04
Clean	Avg Poly Bag		0.99	0.97	0.98	0.98	0.96	0.95	0.90	0.73	0.42	0.13	0.03	0.02	0.01	0.00	0.00
Loaded	Avg Cardboard		1.01	1.00	1.00	1.00	0.99	1.00	0.99	0.98	0.95	0.88	0.75	0.70	0.57	0.49	0.39
Loaded	Avg Styrofoam		1.00	1.00	1.00	1.00	1.00	1.00	1.00	0.99	0.96	0.84	0.69	0.62	0.51	0.43	0.38
Loaded	Avg Fiberglass		1.01	1.00	1.01	1.00	1.00	1.00	0.99	0.93	0.75	0.47	0.29	0.24	0.18	0.14	0.11
Loaded	Avg Paper Mesh		1.02	1.01	1.00	1.01	0.99	0.99	0.93	0.72	0.38	0.13	0.06	0.03	0.02	0.01	0.01
Loaded	Avg Poly Bag		0.98	0.97	0.97	0.97	0.96	0.94	0.90	0.74	0.40	0.10	0.02	0.02	0.01	0.01	0.00

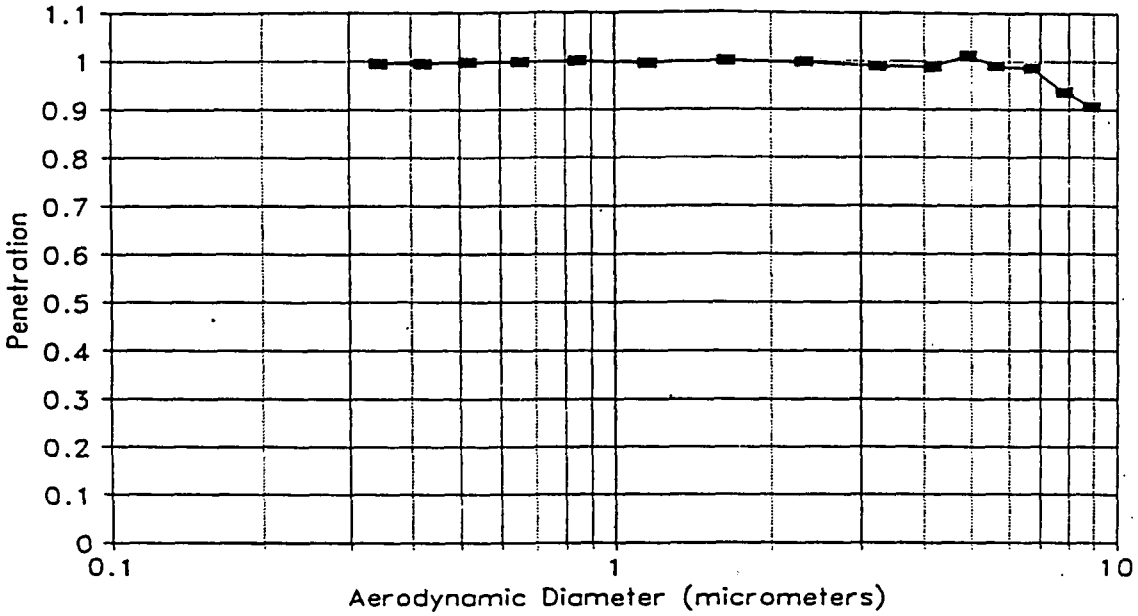

Figure 8. Average of No-Filter Fractional Penetration

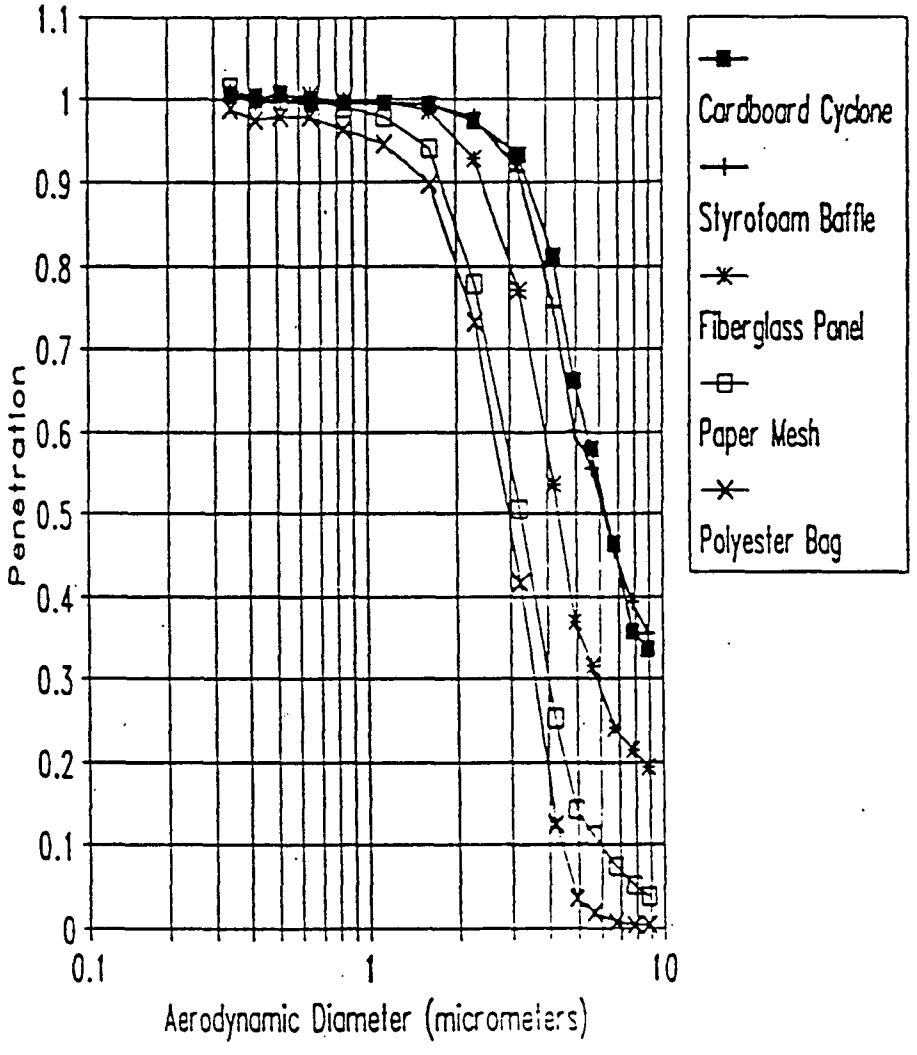

Figure 9. Summary of Fractional Penetration, Clean

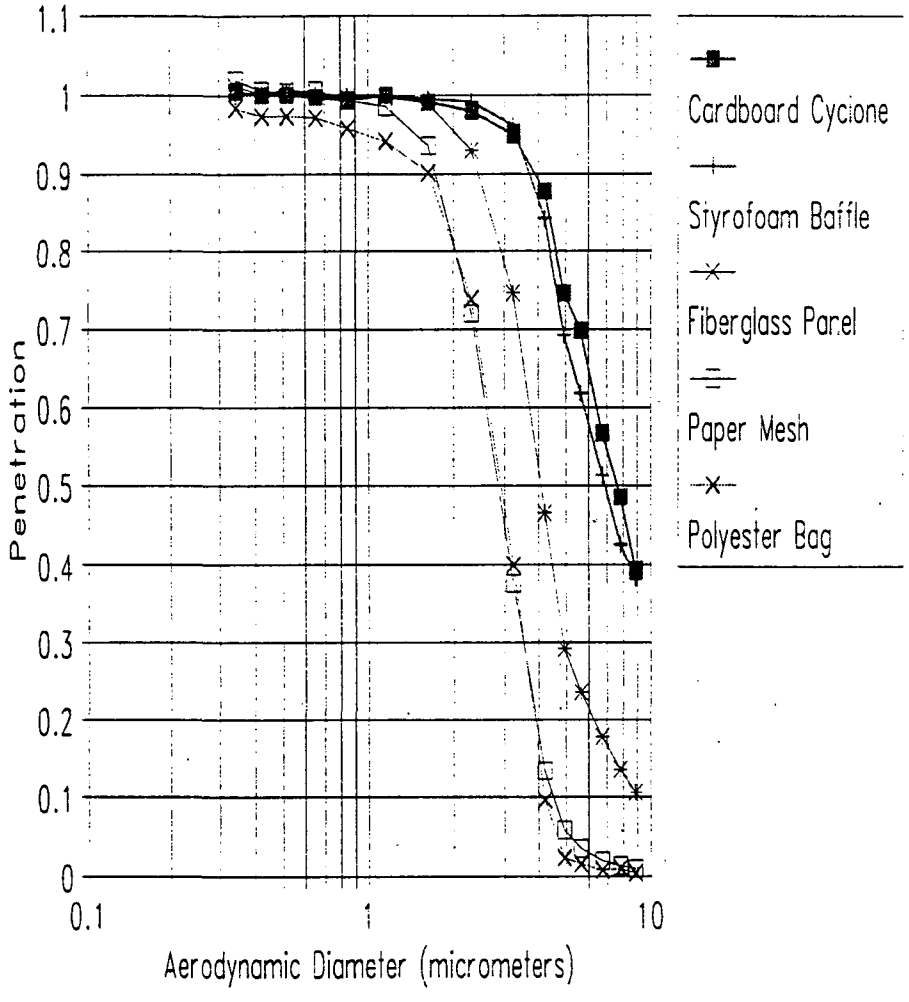

Figure 10. Summary of Fractional Penetration, Loaded

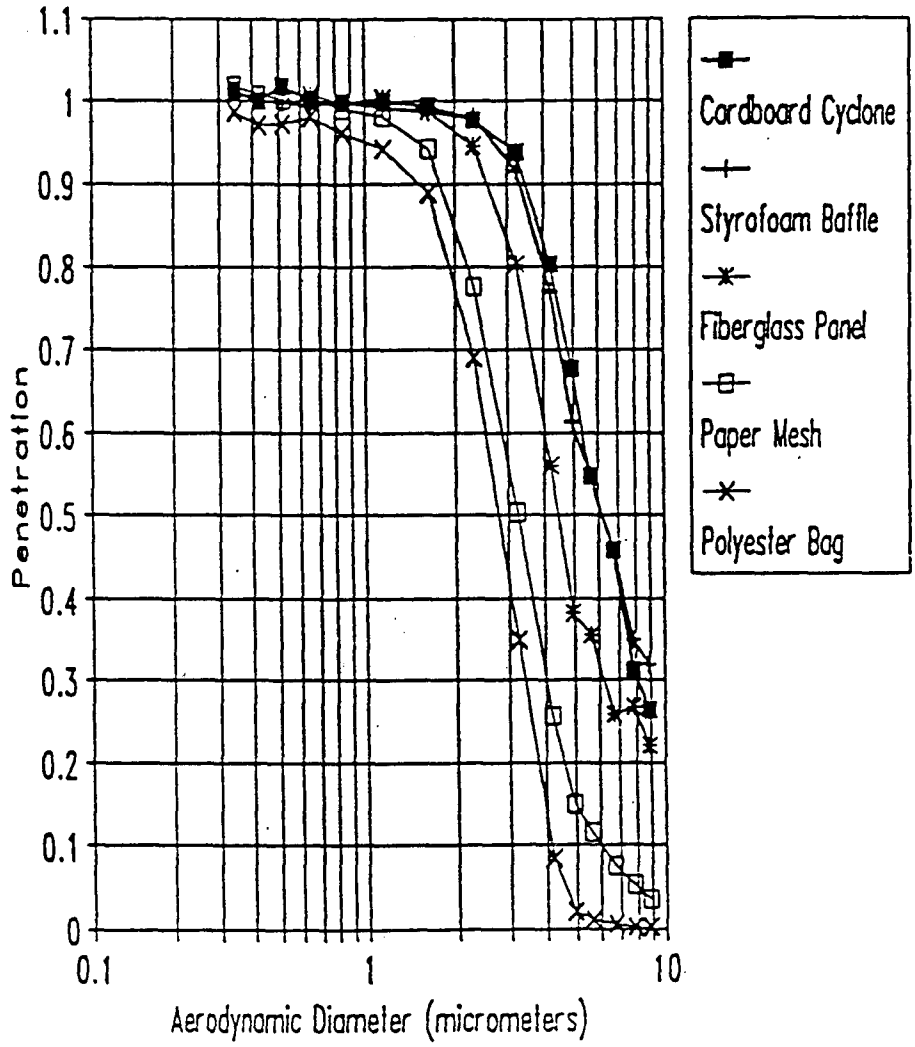

Figure 11. Fractional Penetration, Round 1, Clean

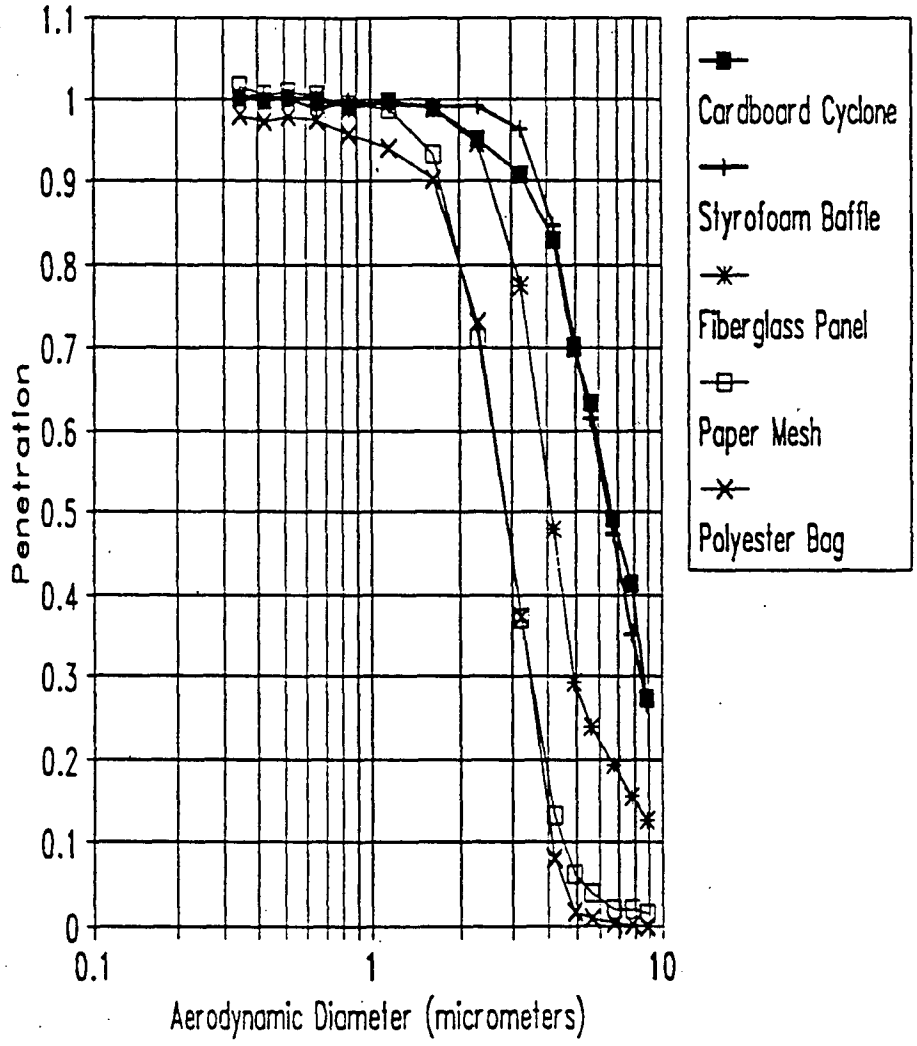

Figure 12. Fractional Penetration, Round 1, Loaded

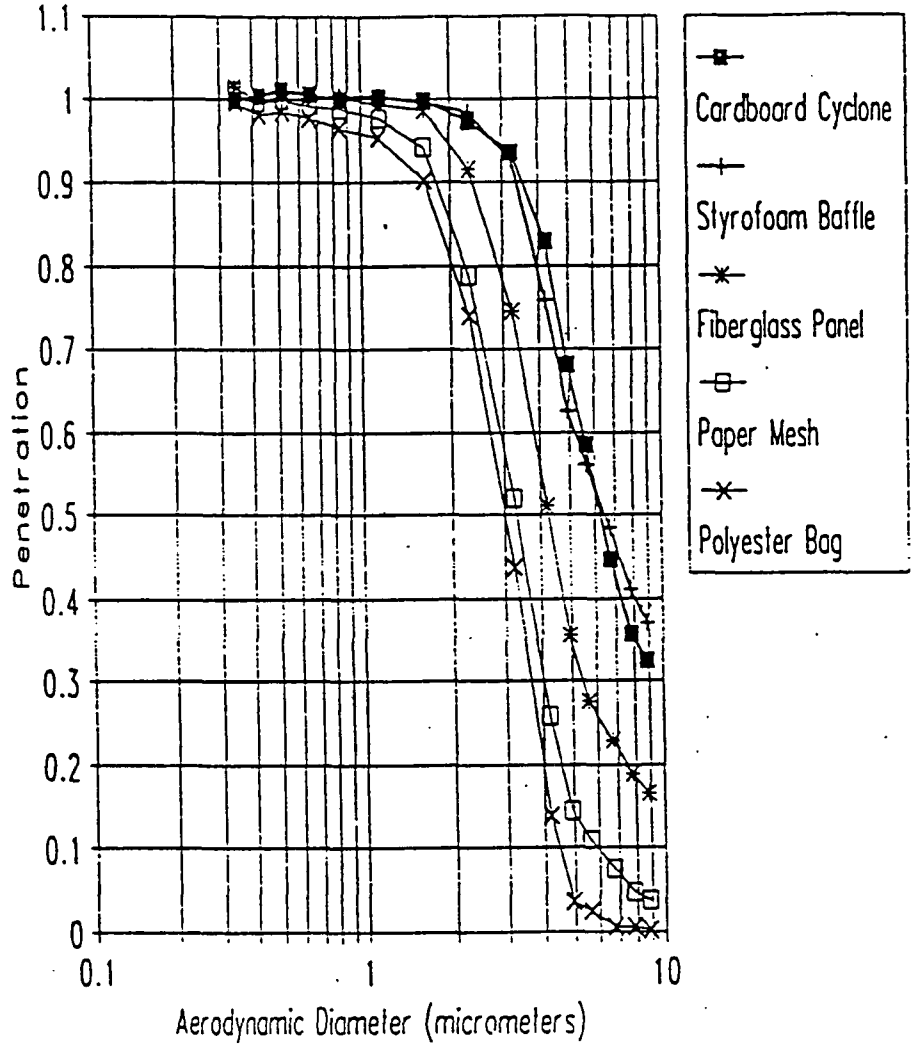

Figure 13. Fractional Penetration, Round 2, Clean

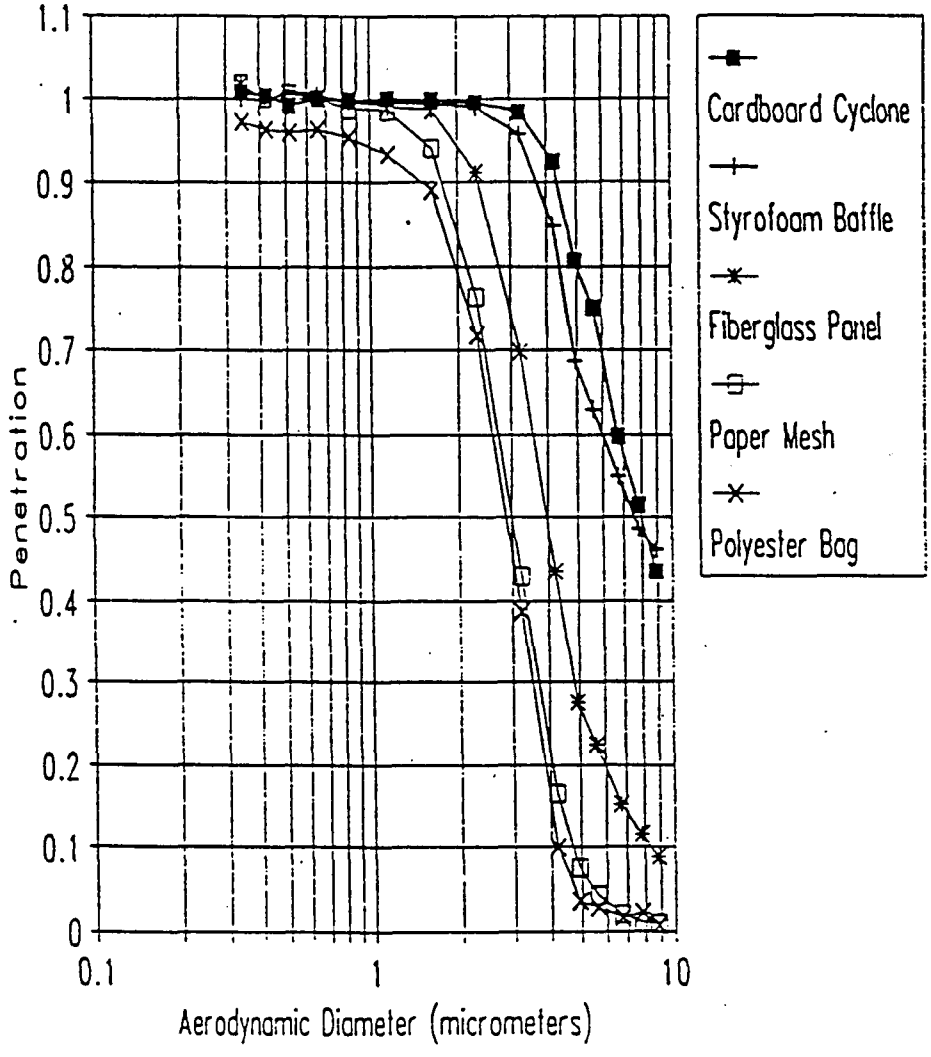

Figure 14. Fractional Penetration, Round 2, Loaded

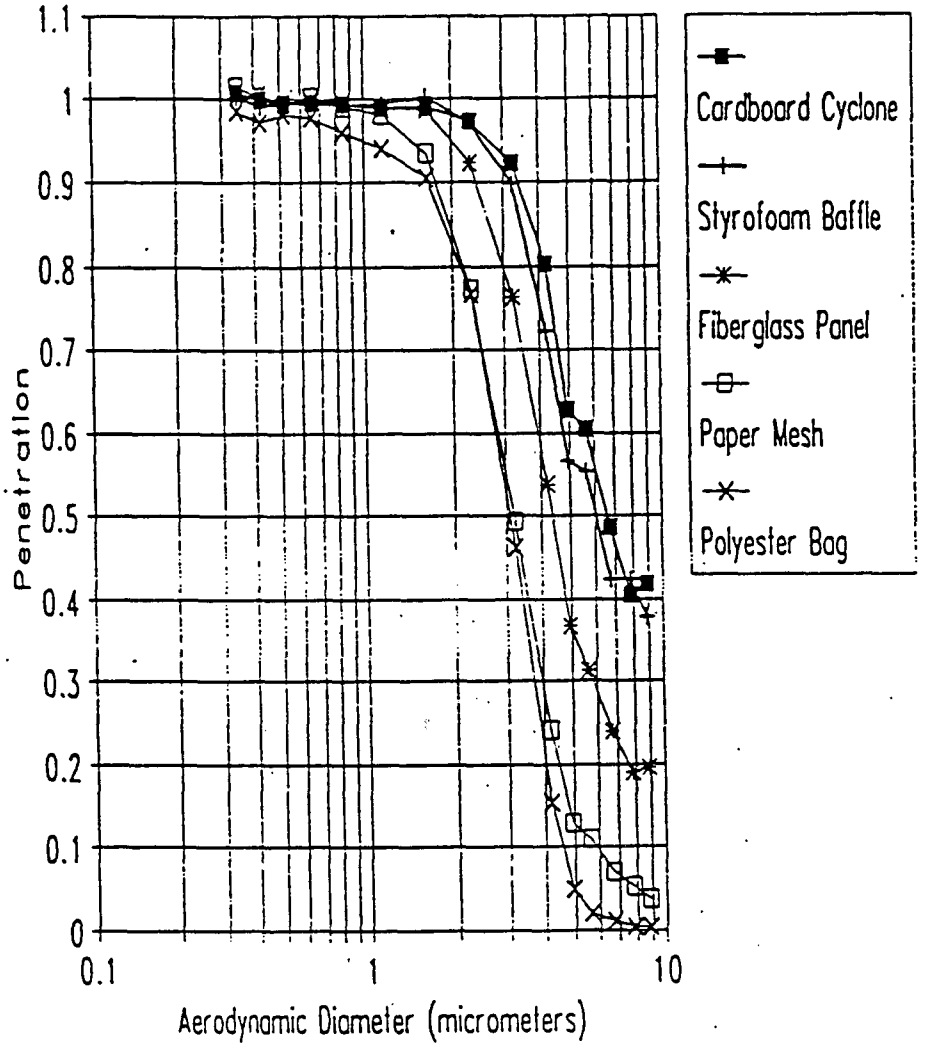

Figure 15. Fractional Penetration, Round 3, Clean

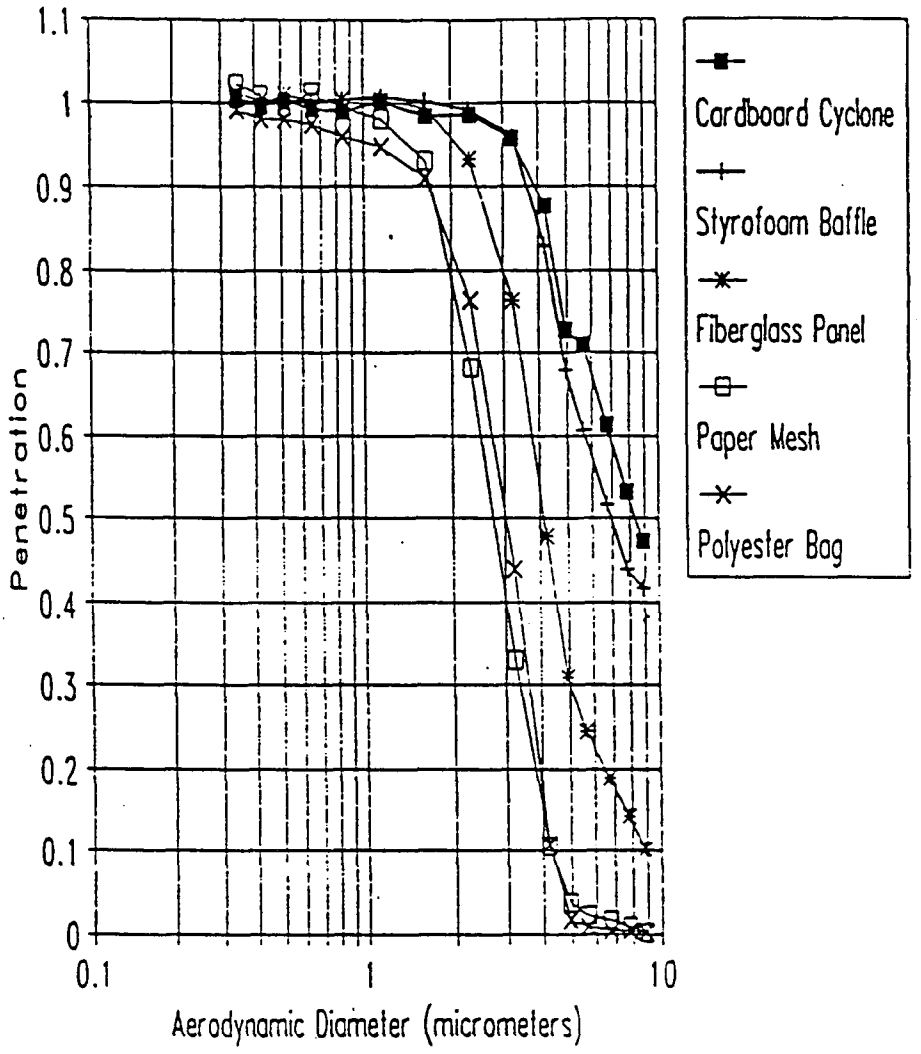

Figure 16. Fractional Penetration, Round 3, Loaded

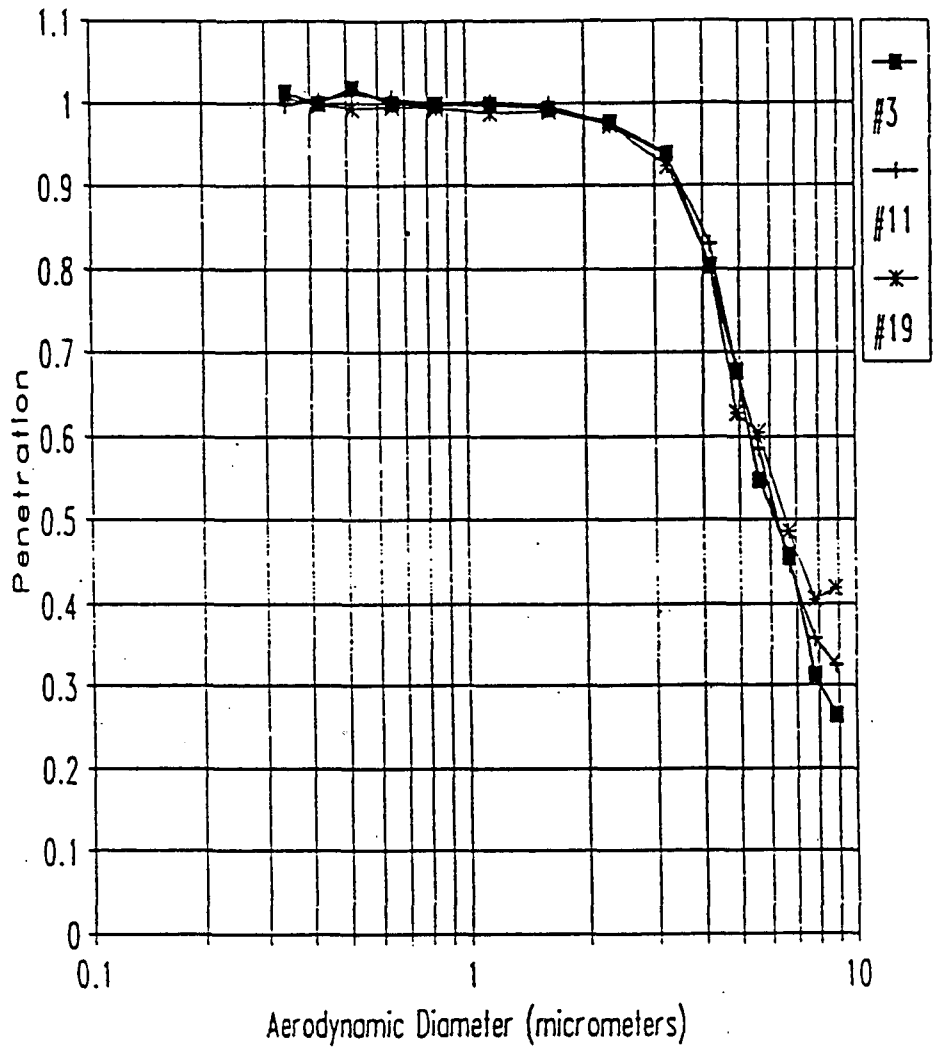

Figure 17. Fractional Penetration, Cardboard Cyclone, Clean

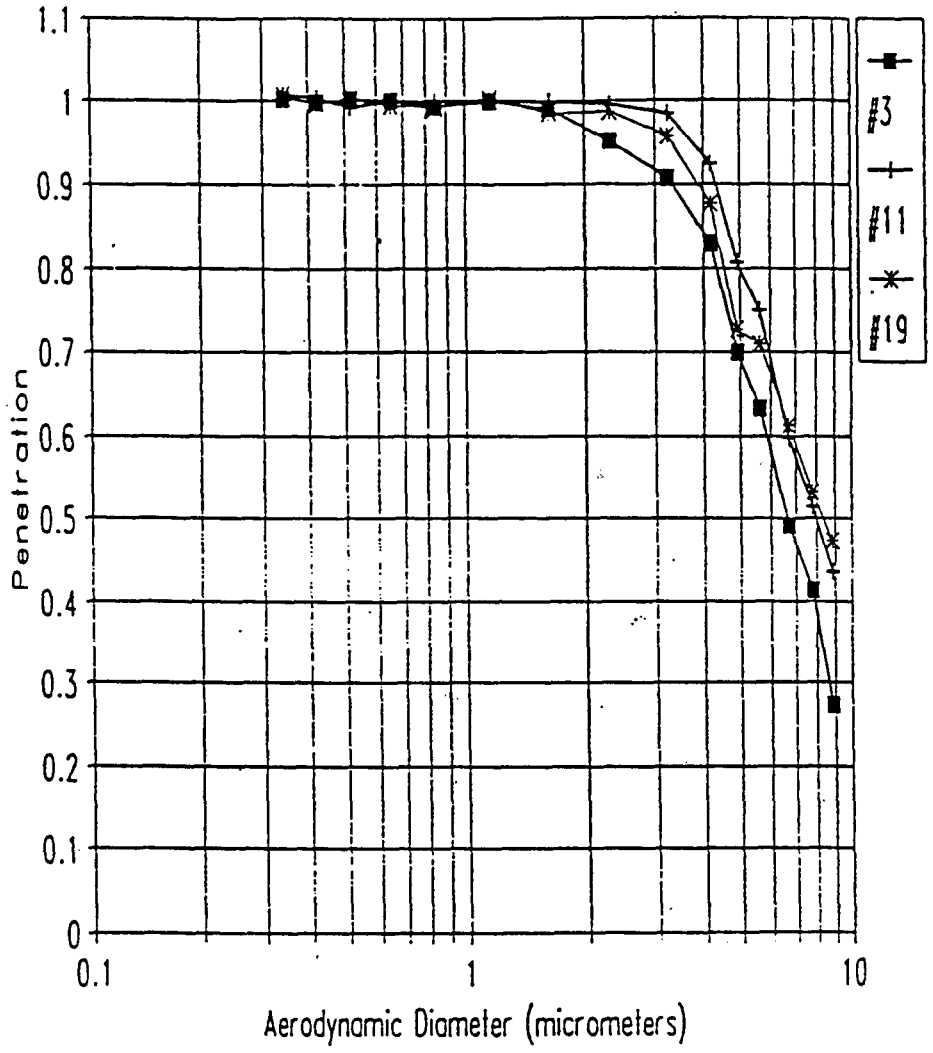

Figure 18. Fractional Penetration, Cardboard Cyclone, Loaded

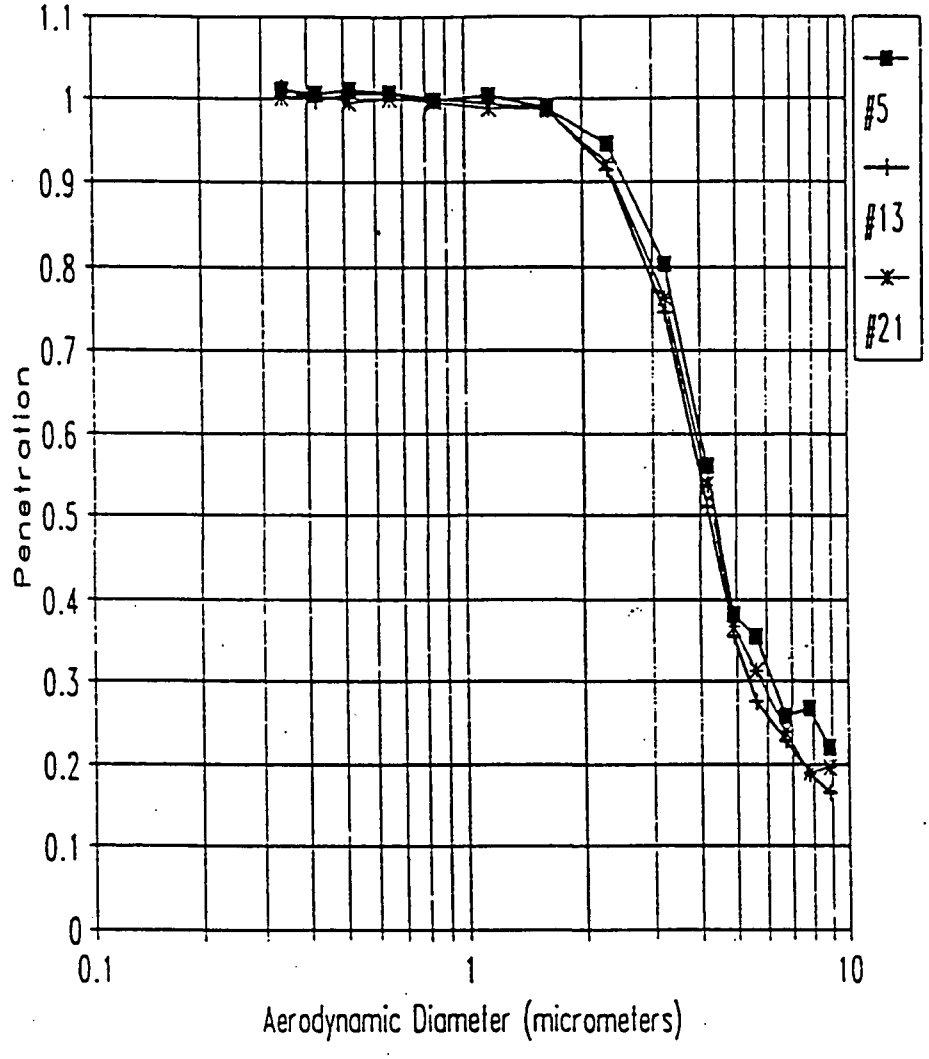

Figure 19. Fractional Penetration, Fiberglass Panel, Clean

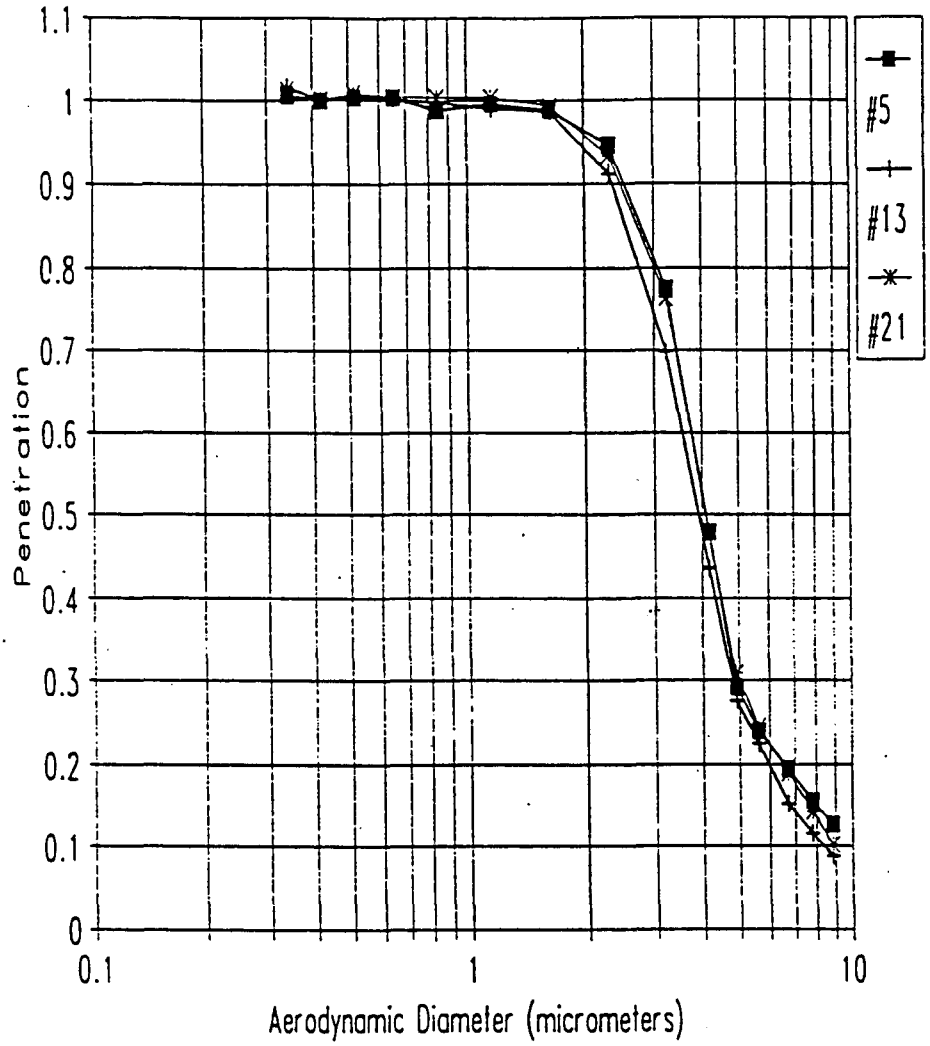

Figure 20. Fractional Penetration, Fiberglass Panel, Loaded

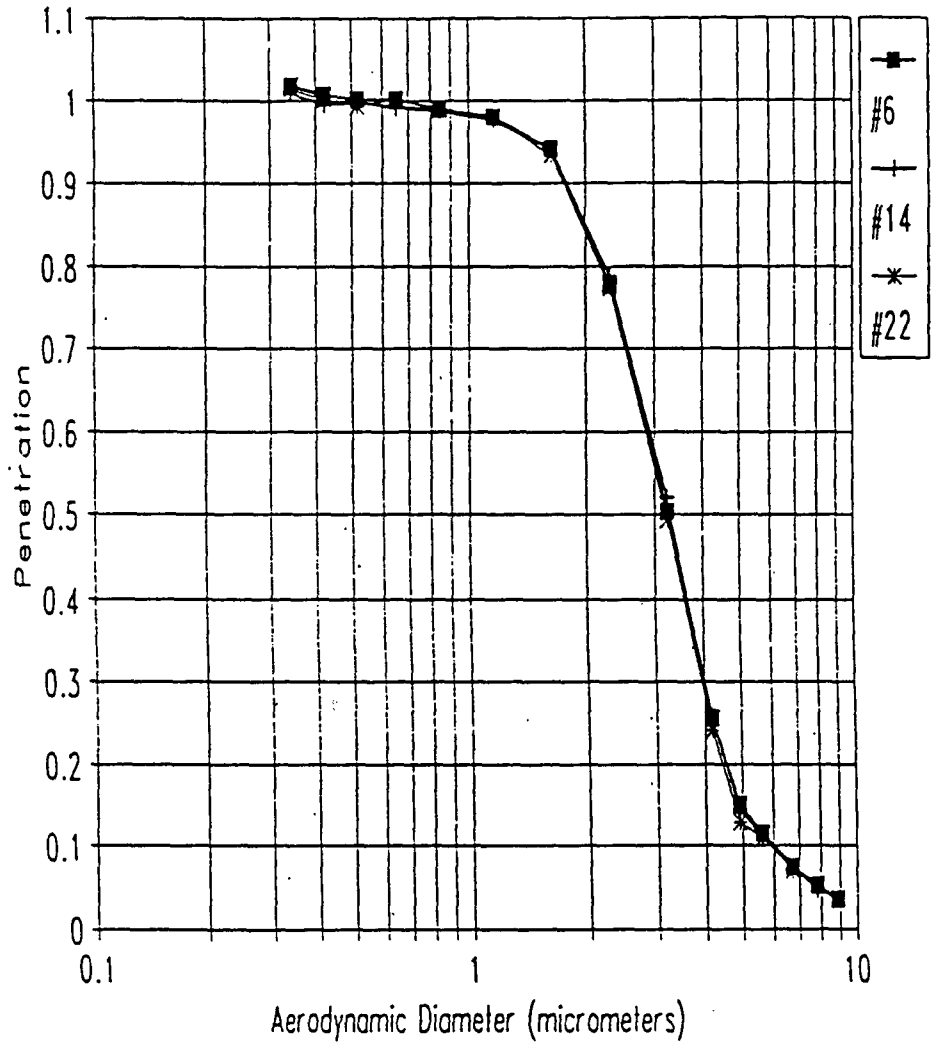

Figure 21. Fractional Penetration, Paper Mesh, Clean

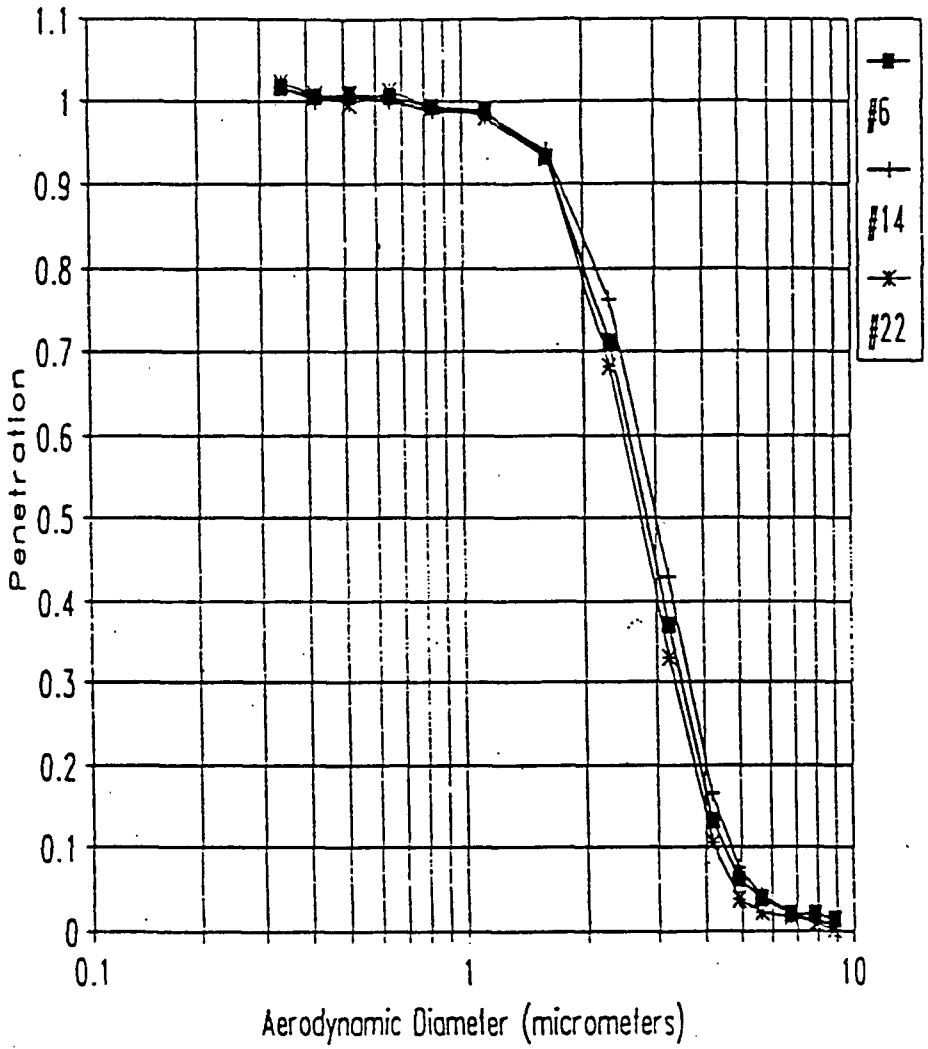

Figure 22. Fractional Penetration, Paper Mesh, Loaded

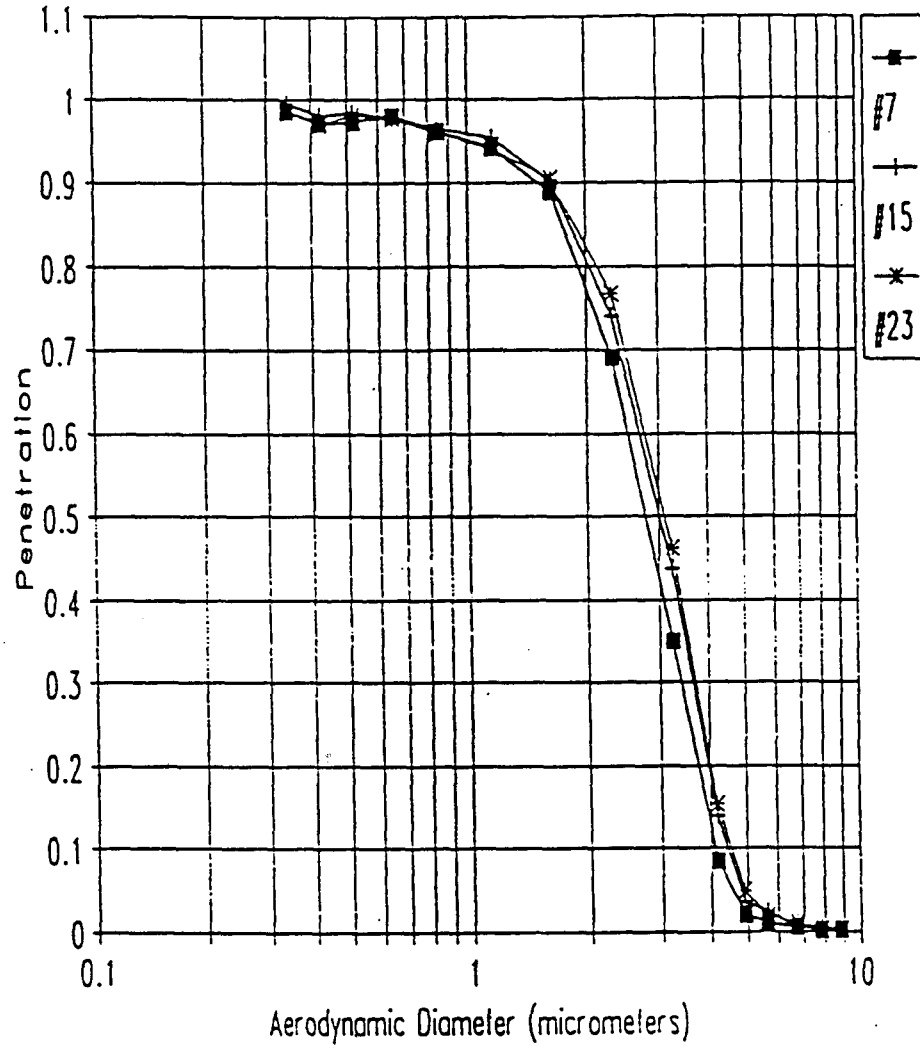

Figure 23. Fractional Penetration, Polyester Bag, Clean

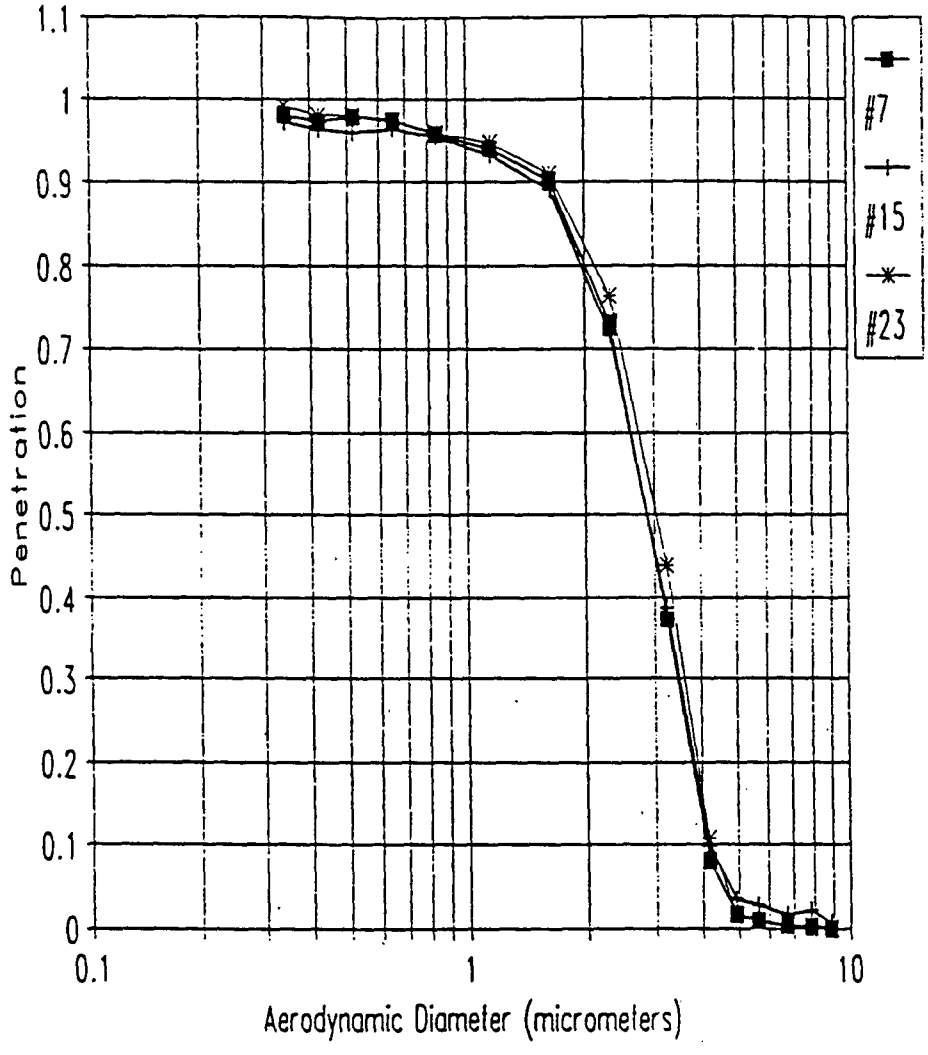

Figure 24. Fractional Penetration, Polyster Bag, Loaded

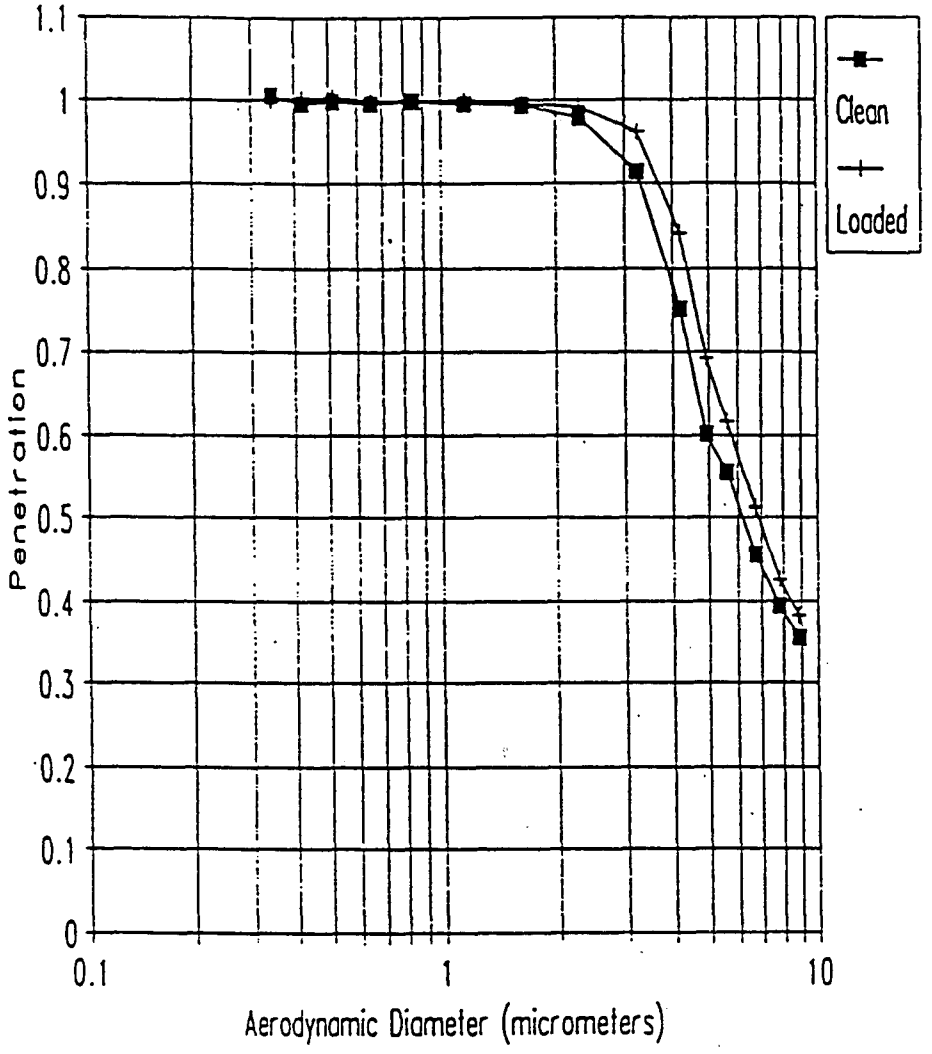

Figure 25. Fractional Penetration, Styrofoam Baffle, Clean

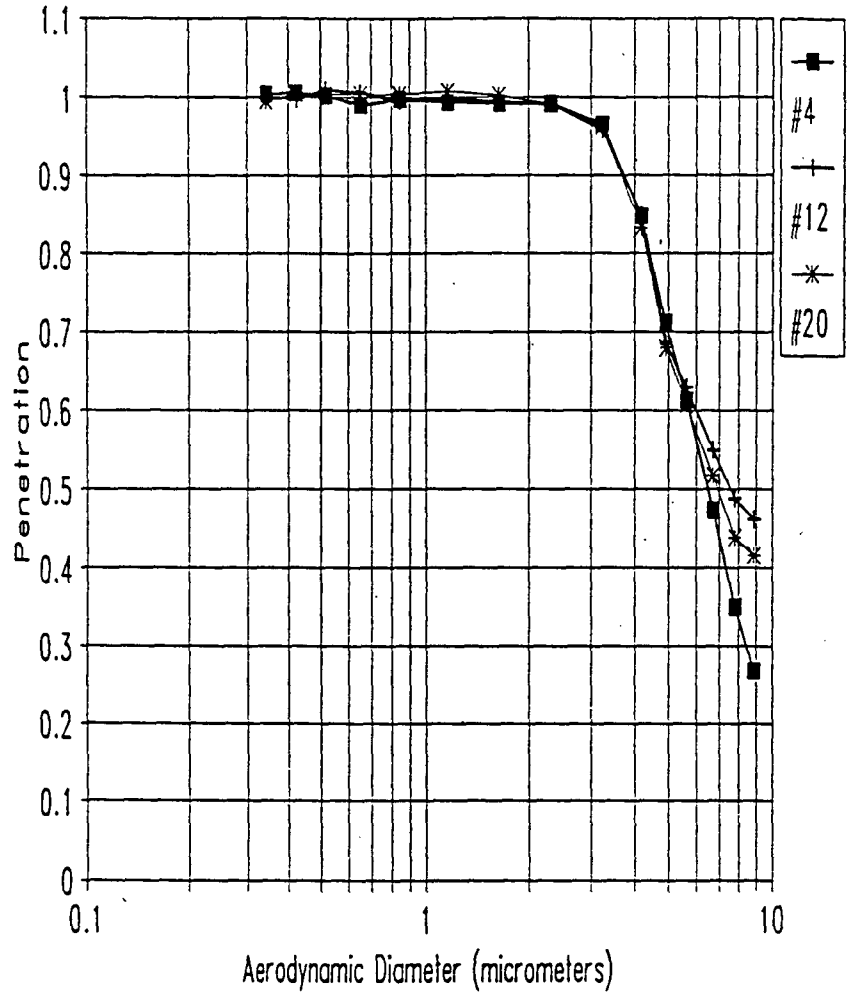

Figure 26. Fractional Penetration, Styrofoam Baffle, Loaded

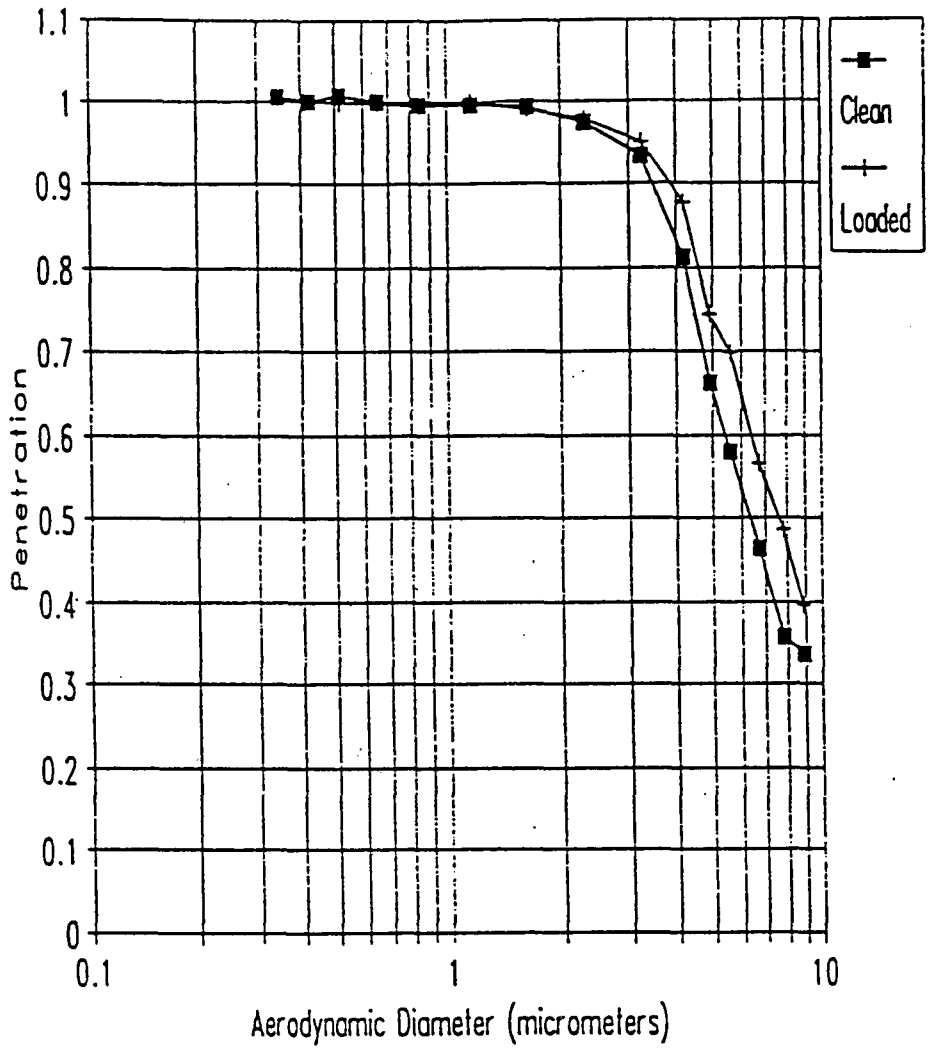

Figure 27. Fractional Penetration, Summary, Cardboard Cyclone

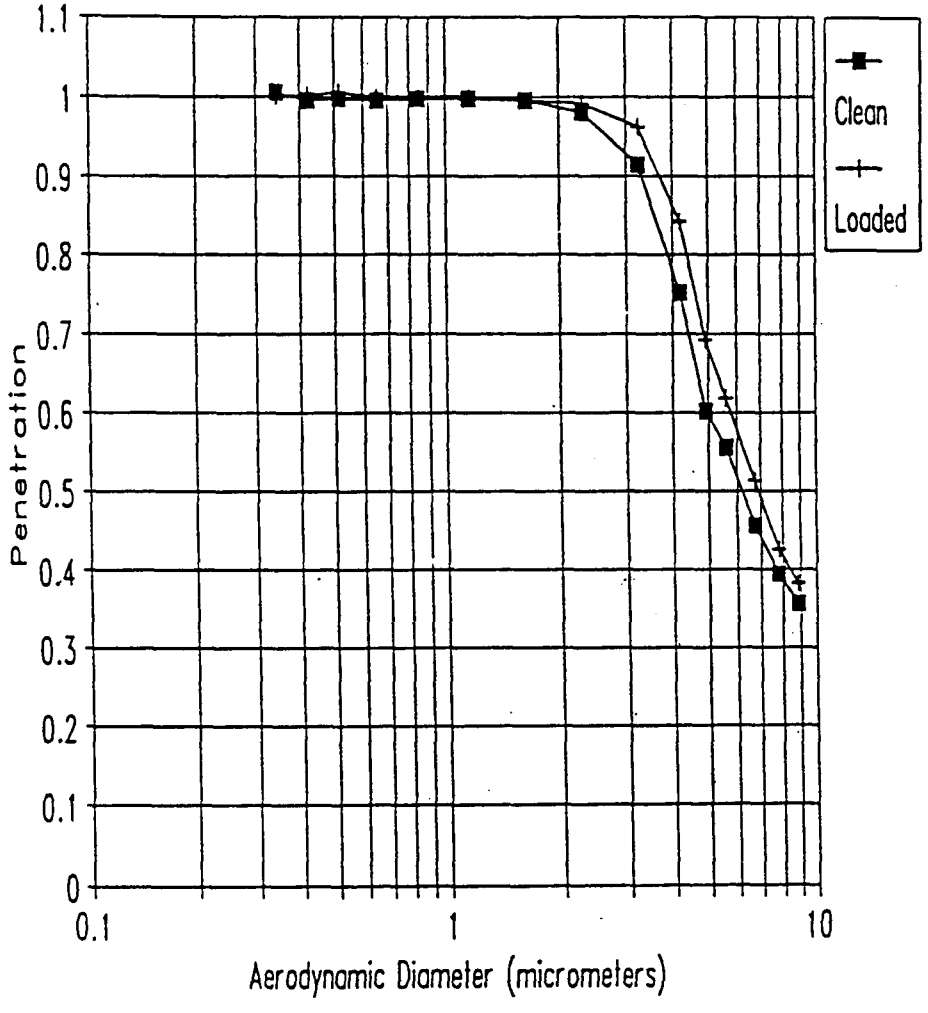

Figure 28. Fractional Penetration, Summary, Styrofoam Baffle

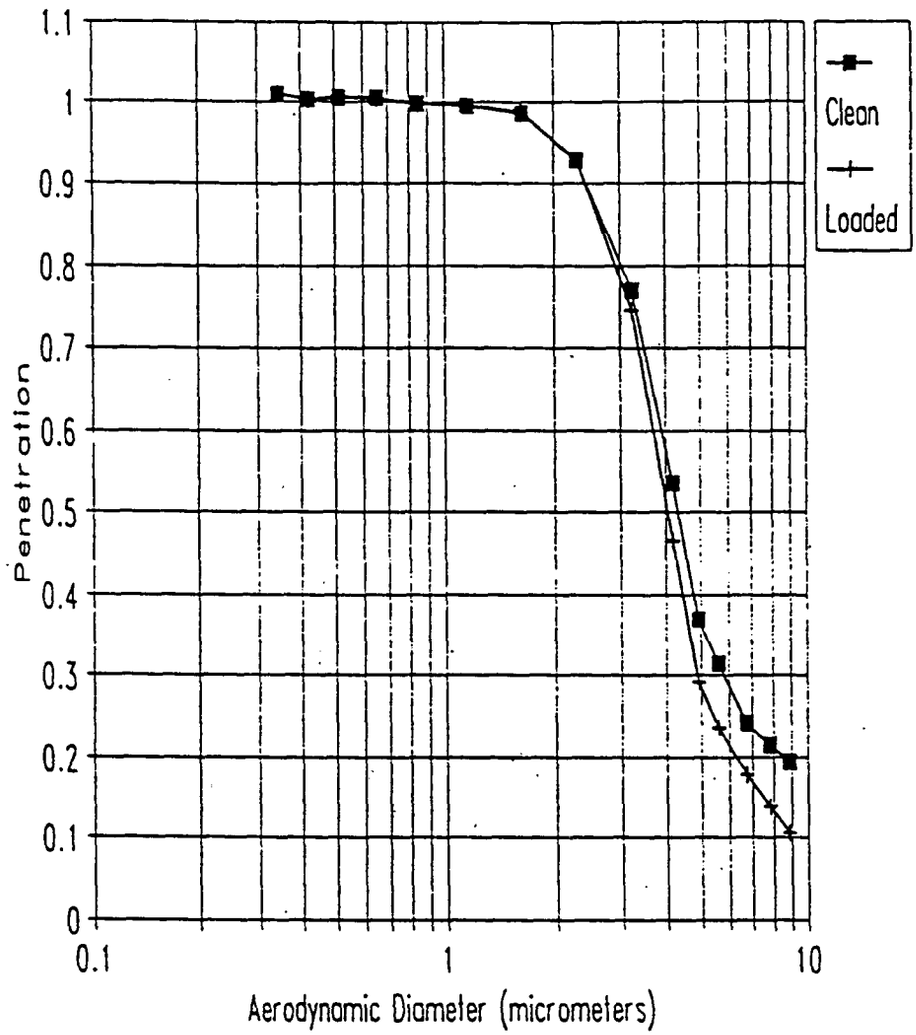

Figure 29. Fractional Penetration, Summary, Fiberglass Panel

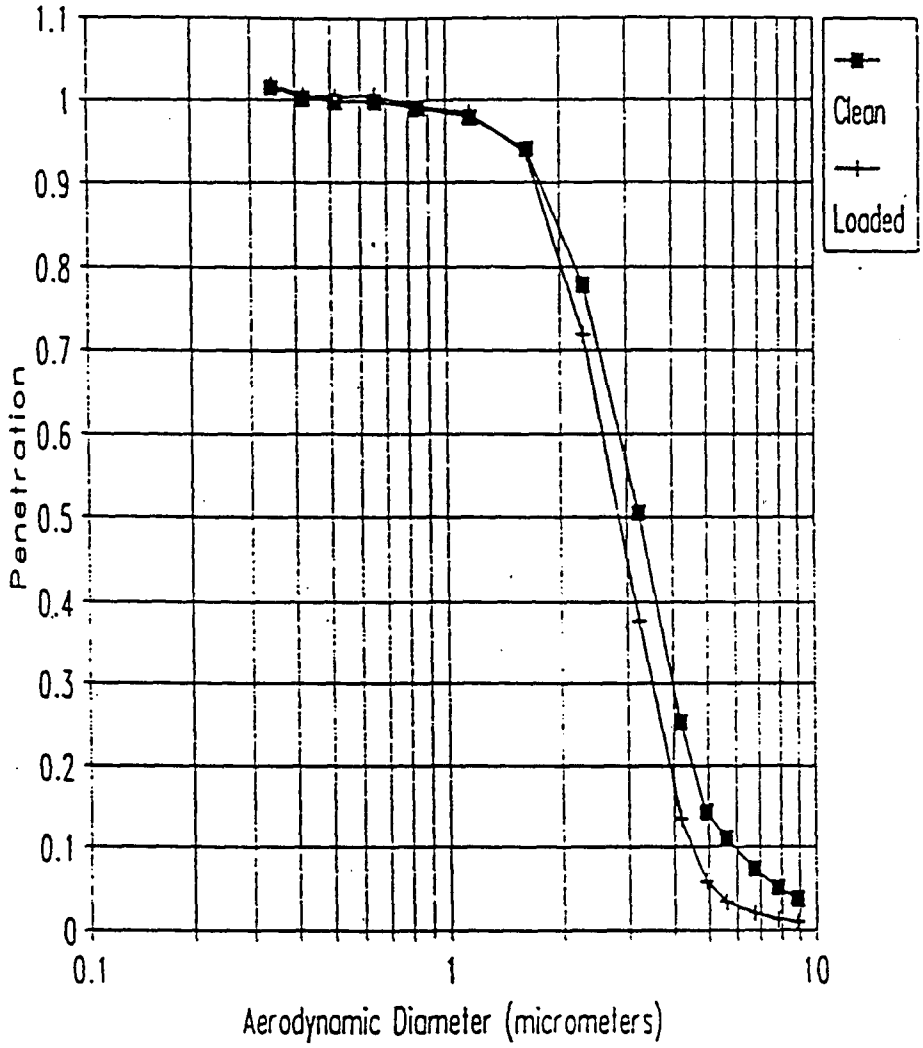

Figure 30. Fractional Penetration , Summary, Paper Mesh

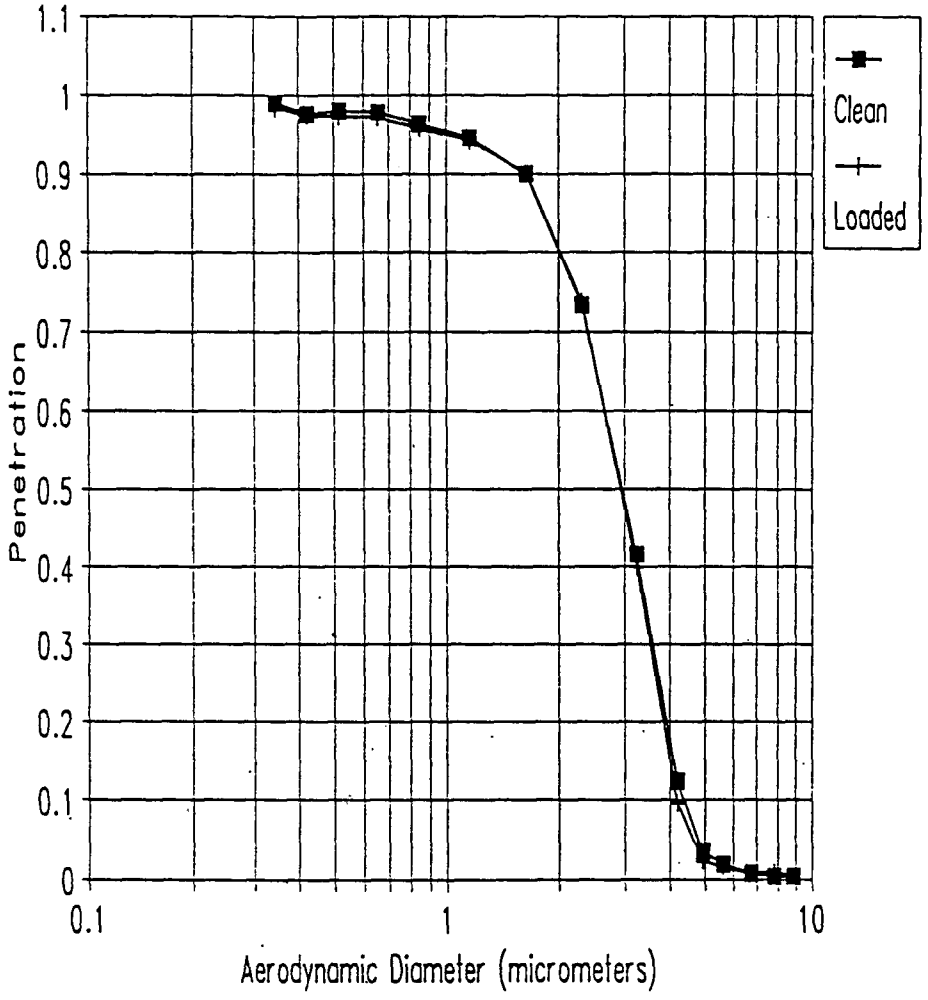

Figure 31. Fractional Penetration, Summary, Polyester Bag

8.0 Discussion

A significant factor is the weight gain by the backup filter. This weight gain represents the paint that penetrated the test POAs, and in a painting facility would have either coated the ducts in the spray booth (creating either a hazardous material cleanup or a fire hazard) or would have been emitted into the environment. The weight gain of the backup filter during the testing varied from 1.4 grams for the polyester bag to 38.5 grams for the cardboard cyclone. This is a 27.5:1 difference in the emissions from arrestors.

The dispersion of measured values above 7 µm for the cardboard cyclone and the polystyrene or styrofoam baffle confounds (i.e., mixes the results without providing a means of separating) the test variance with the arrestor variance. Notice in Figures 17 and 18 that the styrofoam baffle results above 7µm tend to exhibit a greater dispersion than results below 7µm. A similar penetration characteristic is also evident for the cardboard cyclone as shown in Figures 25 and 26. These are the only POAs that were tested which had relatively large dispersions. The 90% confidence interval for the fractional penetration exceeded the 0.1 DQO slightly.

The results of the triplicate measurements of fractional penetration show that the test is highly repeatable, and indicate that, except for two data points, the test methodology and paint arrestors operate consistently under the test conditions. Finally, Figures 27 through 31 present the mean value of fractional penetration for each type of POA in the clean and loaded conditions. The cardboard cyclone and styrofoam baffle gave comparable performance. They showed a 50% probability of capture of a particle of approximately 7 µm diameter.

The fiberglass paint filter indicated a 50% probability of capture of particles between 4 µm and 5 µm in diameter. In addition the droplet capture efficiency was improved as loading increased using the high solids baking enamel, Figure 29.

The paper mesh filters capture efficiency improved for all droplet diameters above 1 µm when loaded, Figure 30. At that point the paper mesh arrestor approached the performance of the polyester bag arrestor. As shown in Figures 9 and 10 the efficiency of the paper mesh arrestor converged to approximately that of the polyester bag system. The design of the paper mesh system is a combination of multiple stages of inertial separation and fiber filtration. The wet walls of the inertial separators apparently capture droplets better than dry walls, while the fiber filter retains the droplets, not allowing re-entrainment.

Figures 23 and 24 present the results of the polyester bag system evaluations. The polyester bag arrestor showed the best

performance of any paint filter tested. It showed no change in fractional penetration as a result of loading. There was no significant change in droplet capture efficiency between the clean and loaded conditions. This phenomenon was noticeably different from the other POAs. This filter also was the only two-stage filter system tested.

The high solids baking enamel was found to flow from the POAs instead of remaining on the surfaces. Therefore, the time and amount of paint required to load the POA to the manufacturer's recommended pressure drop for "end of life" were considered excessive. As a result, loading was not extended to the end of service life as was originally specified in the test plan. Instead, fractional penetration was measured for each arrestor after spraying approximately 1 quart (1240 grams) of paint at the arrestor. This loading took approximately 20 minutes. Normal service life is typically measured in 8 hour shifts.

The section of the wind tunnel test facility between the spray gun and the paint overspray filter became thoroughly coated with paint, requiring cleanup before installation of the next filter. This was apparently caused by the "tails" of the spatial distribution in the turbulent flow, and the fact that the spray pattern was round while the POA was square.

When re-entrainment occurred, cleanup was required downstream of the POA. In loading the filter with paint, cyclone types of paint overspray filters retained a substantial amount of this paint, letting the excess drain off, and without noticeable re-entrainment. On the other hand, the inertial separator type of paint overspray filters produced a very noticeable re-entrainment of some of the paint deposited on their walls. The paint that was re-entrained typically formed droplets, some of which were too large to be carried by the air flow as far as the backup high efficiency filter.

9.0 Conclusions

Based on the results of the filter testing program the following conclusions are derived from the data developed during testing.

1. POA designs will have a measurably different 50 percent cut-off for discrete particle sizes in the PM10 size range.

2. The most efficient POA of those tested was shown to be the polyester bag system. Its cut-off diameter, where 50% of a discrete droplet size is captured and 50% penetrates the filter, is 3 μm diameter.

3. The less effective POAs, the cardboard and styrofoam designs, allowed a consistently larger mass of particles over a broader portion of the PM10 range to penetrate. Their cut-off diameter was 7 µm.

The cardboard cyclone and styrofoam paint overspray filters gave the lowest capture efficiency of PM 10 particles. This suggests that gain in pressure drop with loading was the principal design consideration for these arrestors.
The test protocol developed for this program was found to be suitable for use on a broad range of POA designs.

10.0 Recommendations

Based on the results of this study, the following recommendations are presented:

1. Further studies will ascertain the effects of different types of paint, and loading to higher pressure drops than achieved for this study. Any additional work should include, but not be limited to, the use of other paint systems that will produce and a buildup of deposits within the POAs greater than that achieved during this testing.

2. If possible, extend the measurements to include the solid-phase aerosol. It was observed during the preliminary study that solid-phase particles may penetrate paint overspray filters to a significantly higher degree than the liquid-phase. Because some paint overspray dries before it reaches the filter, performance using dry particles should be evaluated.

11.0 Quality Assurance

This research project was conducted at an EPA Quality Assurance Level 2, which is suitable for data having potential regulatory impact. The results of a prior study were used to guide this current research effort. The prior study, using particles of potassium chloride to simulate paint droplets with oleic acid coated POAs, determined the approximate magnitude of penetration for 0.3 µm to 10 µm particles through the test arrestor. The true fractional penetration of liquid droplets was overestimated by this procedure, since particles larger than about 5 µm bounced from the surface, instead of adhering to it as a liquid droplet would.

In Section 3.0 of the Project Work and Quality Assurance Plan, the data quality objectives (DQOs) were to define the fractional penetration to the nearest 0.1 at the 90% confidence level, over the range of 0.3 µm to 10 µm, and measure the droplet

size to ±20% of the droplet diameter, at an air flow rate of 120 fpm ±5%.

The DQOs were in three categories: 1) fractional penetration, 2) polystyrene latex (PSL) equivalent droplet diameter, and 3) flow rate. Each of these is addressed for precision and accuracy.

11.1 Fractional Penetration

The fractional penetration was computed as the ratio of droplet counts downstream to upstream, after correction for background, and losses to the wall and the sample lines. The background and no-filter measurements were made to determine these correction factors. The no-filter correction factor varied from 1.01 to 0.91, which called for a maximum of 9% correction in the ratio of droplet counts when computing the fractional penetration.

The precision was based on digital counts of pulses in the OPC. The droplet counts were at least 50 per channel for each of the 10 samples. The data from the 10 samples were averaged, which provided a count in the denominator of 500 (minimum), giving a resolution of less than 0.2%.

The precision and accuracy of the fractional penetration therefore had an uncertainty of less than 9.2%, while the DQO allowed up to 10%.

11.2 PSL Equivalent Droplet Diameter

The OPC measures droplet diameter by the amount of light scattered over a large solid angle. This scattered light is collected by an elliptical mirror and focused on a detector. The counts were generated by sensing the level of the pulses in the OPC, sorting them by their voltage amplitude, and placing the pulses in the appropriate OPC channel.

The droplet diameter corresponding to each channel was determined by the manufacturer's calibration, using a PSL aerosol. The oleic acid challenge aerosol was selected because it has optical properties similar to those of PSL, thereby maintaining the accuracy of the OPC. This calibration could have been rendered not applicable by 1) using an aerosol with an inappropriate index of refraction or 2) deposition on the mirror.

Oleic acid is known to have an index of refraction of 1.458. The index of refraction of PSL is 1.546. The calibration of such an instrument is not sensitive to the index of refraction over this range.

Prior to testing, the OPC calibration was checked by challenge with 0.451 µm, 0.720 µm, and 3.70 µm monodisperse PSL aerosol. The calibration was again checked each day by challenge with a 0.720 µm monodisperse PSL aerosol. This was to ensure that there was no fouling of the mirror, or any other cause which would have produced a shift in OPC response. The response to the monodisperse peaked in the appropriate channels. The accuracy and precision of the measurement could be ensured to 20% by this calibration check.

The peaking of the response is to be expected because there is some standard deviation to the diameter of the monodisperse, and there is also some residual surfactant on the aerosol droplets. When clumps of two or more droplets are present, they are sensed as appropriately larger sizes.

11.3 Flow Rate

The flow rate was measured with a thermal anemometer and a pitot tube. The thermal anemometer was considered the more accurate, and was the principal measurement because it had a digital readout which was easily read. A velocity traverse of the duct confirmed that the centerline velocity was 5% greater than the average. The flow rate was therefore monitored at the centerline, using the 5% correction to ensure that the reading of the anemometer represented an average of 120 fpm at the face of the POA.

The thermal anemometer is accurate to less than 5%.

11.4 Completeness

According to the Quality Assurance Manual[8], completeness has two aspects for an experiment such as this one. The first aspect is whether all of the planned data were collected. All of the planned data for the test matrix were collected.

The second aspect is whether all of the data met the DQO. Based on this criterion, the completeness was 98.5%. This is obtained by multiplying the five types of POAs by the 15 channels of the OPC and two conditions of loading, and noting that in only two cases was the standard deviation of data slightly too large. In both cases, the variability of the data collection was confounded with variability of the sample.

The effect of these two data points is trivial, because they affect only the last point on two fractional penetration curves, where the curves are below 50%.

The quality assurance procedures were audited by C.D. Wolbach, of Acurex Environmental Corporation and found to meet the stated objectives.

12.0 References

1. Chan, T.T., J.B. D'Arcy, and R.M. Schreck, High-Solids Paint Overspray Aerosols in a Spray Painting Booth: Particle Size Analysis and Scrubber Efficiency, American Industrial Hygiene Association Journal, 47(7):411-417, July 1986

2. Hinds, William, Aerosol Technology, John Wiley & Sons, 1982.

3. Darvin, Charles H., Optimizing Transfer Efficiency in Spray Painting, Plating and Surface Finishing, 74:7, 12 and 72, July 1987.

4. Method of Testing Air-Cleaning Devices Used in General Ventilation for Removing Particulate Matter, ASHRAE Standard No. 52-76, The American Society for Heating, Refrigerating and Air-Conditioning Engineers, Inc., Atlanta, GA, 1976.

5. Handbook of Chemistry and Physics, 73rd Edition, CRC Press, 1992.

6. OSHA 29 CFR 1910.107 (b)(5)(I), Ch. XVII (7-1-87 edition).

7. Hanley, James T., D. Smith, and D. S. Ensor, A Fractional Aerosol Filtration Test Method For Ventilation Air Cleaners, ASHRAE Transactions 1995, V. 101, Pt.1.

8 U.S. Environmental Protection Agency. AEERL Quality Assurance Procedures Manual for Contractors and Financial Assistance Recipients, Research Triangle Park, NC, April 12, 1994.

APPENDIX A

Example Fractional Penetration Calculation

Run No. 7 Polyester Bag System

Sample Calculation for Table No. 5.

I. Mean particle diameter for OPC channel no. 10 is defined as **4.4µm**.

II. Average no filter reading P_{100} correction factor is: **0.99**.

III.

Test Reading for Round 1 Test #7.

Sample #	1	2	3	4	5	6	7	8	9	10	Average
Inlet	2381	2282	2270	2257	2220	2236	2175	2239	2261	2337	2265
Outlet	181	193	198	196	189	173	179	159	202	208	188

IV. Calculation:

P= [Outlet - Inlet]/ (No filter correction factor)

$P= [(D_{ave} - D_b)/(U_{ave} - U_b)]/P_{100}$

P= [(187.8 -0)/(2265.4 - 1)]/.99

P= 0.08

U_b= average upstream background reading for each test
D_b= average downstream background reading for each test

#7, clean

Upstream and Downstream Particle Counts per Indicated OPC Channel (1.25-Minute Samples @ 7.1 L/min)

OPC Channel Number	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
Min. Diam. (um)	0.33	0.4	0.5	0.6	0.8	1	1.5	2	3	3.92	5	5.42	6.54	7.74	8.82
Max. Diam. (um)	0.4	0.5	0.6	0.8	1	1.5	2	3	3.92	5	5.42	6.54	7.74	8.82	10
Geo. Mean Diam (um)	0.36	0.45	0.55	0.69	0.89	1.22	1.73	2.45	3.43	4.43	5.21	5.95	7.11	8.26	9.39
Upstream Bkg	4	1	1	1	0	0	0	1	2	0	0	0	0	0	0
Upstream Bkg	1	1	0	3	0	1	2	0	0	0	0	0	0	0	0
Upstream Bkg	2	0	1	1	0	0	0	1	0	0	0	0	0	0	0
Upstream Bkg	1	0	0	0	0	1	0	0	0	0	0	0	0	0	0
Upstream Bkg	3	0	1	1	0	1	1	0	0	0	0	0	0	0	0
Upstream	14220	21300	14410	20860	13560	33980	30270	13960	6925	2381	269	440	201	113	70
Upstream	13440	20580	13790	19990	13140	32940	29300	13640	6925	2282	224	424	173	113	50
Upstream	13720	20350	13510	20110	13000	32430	28830	13400	6732	2270	241	396	185	80	75
Upstream	13710	20500	13740	19810	13140	32440	28730	13260	6748	2257	248	414	185	101	61
Upstream	13420	19910	13480	19620	12790	31900	28180	13190	6621	2220	239	391	222	103	72
Upstream	13080	19580	13240	19590	12670	31790	27960	13040	6619	2232	236	433	212	104	69
Upstream	13330	19830	13330	19690	12850	32380	28350	13160	6561	2175	235	390	205	88	53
Upstream	12870	19460	13150	19010	12650	31610	27650	12830	6300	2239	273	387	210	96	69
Upstream	13230	19830	13440	19500	12610	31930	27660	13200	6311	2261	221	337	169	85	64
Upstream	13230	19560	13460	20070	12950	31420	30140	13440	6807	2327	266	405	210	98	68
Upstream Bkg	3	2	3	3	0	3	4	1	0	0	0	0	0	0	0
Upstream Bkg	2	4	0	0	2	2	0	2	0	0	0	0	0	0	0
Upstream Bkg	2	2	0	1	0	0	0	1	0	0	0	0	0	0	0
Upstream Bkg	2	3	0	0	1	1	0	0	0	0	0	0	0	0	0
Upstream Bkg	6	9	1	5	2	3	0	2	0	0	0	0	0	0	0
Downstream Bkg	0	0	2	1	0	0	0	0	0	0	0	0	0	0	0
Downstream Bkg	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Downstream Bkg	0	1	2	0	0	0	0	0	0	0	0	0	0	0	0
Downstream Bkg	4	2	0	1	0	1	0	0	0	0	0	0	0	0	0
Downstream Bkg	1	0	0	2	0	0	0	0	0	0	0	0	0	0	0
Downstream	13850	20230	13810	20300	13060	31520	26530	9412	2383	181	8	6	2	1	0
Downstream	13730	20060	13550	19830	12710	31140	26060	9510	2379	193	2	3	0	0	0
Downstream	13400	19710	13520	19710	12670	30920	25910	9175	2340	198	7	5	0	0	0
Downstream	13110	19180	13220	19230	12290	30170	25090	8999	2180	196	2	4	2	0	0
Downstream	13490	19690	13150	19630	12540	30580	25520	9213	2223	189	4	1	0	0	0
Downstream	12980	19240	12950	19140	12300	30240	24790	8920	2185	173	7	6	1	0	0
Downstream	13120	19370	12860	19050	12330	29920	24560	8836	2206	179	4	4	0	0	0
Downstream	12740	19150	13100	19000	12130	29910	24590	8962	2172	159	4	3	1	0	0
Downstream	12680	18800	12740	18950	12320	28930	25930	9380	2401	202	3	6	1	0	0
Downstream	12780	18820	12640	19150	11890	29310	26230	9338	2539	208	7	4	2	0	1
Downstream Bkg	2	0	2	2	3	1	3	2	0	0	0	0	0	0	0
Downstream Bkg	2	0	2	1	1	2	0	0	0	0	0	0	0	0	0
Downstream Bkg	1	2	0	2	0	0	0	0	0	0	0	0	0	0	0
Downstream Bkg	3	0	2	1	0	0	0	0	0	0	0	0	0	0	0
Downstream Bkg	2	0	0	0	0	0	0	0	1	0	0	0	0	0	0
Meas. Penetration	0.98	0.97	0.97	0.98	0.96	0.94	0.89	0.69	0.35	0.08	0.02	0.01	0.00	0.00	0.00
P100 correction values	0.99	1.00	1.00	1.00	1.00	1.00	1.00	1.00	0.99	0.99	1.01	0.99	0.99	0.94	0.91
Corrected Penetration	0.99	0.97	0.97	0.98	0.96	0.94	0.89	0.69	0.35	0.08	0.02	0.01	0.00	0.00	0.00
Corrected Efficiency (%)	1	3	3	2	4	6	11	31	65	92	98	99	100	100	100

#1 No Filter

Particle Counts per Indicated OPC Channel (1.00-Minute Samples @ 7.1 L/min)

OPC Channel Number	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
Upstream-Bkg	2	2	0	1	0	0	0	0	0	0	0	0	0	0	0
Upstream-Bkg	6	1	1	0	1	0	0	0	0	0	0	0	0	0	0
Upstream-Bkg	5	3	1	2	1	0	0	2	0	0	0	0	0	0	0
Upstream-Bkg	1	0	1	0	0	0	0	0	0	0	0	0	0	0	0
Upstream-Bkg	2	5	1	0	1	0	2	2	0	0	0	0	0	0	0
Upstream	11380	16730	11270	17050	11090	26690	24240	11620	6229	2160	245	382	198	118	64
Upstream	11180	16940	11490	16940	11020	26580	24660	11730	6089	2136	250	381	204	100	59
Upstream	11340	16650	11340	16970	10990	27050	24600	11790	6101	2048	258	384	193	94	64
Upstream	11420	16920	11670	17270	11210	27490	25160	12030	6380	2193	246	379	229	104	76
Upstream	11020	16520	11300	16960	10640	26410	24140	11450	5890	2165	234	363	198	87	47
Upstream	11250	16360	11250	16770	10930	26710	24640	11600	6133	2128	222	371	193	111	64
Upstream	11420	16710	11220	17080	11180	27120	24730	11770	6069	2218	233	423	224	110	71
Upstream	11110	16440	11180	16580	10710	26150	24230	11340	6042	2090	245	408	192	100	66
Upstream	11010	16540	11030	16690	10910	26640	24180	11660	6223	2148	258	390	201	92	54
Upstream	11100	16220	11260	16800	10890	26810	24440	11700	6140	2203	250	387	191	113	65
Upstream-Bkg	2	1	0	1	2	2	1	1	0	0	0	0	0	0	0
Upstream-Bkg	3	2	0	0	1	0	1	0	0	0	0	0	0	0	0
Upstream-Bkg	3	1	0	0	2	0	0	0	0	0	0	0	0	0	0
Upstream-Bkg	3	2	0	2	0	1	0	0	0	0	0	0	0	0	0
Upstream-Bkg	2	3	0	0	0	1	0	0	0	0	0	0	0	0	0
Downstream-Bkg	5	4	0	1	0	0	0	0	0	1	0	0	0	0	0
Downstream-Bkg	5	0	0	0	0	1	1	0	0	0	0	0	0	0	0
Downstream-Bkg	2	1	0	2	0	1	0	0	0	0	0	0	0	0	0
Downstream-Bkg	2	0	3	0	1	0	0	0	0	0	0	0	0	0	0
Downstream-Bkg	1	7	0	0	0	0	1	0	0	0	0	0	0	1	0
Downstream	11330	17050	11420	17230	11130	27680	24640	11760	6009	2200	256	352	197	64	61
Downstream	11350	16850	11230	17090	10950	27070	24760	11580	6060	2093	256	377	160	88	50
Downstream	11280	17100	11380	17120	10990	27060	25240	11840	6092	2141	271	379	186	108	43
Downstream	11020	16580	11160	17120	10890	26900	24470	11690	6038	2103	242	356	225	82	54
Downstream	11350	16800	11420	17200	10980	26730	24660	11710	6092	2138	253	350	191	95	48
Downstream	11160	16710	11190	16870	10810	26470	24070	11550	5928	2107	245	394	191	85	52
Downstream	11190	16410	11290	16990	10970	26730	24570	11510	6010	2097	238	399	193	94	44
Downstream	11120	16380	11130	16470	10580	26450	24570	11460	5992	2073	244	375	187	72	52
Downstream	10970	16010	11300	16500	10800	26280	24200	11310	5950	2104	241	329	187	67	52
Downstream	11040	16320	11030	16650	10660	26440	24370	11460	6067	2059	252	362	190	85	43
Downstream-Bkg	4	4	0	2	1	0	2	1	0	0	0	0	0	0	0
Downstream-Bkg	3	3	0	1	1	0	0	0	0	0	0	0	0	0	0
Downstream-Bkg	4	3	1	0	0	0	2	0	0	0	0	0	0	0	0
Downstream-Bkg	2	2	1	3	1	0	1	0	0	0	0	0	0	0	0
Downstream-Bkg	5	5	1	0	0	1	0	1	0	0	0	0	0	0	0
Meas. Penetration	1.00	1.00	1.00	1.00	0.99	1.00	1.00	0.99	0.98	0.98	1.02	0.95	0.94	0.82	0.79

APPENDIX B

FRACTIONAL PENETRATION TEST RESULTS

Note: Test results not corrected for "no filter" correction factor.

#1, No Filter

Particle Counts per Indicated OPC Channel (1.00-Minute Samples @ 7.1 L/min)

OPC Channel Number	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
Upstream-Bkg	2	2	0	1	0	0	0	0	0	0	0	0	0	0	0
Upstream-Bkg	6	1	1	0	1	0	0	0	0	0	0	0	0	0	0
Upstream-Bkg	5	3	1	2	1	0	0	2	0	0	0	0	0	0	0
Upstream-Bkg	1	0	1	0	0	0	0	0	0	0	0	0	0	0	0
Upstream-Bkg	2	5	1	0	1	0	2	2	0	0	0	0	0	0	0
Upstream	11380	16730	11270	17050	11090	26690	24240	11620	6229	2160	245	382	198	118	64
Upstream	11180	16940	11490	16940	11020	26580	24660	11730	6089	2136	250	381	204	100	59
Upstream	11340	16650	11340	16970	10990	27050	24600	11790	6101	2048	258	384	193	94	64
Upstream	11420	16920	11670	17270	11210	27490	25160	12030	6380	2193	246	379	229	104	76
Upstream	11020	16520	11300	16960	10640	26410	24140	11450	5890	2165	234	363	198	87	47
Upstream	11250	16360	11250	16770	10930	26710	24640	11600	6133	2128	222	371	193	111	64
Upstream	11420	16710	11220	17080	11180	27120	24730	11770	6069	2218	233	423	224	110	71
Upstream	11110	16440	11180	16580	10710	26150	24230	11340	6042	2090	245	408	192	100	66
Upstream	11010	16540	11030	16690	10910	26640	24180	11660	6223	2148	258	390	201	92	54
Upstream	11100	16220	11260	16800	10890	26810	24440	11700	6140	2203	250	387	191	113	65
Upstream-Bkg	2	1	0	1	2	2	1	1	0	0	0	0	0	0	0
Upstream-Bkg	3	2	0	0	1	0	1	0	0	0	0	0	0	0	0
Upstream-Bkg	3	1	0	0	2	0	0	0	0	0	0	0	0	0	0
Upstream-Bkg	3	2	0	2	0	1	0	0	0	0	0	0	0	0	0
Upstream-Bkg	2	3	0	0	0	1	0	0	0	0	0	0	0	0	0
Downstream-Bkg	5	4	0	1	0	0	0	0	0	1	0	0	0	0	0
Downstream-Bkg	5	0	0	0	0	1	1	0	0	0	0	0	0	0	0
Downstream-Bkg	2	1	0	2	0	1	0	0	0	0	0	0	0	0	0
Downstream-Bkg	2	0	3	0	1	0	0	0	0	0	0	0	0	0	0
Downstream-Bkg	1	7	0	0	0	0	1	0	0	0	0	0	0	1	0
Downstream	11330	17050	11420	17230	11130	27680	24640	11760	6009	2200	256	352	197	64	61
Downstream	11350	16850	11230	17090	10950	27070	24760	11580	6060	2093	256	377	160	88	50
Downstream	11280	17100	11380	17120	10990	27060	25240	11840	6092	2141	271	379	186	108	43
Downstream	11020	16580	11160	17120	10890	26900	24470	11690	6038	2103	242	356	225	82	54
Downstream	11350	16800	11420	17200	10980	26730	24660	11710	6092	2138	253	350	191	95	48
Downstream	11160	16710	11190	16870	10810	26470	24070	11550	5928	2107	245	394	191	85	52
Downstream	11190	16410	11290	16990	10970	26730	24570	11510	6010	2097	238	399	193	94	44
Downstream	11120	16380	11130	16470	10580	26450	24570	11460	5992	2073	244	375	187	72	52
Downstream	10970	16010	11300	16500	10800	26280	24200	11310	5950	2104	241	329	187	67	52
Downstream	11040	16320	11030	16650	10660	26440	24370	11460	6067	2059	252	362	190	85	43
Downstream-Bkg	4	4	0	2	1	0	2	1	0	0	0	0	0	0	0
Downstream-Bkg	3	3	0	1	1	0	0	0	0	0	0	0	0	0	0
Downstream-Bkg	4	3	1	0	0	0	2	0	0	0	0	0	0	0	0
Downstream-Bkg	2	2	1	3	1	0	1	0	0	0	0	0	0	0	0
Downstream-Bkg	5	5	1	0	0	1	0	1	0	0	0	0	0	0	0
Meas. Penetration	1.00	1.00	1.00	1.00	0.99	1.00	1.00	0.99	0.98	0.98	1.02	0.95	0.94	0.82	0.79

#2. HEPA

Particle Counts per Indicated OPC Channel (1.00-Minute Samples @ 7.1 L/min)

OPC Channel Number	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
Upstream-Bkg	4	9	1	0	0	0	1	0	0	0	0	0	0	0	0
Upstream-Bkg	4	4	0	1	0	1	0	0	0	0	0	0	0	0	0
Upstream-Bkg	3	2	2	1	0	0	0	1	0	0	0	0	0	0	0
Upstream-Bkg	3	4	0	0	0	0	0	0	0	0	0	0	0	0	0
Upstream-Bkg	4	5	0	1	0	0	0	0	0	0	0	0	0	0	0
Upstream	11040	16600	1 020	16960	10880	25720	24610	11730	5955	2220	239	408	207	83	61
Upstream	10960	16100	11160	16720	10730	25790	23930	11430	6013	2078	216	409	211	75	83
Upstream	11050	16230	10900	16570	10540	25270	24390	11280	5935	2080	230	332	184	101	61
Upstream	10680	16080	10770	16310	10420	25150	23620	11070	5906	2072	249	380	202	112	65
Upstream	11010	16480	11140	16590	10540	25910	24130	11420	5907	2072	239	420	201	80	67
Upstream	10920	16170	10960	16400	10410	25540	23970	11260	5935	2154	237	395	204	90	61
Upstream	10900	16020	10990	16280	10490	25280	23640	11280	5927	2056	227	399	204	94	77
Upstream	10940	15850	10920	16670	10510	25370	23770	11220	5890	2130	245	364	191	100	65
Upstream	10840	15980	10880	16410	10490	25610	24320	11440	5903	2089	228	398	212	89	64
Upstream	10860	15840	10830	16710	10410	25490	24350	11550	5893	2098	233	399	166	108	67
Upstream-Bkg	7	2	0	1	1	1	0	1	0	0	0	0	0	0	0
Upstream-Bkg	2	1	0	3	0	0	0	0	0	0	0	0	0	0	0
Upstream-Bkg	2	4	1	0	0	0	0	0	0	0	0	0	0	0	0
Upstream-Bkg	4	2	0	1	0	0	0	0	0	0	0	0	0	0	0
Upstream-Bkg	1	1	1	1	0	0	0	0	0	0	0	0	0	0	0
Downstream-Bkg	1	0	0	0	0	0	0	1	0	0	0	0	0	0	0
Downstream-Bkg	0	0	0	1	0	0	0	1	0	0	0	0	0	0	0
Downstream-Bkg	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Downstream-Bkg	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Downstream-Bkg	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Downstream	5	3	8	3	7	7	9	4	2	0	0	0	0	0	0
Downstream	8	10	7	4	6	8	9	6	2	0	0	0	0	0	0
Downstream	5	6	4	12	2	9	10	5	1	0	0	0	0	0	0
Downstream	8	3	4	9	6	14	10	4	0	0	0	0	0	0	0
Downstream	3	9	3	8	6	8	12	4	3	0	0	0	0	0	0
Downstream	3	6	2	3	3	10	9	4	0	0	0	1	0	0	0
Downstream	5	5	7	11	2	10	12	2	2	0	0	0	0	0	0
Downstream	8	9	5	6	2	13	14	7	1	0	0	0	0	0	0
Downstream	5	13	5	6	7	13	13	7	0	0	0	0	0	0	0
Downstream	4	10	6	8	6	6	5	6	1	0	0	0	0	0	0
Downstream-Bkg	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Downstream-Bkg	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Downstream-Bkg	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Downstream-Bkg	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Downstream-Bkg	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0
Meas. Penetration	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000

#3, Cardboard

Particle Counts per Indicated OPC Channel (1.00-Minute Samples @ 7.1 L/min)

OPC Channel Number	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
Upstream-Bkg	4	1	0	0	0	0	0	0	0	0	0	0	0	0	0
Upstream-Bkg	3	3	0	1	0	0	1	0	0	1	0	0	0	0	0
Upstream-Bkg	2	0	1	0	0	0	0	0	0	0	0	0	0	0	0
Upstream-Bkg	0	2	1	0	0	0	0	0	0	0	0	0	0	0	0
Upstream-Bkg	2	1	0	1	0	0	0	0	0	0	0	0	0	0	0
Upstream	11090	16680	11160	16630	10830	26920	23900	11170	5715	1896	202	365	185	90	57
Upstream	11080	16700	11200	16630	10720	26850	23620	11140	5572	1779	225	336	191	71	72
Upstream	11300	16920	11200	16570	10680	26640	23940	11210	5576	1994	218	343	199	96	66
Upstream	10880	16060	10720	15890	10190	25640	22430	10600	5252	1806	197	323	155	90	47
Upstream	11230	16210	10880	16040	10270	26020	22460	10730	5375	1879	188	319	163	89	68
Upstream	10960	16130	10790	15740	10230	25930	22580	10630	5377	1840	191	330	160	84	80
Upstream	10930	15880	10540	15840	10230	25270	23150	10740	5549	1938	220	362	153	98	49
Upstream	11020	16410	10790	16070	10580	26010	23710	11030	5412	1930	213	375	197	106	61
Upstream	10640	15780	10450	15850	10130	25040	23050	10730	5444	1844	222	341	170	85	58
Upstream	10720	15710	10620	16010	10180	25230	23380	11030	5522	1930	211	355	174	86	69
Upstream-Bkg	5	4	0	0	0	0	0	0	0	0	0	0	0	0	0
Upstream-Bkg	4	3	1	1	0	0	0	0	0	0	0	0	0	0	0
Upstream-Bkg	1	0	1	0	0	0	0	0	0	0	0	0	0	0	0
Upstream-Bkg	3	1	2	0	0	1	0	0	0	0	0	0	0	0	0
Upstream-Bkg	2	2	1	1	1	0	1	1	0	0	0	0	0	0	0
Downstream-Bkg	1	1	0	1	1	1	0	0	0	0	0	0	0	0	0
Downstream-Bkg	1	0	0	2	3	0	0	2	0	0	0	0	0	1	0
Downstream-Bkg	3	2	1	0	1	2	0	0	0	1	0	0	0	0	0
Downstream-Bkg	5	3	1	4	1	1	2	0	0	0	0	0	0	0	0
Downstream-Bkg	2	1	0	2	3	2	1	2	0	0	0	0	0	0	0
Downstream	11400	16590	11210	16430	10590	26620	23330	10810	5174	1499	131	174	67	38	14
Downstream	11390	16270	11220	16390	10710	26800	23120	10760	4999	1549	143	177	71	20	15
Downstream	11120	16300	11120	16180	10160	25940	22510	10520	5129	1494	141	172	77	20	21
Downstream	11220	16790	11490	16650	10540	26320	23310	10740	5071	1395	181	183	86	12	13
Downstream	11140	16270	11040	15880	10320	25950	22710	10550	4993	1428	133	177	83	32	15
Downstream	10950	16290	10860	16080	10480	25800	22970	10800	5313	1489	143	182	80	36	21
Downstream	10900	15830	11010	16140	10250	25460	23330	10620	5020	1507	154	189	91	36	10
Downstream	10940	15910	10770	15740	10200	25190	23400	10520	5176	1552	147	214	82	22	13
Downstream	10930	15690	10730	15610	10130	24650	22720	10420	4989	1483	139	199	70	28	12
Downstream	10840	15760	10540	15690	10230	25290	23260	10580	5109	1547	119	205	82	19	16
Downstream-Bkg	5	1	4	1	0	0	2	3	0	1	0	0	0	0	0
Downstream-Bkg	4	3	0	1	0	1	1	0	0	0	0	0	0	0	0
Downstream-Bkg	1	0	1	0	0	0	0	0	0	0	0	0	0	0	0
Downstream-Bkg	5	2	0	1	0	0	1	0	0	0	0	0	0	0	0
Downstream-Bkg	0	1	2	0	0	0	0	0	0	0	0	0	0	0	0
Meas. Penetration	1.01	1.00	1.02	1.00	1.00	0.99	0.99	0.98	0.93	0.79	0.69	0.54	0.45	0.29	0.24

#3, Cardboard Loaded

Particle Counts per Indicated OPC Channel (1.00-Minute Samples @ 7.1 L/min)

OPC Channel Number	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
Upstream-Bkg	8	2	0	1	1	0	0	0	0	0	0	0	0	0	0
Upstream-Bkg	5	4	0	0	0	0	0	0	0	0	0	0	0	0	0
Upstream-Bkg	4	1	2	1	0	0	0	0	0	0	0	0	0	0	0
Upstream-Bkg	6	2	0	0	0	0	0	0	0	0	0	0	0	0	0
Upstream-Bkg	4	2	3	0	0	1	0	0	0	0	0	0	0	0	0
Upstream	10020	14490	10060	14890	9428	23100	21770	9886	4945	1711	190	295	150	89	53
Upstream	10090	14790	9831	14830	9359	23010	21470	9996	5034	1683	180	305	169	87	52
Upstream	10250	14800	10100	14940	9498	23620	21080	9815	5071	1785	206	317	164	74	59
Upstream	10210	15060	10180	15300	9575	23760	21340	9954	4851	1646	195	298	149	69	49
Upstream	10720	15500	10230	15560	10050	24560	22290	10220	5069	1812	195	276	150	80	58
Upstream	10590	15510	10510	15430	10200	24530	22420	10240	5109	1729	189	326	177	84	54
Upstream	10500	15170	10280	15420	9783	23650	23170	10540	5220	1857	203	310	169	75	63
Upstream	10510	15110	10190	15690	10170	23860	23710	10680	5434	1851	193	334	185	81	49
Upstream	10510	15360	10300	15370	9865	23470	23400	10390	5297	1867	225	380	162	86	54
Upstream	10790	15530	10400	15590	10080	24650	22130	10170	4946	1747	199	307	154	88	49
Upstream-Bkg	0	3	0	0	0	0	0	0	0	0	0	0	0	0	0
Upstream-Bkg	6	5	1	0	0	0	0	0	0	0	0	0	0	0	0
Upstream-Bkg	2	2	1	0	0	1	0	0	0	0	0	0	0	0	0
Upstream-Bkg	2	1	0	1	0	0	0	0	0	0	0	0	0	0	0
Upstream-Bkg	7	24	12	5	1	16	12	4	2	0	1	0	0	0	0
Downstream-Bkg	6	4	1	3	0	0	0	0	0	0	0	0	0	0	0
Downstream-Bkg	4	7	4	1	2	6	1	0	0	0	0	0	0	0	0
Downstream-Bkg	7	7	2	4	0	2	0	2	0	0	0	0	0	0	0
Downstream-Bkg	5	1	0	2	1	0	0	0	0	0	0	0	0	0	0
Downstream-Bkg	11	4	0	0	0	1	0	1	0	0	0	0	0	0	0
Downstream	10190	14610	9918	15030	9741	23250	21680	9629	4554	1562	146	183	76	24	10
Downstream	10180	14830	10140	15010	9380	23850	21100	9298	4497	1377	129	197	59	31	10
Downstream	10010	14900	9988	14610	9519	23250	21060	9330	4388	1275	147	192	76	30	11
Downstream	10190	14630	9989	14730	9393	23490	20930	9445	4400	1298	132	176	69	30	15
Downstream	10620	15300	10500	15510	9874	24410	22190	9883	4491	1499	146	207	65	22	15
Downstream	10590	15250	10460	15690	10020	23740	22890	9950	4804	1515	154	207	91	34	19
Downstream	10460	15040	10150	15400	9857	23320	23050	9808	4696	1517	144	205	91	30	11
Downstream	10520	15010	9998	15370	9607	23260	22540	9951	4653	1462	143	221	85	48	16
Downstream	10490	15430	10240	15630	9731	23300	23030	9848	4800	1556	140	228	79	30	12
Downstream	10580	15460	10530	15610	10000	24700	22150	9737	4533	1441	118	159	99	35	15
Downstream-Bkg	3	3	1	1	0	2	0	0	0	0	0	0	0	0	0
Downstream-Bkg	3	3	2	0	0	0	2	0	0	0	0	0	0	0	0
Downstream-Bkg	3	2	0	2	1	0	0	2	0	0	0	0	0	0	0
Downstream-Bkg	2	1	0	0	1	1	0	0	0	0	0	0	0	0	0
Downstream-Bkg	4	1	0	1	0	0	0	0	0	0	0	0	0	0	0
Meas. Penetration	1.00	0.99	1.00	1.00	0.99	0.99	0.99	0.95	0.90	0.82	0.71	0.63	0.48	0.39	0.25

#4, Styrofoam

Particle Counts per Indicated OPC Channel (1.00-Minute Samples @ 7.1 L/min)

OPC Channel Number	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
Upstream-Bkg	1	2	0	0	0	0	0	0	0	0	0	0	0	0	0
Upstream-Bkg	2	1	0	0	0	0	0	1	0	0	0	0	0	0	0
Upstream-Bkg	3	0	0	0	0	1	0	0	0	0	0	0	0	0	0
Upstream-Bkg	3	0	0	0	1	0	0	0	0	0	0	0	0	0	0
Upstream-Bkg	4	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Upstream	11270	16740	11340	17160	10880	26980	24680	11660	6006	2131	234	410	226	109	60
Upstream	11180	16340	11280	16890	10880	26610	24710	11690	6171	2131	269	439	202	97	75
Upstream	11240	16820	11310	16860	10870	26800	24300	11390	5939	2134	260	400	228	101	61
Upstream	11000	16380	11380	16600	10560	26560	23660	11240	5906	2015	263	405	194	80	61
Upstream	10890	16360	11140	16880	10870	26500	24290	11370	5965	2074	266	381	184	92	63
Upstream	10950	16350	11440	16720	10840	26430	23930	11340	5724	2077	258	387	201	92	66
Upstream	10750	16400	11270	16640	10590	26240	23740	11200	5879	2108	235	434	182	98	71
Upstream	11070	16900	11280	16850	10740	26740	24060	11230	5903	2097	231	365	198	109	60
Upstream	10790	15870	10830	16380	10510	25650	23140	10940	5657	2062	241	347	183	91	62
Upstream	11100	16960	11430	16790	10960	26780	24120	11370	5978	2075	250	395	188	94	59
Upstream-Bkg	1	5	0	0	1	2	2	1	1	0	0	0	0	0	0
Upstream-Bkg	0	1	0	0	1	1	0	0	0	0	0	0	0	0	0
Upstream-Bkg	0	2	0	0	0	0	0	0	0	0	0	0	0	0	0
Upstream-Bkg	3	2	0	0	1	2	0	0	0	0	0	0	0	0	0
Upstream-Bkg	1	1	0	1	1	0	1	0	0	0	0	0	0	0	0
Downstream-Bkg	1	4	0	0	0	2	1	0	0	0	0	0	0	0	0
Downstream-Bkg	2	1	2	0	0	0	0	0	0	0	0	0	0	0	0
Downstream-Bkg	5	3	1	0	0	1	0	0	0	0	0	0	0	0	0
Downstream-Bkg	1	3	1	0	1	2	0	0	0	0	0	0	0	0	0
Downstream-Bkg	2	2	0	0	0	0	0	0	0	0	0	0	0	0	0
Downstream	11220	16820	11290	16920	10970	26430	24320	11420	5443	1660	173	214	100	30	23
Downstream	11230	16640	11330	17120	10940	26700	24220	11430	5461	1597	173	224	90	42	31
Downstream	10960	16230	11280	16580	10700	26060	23410	10820	5242	1572	123	233	83	30	23
Downstream	11180	16720	11570	16900	10630	27050	24220	11420	5435	1587	169	213	103	25	18
Downstream	10840	15870	10900	16270	10570	25540	23350	10890	5311	1548	155	229	88	25	14
Downstream	11450	16790	11340	16930	10920	27060	24270	11370	5451	1591	152	219	91	33	13
Downstream	10900	16190	11110	16460	10750	25700	23400	11040	5338	1615	161	206	73	29	13
Downstream	11120	16540	11120	16400	10690	26050	23340	10970	5347	1567	138	208	89	42	22
Downstream	10930	16200	11120	16460	10690	25820	23770	10920	5308	1622	138	205	86	29	15
Downstream	11170	16330	10970	16270	10360	25460	23250	10690	5269	1582	172	209	94	30	13
Downstream-Bkg	1	2	2	0	0	0	0	0	0	0	0	0	0	0	0
Downstream-Bkg	5	2	1	1	0	3	2	0	0	0	0	0	0	0	0
Downstream-Bkg	1	2	0	1	0	1	1	0	1	0	0	0	0	0	0
Downstream-Bkg	2	2	0	0	0	0	0	0	0	0	0	0	0	0	0
Downstream-Bkg	4	1	1	1	0	1	0	0	0	0	0	0	0	0	0
Meas. Penetration	1.01	1.00	0.99	0.99	1.00	0.99	0.99	0.98	0.91	0.76	0.62	0.55	0.45	0.33	0.29

#4, Styrofoam Loaded

Particle Counts per Indicated OPC Channel (1.00-Minute Samples @ 7.1 L/min)

OPC Channel Number	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
Upstream-Bkg	4	1	2	1	1	1	1	0	0	0	0	0	0	0	0
Upstream-Bkg	0	0	0	1	0	1	0	0	0	0	0	0	0	0	0
Upstream-Bkg	4	0	1	1	0	0	0	0	0	0	0	0	0	0	0
Upstream-Bkg	3	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Upstream-Bkg	2	1	0	0	0	1	0	0	0	0	0	0	0	0	0
Upstream	11200	16940	11680	17860	11350	27290	25040	11180	5306	1842	201	309	135	83	48
Upstream	11550	16790	11540	17500	11420	27620	24760	11110	5257	1857	180	327	148	78	48
Upstream	11300	17000	11740	17530	11140	27240	24770	11190	5388	1792	197	286	175	81	35
Upstream	12010	17350	12000	17980	11400	27670	25470	11590	5515	1806	213	300	165	70	41
Upstream	11260	16830	11300	17340	10750	26730	24160	10930	5041	1774	181	329	152	78	43
Upstream	11550	16820	11580	17300	11100	27130	24370	11120	5123	1687	195	301	178	66	43
Upstream	11460	17030	11640	17520	11150	27300	24690	11240	5292	1790	224	300	155	81	42
Upstream	11560	16840	11790	17310	10990	27270	24820	11170	5325	1734	197	313	158	80	41
Upstream	11520	17050	11480	17610	11290	27350	24470	11320	5282	1710	199	319	162	58	54
Upstream	11190	16770	11310	16960	10720	26690	24190	11000	5250	1666	191	302	147	73	45
Upstream-Bkg	2	3	4	4	2	4	4	0	0	0	0	0	0	0	0
Upstream-Bkg	0	1	1	0	2	0	2	0	1	1	0	0	1	0	0
Upstream-Bkg	1	0	0	0	1	0	0	0	0	0	0	0	0	0	0
Upstream-Bkg	1	0	0	0	1	1	0	0	0	0	0	0	0	0	0
Upstream-Bkg	1	1	1	0	1	1	0	0	0	0	0	0	0	0	0
Downstream-Bkg	1	1	0	1	0	0	0	0	0	0	0	0	0	0	0
Downstream-Bkg	1	2	0	0	1	0	0	1	0	0	0	0	0	0	0
Downstream-Bkg	0	1	2	1	0	0	0	0	0	0	0	0	0	0	0
Downstream-Bkg	3	3	2	3	3	2	3	1	0	0	0	0	0	0	0
Downstream-Bkg	2	2	0	2	1	2	1	0	0	0	0	0	0	0	0
Downstream	11390	17110	11430	17320	11220	26920	24390	11100	5010	1471	135	187	74	18	10
Downstream	11530	17180	11580	17430	11130	27330	24850	11280	5065	1480	147	178	76	29	11
Downstream	11640	16990	11810	17470	11340	27080	24660	11150	5056	1530	131	172	79	23	6
Downstream	11390	16800	11500	17160	11040	26770	24210	10970	5036	1441	145	177	65	25	13
Downstream	11530	16970	11540	17180	11110	26970	24500	11010	5013	1523	138	190	74	26	16
Downstream	11220	16790	11540	17160	10930	26630	24220	10940	5084	1430	132	183	72	21	18
Downstream	11590	17120	11930	17540	11260	27400	24980	11290	5220	1498	156	200	68	28	10
Downstream	11110	16530	11290	17050	10800	26450	23960	10820	4913	1464	147	205	72	22	6
Downstream	11530	17040	11610	17410	11090	27020	24700	11230	5107	1445	142	190	73	29	7
Downstream	11530	16910	11520	16880	10890	26810	24220	10890	4887	1500	152	193	82	25	10
Downstream-Bkg	6	2	2	1	0	1	1	0	1	0	0	0	0	0	0
Downstream-Bkg	6	4	0	0	0	1	0	0	0	0	0	0	0	0	0
Downstream-Bkg	0	1	1	1	0	0	1	0	0	0	0	0	0	0	0
Downstream-Bkg	2	3	0	2	0	1	0	0	0	0	0	0	0	0	0
Downstream-Bkg	4	1	1	1	1	0	0	0	0	0	0	0	0	0	0
Meas. Penetration	1.00	1.00	1.00	0.99	1.00	0.99	0.99	0.99	0.95	0.84	0.72	0.61	0.47	0.33	0.24

#5, Fiberglass

Particle Counts per Indicated OPC Channel (1.00-Minute Samples @ 7.1 L/min)

OPC Channel Number	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
Upstream-Bkg	6	2	4	1	1	3	1	0	0	0	0	0	0	0	0
Upstream-Bkg	1	2	1	0	0	0	0	0	0	0	0	0	0	0	0
Upstream-Bkg	0	1	0	0	0	1	0	0	0	0	0	0	0	0	0
Upstream-Bkg	2	0	0	1	0	1	1	0	0	0	0	0	0	0	0
Upstream-Bkg	2	2	0	0	0	1	0	1	0	0	0	0	0	0	0
Upstream	11560	16880	11140	16790	10790	26290	24230	11200	5640	1959	220	338	190	91	53
Upstream	11600	16760	11100	16520	10740	26120	24060	11120	5700	1997	211	334	197	75	61
Upstream	11400	16390	11320	16740	10620	25380	24960	11390	6009	2028	254	395	190	89	76
Upstream	11260	16370	10940	16880	10600	25390	25290	11550	5757	2176	229	419	202	103	71
Upstream	11290	16660	10960	17200	10760	25490	25180	11340	5926	2147	212	386	225	102	63
Upstream	11560	16870	11160	16560	10660	25850	24230	11170	5530	1936	235	351	180	88	55
Upstream	11510	16810	11230	16800	10680	26290	24530	11270	5757	1941	244	334	214	111	77
Upstream	11360	16810	11030	16310	10510	25780	23810	11040	5546	1920	222	334	189	87	65
Upstream	11360	16720	10820	16210	10570	25830	23670	10930	5559	1894	212	368	186	78	61
Upstream	11230	16350	10980	16070	10570	25300	23430	10900	5484	1982	230	389	199	98	58
Upstream-Bkg	3	0	0	0	3	1	2	3	0	1	0	0	0	0	0
Upstream-Bkg	6	1	0	1	0	1	0	0	0	0	0	0	0	0	0
Upstream-Bkg	3	2	2	0	0	0	0	0	0	0	0	0	0	0	0
Upstream-Bkg	1	3	1	1	0	0	1	0	0	0	0	0	0	0	0
Upstream-Bkg	2	2	0	0	0	0	0	0	0	0	0	0	0	0	0
Downstream-Bkg	3	4	0	1	1	2	1	0	0	1	0	0	0	1	0
Downstream-Bkg	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0
Downstream-Bkg	5	3	1	3	0	2	2	3	0	0	0	0	0	0	0
Downstream-Bkg	0	0	1	0	0	1	0	0	0	0	0	0	0	0	0
Downstream-Bkg	1	0	1	1	0	1	0	0	0	0	0	0	0	0	0
Downstream	11720	16950	11350	17050	10790	26650	23950	10690	4468	1056	80	135	57	21	10
Downstream	11640	16750	11260	16830	10690	25850	23880	10540	4480	1089	93	145	45	20	13
Downstream	11710	16720	11080	17290	10810	25880	25640	11000	4939	1197	111	143	61	26	18
Downstream	11480	16410	10990	16780	10590	24980	24980	10660	4682	1284	100	138	62	27	15
Downstream	11550	16870	11100	16780	10430	25990	23810	10670	4447	1066	92	135	49	18	8
Downstream	11410	16520	11220	16560	10560	25460	23480	10560	4510	1065	81	128	46	23	7
Downstream	11450	16530	11310	16510	10620	25630	23600	10570	4405	1083	84	118	56	23	11
Downstream	11270	16810	11210	16620	10610	25800	23870	10350	4429	1113	79	105	50	33	10
Downstream	11130	16400	11050	16250	10400	25310	23410	10320	4460	1013	67	134	33	17	25
Downstream	11420	16780	10970	16440	10630	26000	23850	10350	4504	1120	91	103	43	25	11
Downstream-Bkg	7	2	1	2	0	2	2	1	1	0	0	0	0	0	0
Downstream-Bkg	2	3	1	0	0	2	0	0	0	0	0	0	0	0	0
Downstream-Bkg	4	2	1	2	0	2	1	0	0	0	0	0	0	0	0
Downstream-Bkg	14	14	14	15	8	17	17	13	1	0	0	0	0	0	0
Downstream-Bkg	2	2	3	1	0	0	0	0	0	0	0	0	0	0	0
Meas. Penetration	1.01	1.00	1.01	1.01	1.00	1.00	0.99	0.94	0.80	0.55	0.39	0.35	0.25	0.25	0.20

#5, Fiberglass Loaded

Particle Counts per Indicated OPC Channel (1.00-Minute Samples @ 7.1 L/min)

OPC Channel Number	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
Upstream-Bkg	14	12	6	1	1	4	2	1	0	0	0	0	0	0	0
Upstream-Bkg	8	5	2	2	2	2	1	1	0	0	0	0	0	0	0
Upstream-Bkg	1	8	2	3	2	0	0	0	0	0	0	0	0	0	0
Upstream-Bkg	3	4	5	3	1	0	1	1	0	0	0	0	0	0	0
Upstream-Bkg	2	1	1	0	0	1	0	0	0	0	0	0	0	0	0
Upstream	11300	17160	11390	17400	10930	26430	25990	11460	5908	2203	242	418	221	95	76
Upstream	11190	16170	11200	16640	10500	25130	25090	11300	5736	2097	242	393	197	99	58
Upstream	11360	16560	11030	16930	10770	25770	25450	11390	5882	2147	237	384	198	87	65
Upstream	11090	16370	11030	16300	10460	25450	24180	10860	5556	1927	247	355	177	77	65
Upstream	11280	16400	11140	16270	10500	25520	24300	10870	5656	1974	208	347	185	81	50
Upstream	11350	16200	11020	16270	10530	25430	23780	10710	5486	2028	228	340	202	97	59
Upstream	11260	16320	11040	16310	10540	25450	23970	11130	5497	1941	222	359	172	83	48
Upstream	11270	16710	10920	16080	10450	25450	24020	10830	5601	1957	264	367	178	80	67
Upstream	11460	16300	11410	16730	10770	25880	24370	11050	5664	2038	209	367	176	83	70
Upstream	11150	16380	10860	16370	10460	25510	24210	10830	5484	1964	225	374	155	88	56
Upstream-Bkg	3	4	2	4	2	5	3	3	0	1	0	0	0	0	0
Upstream-Bkg	1	3	0	0	2	1	0	0	0	0	0	0	0	0	0
Upstream-Bkg	5	5	3	0	0	1	0	1	0	0	0	0	0	0	0
Upstream-Bkg	3	1	0	0	0	2	1	0	0	0	0	0	0	0	0
Upstream-Bkg	1	2	1	0	0	1	0	0	0	0	0	0	0	0	0
Downstream-Bkg	3	12	1	6	1	3	4	0	2	0	0	0	0	0	0
Downstream-Bkg	5	8	4	2	2	1	5	1	0	0	0	0	0	0	0
Downstream-Bkg	3	5	2	1	1	0	1	0	0	0	0	0	0	0	0
Downstream-Bkg	0	3	1	3	1	1	1	0	0	0	0	0	0	0	0
Downstream-Bkg	1	2	0	0	0	0	0	0	0	0	0	0	0	0	0
Downstream	11270	16600	11240	17100	10820	25520	25100	10730	4535	1072	65	90	31	12	3
Downstream	11210	16490	11170	16680	10530	25400	25080	10770	4519	1014	66	97	34	15	6
Downstream	11170	16270	10990	16490	10260	24880	24590	10640	4470	1011	69	104	35	17	10
Downstream	11210	16220	11090	16480	10540	24990	23680	10200	4254	930	60	73	35	13	13
Downstream	11410	16520	11290	16590	10490	25670	24230	10360	4263	957	61	77	38	9	8
Downstream	11220	16170	11140	16200	10220	25390	23950	10270	4259	912	65	91	33	14	7
Downstream	11320	16470	11010	16550	10560	25670	23820	10110	4283	870	71	76	37	9	4
Downstream	11350	16310	10970	16600	10330	25570	23880	10450	4299	997	81	102	26	12	10
Downstream	11330	16630	11040	16630	10660	25600	24360	10510	4174	920	71	78	41	13	5
Downstream	11260	16260	11130	16150	10180	25160	23750	10170	4286	928	78	87	44	12	5
Downstream-Bkg	2	2	1	0	0	3	1	0	0	0	0	0	0	0	0
Downstream-Bkg	7	1	1	1	1	2	0	0	1	0	0	0	0	0	0
Downstream-Bkg	0	5	2	1	0	2	0	2	0	0	0	0	0	0	0
Downstream-Bkg	6	3	1	4	1	2	1	4	1	0	0	0	0	0	0
Downstream-Bkg	7	2	1	0	2	2	1	1	0	0	0	0	0	0	0
Meas. Penetration	1.00	1.00	1.00	1.00	0.99	0.99	0.99	0.94	0.77	0.47	0.30	0.24	0.19	0.14	0.12

#6, Paper Mesh

Particle Counts per Indicated OPC Channel (1.00-Minute Samples @ 7.1 L/min)

OPC Channel Number	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
Upstream-Bkg	2	4	1	3	3	1	2	0	0	0	0	0	0	0	0
Upstream-Bkg	1	3	2	3	1	1	1	2	0	0	0	0	0	0	0
Upstream-Bkg	0	2	1	1	1	2	0	0	0	0	0	0	0	0	0
Upstream-Bkg	0	0	1	2	0	0	0	1	0	0	0	0	0	0	0
Upstream-Bkg	5	3	5	2	2	1	0	0	1	0	0	0	0	0	0
Upstream	11010	16230	11160	16320	10520	26640	23790	11010	5594	1865	215	343	153	80	61
Upstream	11100	16610	11290	16490	10750	26750	23500	10970	5377	1873	235	308	154	74	60
Upstream	10940	16230	11100	16280	10690	26530	23760	10810	5542	1855	225	345	166	64	49
Upstream	10990	16200	11090	16200	10720	26600	23470	10970	5444	1878	211	344	170	86	58
Upstream	10800	16070	10760	16090	10510	25920	22970	10670	5321	1868	196	326	159	74	72
Upstream	10880	16500	10960	16190	10490	26060	23040	10880	5292	1787	179	312	161	84	62
Upstream	11270	16610	11160	16550	10670	26990	23910	10980	5275	1964	195	326	195	91	46
Upstream	10650	16010	11050	15820	10460	25950	23290	10930	5366	1792	200	333	157	100	48
Upstream	10790	16110	10910	15860	10490	26400	22530	10830	5214	1718	189	275	169	85	38
Upstream	10260	15780	10600	15660	10270	26030	22410	10690	5240	1770	215	330	146	93	59
Upstream-Bkg	0	2	0	0	1	0	0	0	0	0	0	0	0	0	0
Upstream-Bkg	2	1	0	0	0	0	0	0	0	0	0	0	0	0	0
Upstream-Bkg	5	4	0	2	0	0	1	2	0	0	0	0	0	0	0
Upstream-Bkg	5	0	2	0	1	0	0	1	0	0	0	0	0	0	0
Upstream-Bkg	2	2	0	0	0	1	0	0	0	0	0	0	0	0	0
Downstream-Bkg	4	7	4	6	1	1	1	0	0	0	0	0	0	0	0
Downstream-Bkg	3	2	2	2	1	1	1	0	0	0	0	0	0	0	0
Downstream-Bkg	2	1	1	2	0	0	0	1	0	0	0	0	0	0	0
Downstream-Bkg	2	6	0	2	1	0	0	0	0	0	0	0	0	0	0
Downstream-Bkg	2	7	3	3	0	0	2	1	1	0	0	0	0	0	0
Downstream	11160	16360	10870	16240	10430	25990	22060	8487	2735	448	30	38	14	1	0
Downstream	11290	16750	11310	16600	10470	26200	22300	8608	2752	418	28	32	15	4	1
Downstream	11000	16170	11060	16120	10380	25680	22080	8350	2687	494	29	34	17	3	4
Downstream	11100	16040	10840	15930	10380	25850	21730	8315	2651	474	31	33	18	5	3
Downstream	10830	16220	11020	15840	10420	25680	21800	8360	2673	436	31	46	10	2	4
Downstream	11090	16680	11270	16530	10600	26250	22200	8430	2650	485	33	36	8	9	1
Downstream	11060	16320	10960	16320	10510	25290	22460	8636	2779	518	27	37	14	3	1
Downstream	10850	16130	10840	16140	10480	25440	22250	8599	2693	492	29	34	11	5	2
Downstream	10970	16210	10970	15820	10320	25350	21300	8094	2544	422	40	42	8	4	1
Downstream	10880	15840	10740	15740	10340	25670	21340	8307	2631	457	35	36	5	5	1
Downstream-Bkg	0	0	0	0	0	0	2	0	0	0	0	0	0	0	0
Downstream-Bkg	4	4	3	0	0	1	0	1	0	0	0	0	0	0	0
Downstream-Bkg	1	0	1	0	0	0	0	0	0	0	0	0	0	0	0
Downstream-Bkg	1	2	0	0	1	1	1	0	0	0	0	0	0	0	0
Downstream-Bkg	2	0	0	1	0	0	0	0	0	0	0	0	0	0	0
Meas. Penetration	1.01	1.00	1.00	1.00	0.99	0.98	0.94	0.77	0.50	0.25	0.15	0.11	0.07	0.05	0.03

#6, Paper Mesh Loaded

Particle Counts per Indicated OPC Channel (1.25-Minute Samples @ 7.1 L/min)

OPC Channel Number	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
Upstream-Bkg	4	3	1	3	3	1	1	1	0	0	0	0	0	0	0
Upstream-Bkg	1	1	2	3	2	1	1	0	0	0	0	0	0	0	0
Upstream-Bkg	0	1	0	0	0	1	0	1	0	0	0	0	0	0	0
Upstream-Bkg	3	4	1	1	0	1	0	0	0	0	0	0	0	0	0
Upstream-Bkg	1	2	0	0	0	1	0	0	0	0	0	0	0	0	0
Upstream	13130	19380	13080	19340	12550	31180	27840	13270	6650	2162	227	392	191	96	74
Upstream	12740	19080	12050	19460	12500	30020	29520	13530	6857	2515	283	476	221	108	69
Upstream	12750	18730	12530	19060	12120	29380	28540	13170	6777	2286	270	452	208	97	70
Upstream	12710	18580	12890	18630	12090	30280	27240	12530	6340	2195	221	374	200	87	65
Upstream	12950	19170	12740	18980	12400	30670	27550	12990	6601	2228	223	376	213	95	58
Upstream	12910	18970	12720	18800	12180	30220	27420	12670	6436	2244	241	385	208	86	57
Upstream	12980	19250	13010	18940	12590	30650	27560	13250	6599	2188	243	398	195	103	57
Upstream	12920	19090	12920	19120	12120	30610	27420	12900	6447	2165	244	373	180	77	65
Upstream	12950	19260	12770	18840	12360	30860	27090	12980	6343	2139	235	374	194	99	52
Upstream	12720	19310	12820	18780	12260	30640	27160	12760	6430	2191	228	359	204	85	63
Upstream-Bkg	1	1	2	2	1	1	2	2	2	0	0	0	0	0	0
Upstream-Bkg	1	7	0	2	0	0	3	0	0	0	0	0	0	0	0
Upstream-Bkg	0	1	2	0	0	2	2	0	0	0	0	0	0	0	0
Upstream-Bkg	1	2	0	2	0	2	0	0	0	0	0	0	0	0	0
Upstream-Bkg	3	0	0	2	0	1	1	1	0	0	0	0	0	0	0
Downstream-Bkg	1	2	0	0	0	0	1	0	0	0	0	0	0	0	0
Downstream-Bkg	2	2	1	4	0	3	0	0	0	0	0	0	0	0	0
Downstream-Bkg	1	1	4	1	2	1	0	0	0	0	0	0	0	0	0
Downstream-Bkg	2	3	1	0	0	0	0	0	0	0	0	0	0	0	0
Downstream-Bkg	1	1	0	0	0	1	0	1	0	0	0	0	0	0	0
Downstream	13210	19050	12690	19200	12280	29660	27520	9685	2552	324	19	14	0	1	3
Downstream	13130	18890	12680	19250	12230	29290	27220	9708	2624	340	18	18	6	3	0
Downstream	12820	19080	12760	18950	12190	29990	25490	9119	2335	282	16	20	4	1	0
Downstream	12640	19160	12830	18890	12040	29550	25240	8994	2259	280	20	8	2	1	0
Downstream	13320	19580	13210	19350	12530	30850	26270	9325	2372	288	15	18	5	0	0
Downstream	13180	19340	13170	19040	12350	30750	25810	9435	2457	311	11	12	3	2	0
Downstream	12990	18880	12680	18940	12290	29770	25610	9029	2340	267	16	19	6	3	1
Downstream	12860	19070	12950	19000	12130	30160	25440	8985	2378	282	12	17	4	2	3
Downstream	12970	19120	13150	19170	12340	30100	25400	9057	2383	257	15	16	2	3	1
Downstream	12910	18970	12860	18600	11860	29430	24940	8978	2330	274	11	9	9	2	0
Downstream-Bkg	4	1	1	2	1	2	1	1	1	0	0	0	0	0	0
Downstream-Bkg	2	1	1	0	0	0	0	0	0	0	0	0	0	0	0
Downstream-Bkg	3	5	0	0	0	0	0	0	1	0	0	0	0	0	0
Downstream-Bkg	2	2	1	1	0	0	1	0	0	0	0	0	0	0	0
Downstream-Bkg	1	1	0	0	0	0	0	1	0	0	0	0	0	0	0
Meas. Penetration	1.01	1.00	1.01	1.00	0.99	0.98	0.93	0.71	0.37	0.13	0.06	0.04	0.02	0.02	0.01

#7, Polyester Bag

Particle Counts per Indicated OPC Channel (1.25-Minute Samples @ 7.1 L/min)

OPC Channel Number	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
Upstream-Bkg	4	1	1	1	0	0	0	1	2	0	0	0	0	0	0
Upstream-Bkg	1	1	0	3	0	1	2	0	0	0	0	0	0	0	0
Upstream-Bkg	2	0	1	1	0	0	0	1	0	0	0	0	0	0	0
Upstream-Bkg	1	0	0	0	0	1	0	0	0	0	0	0	0	0	0
Upstream-Bkg	3	0	1	1	0	1	1	0	0	0	0	0	0	0	0
Upstream	14220	21300	14410	20860	13560	33980	30270	13960	6925	2381	269	440	201	113	70
Upstream	13440	20580	13790	19990	13140	32940	29300	13640	6925	2282	224	424	173	113	50
Upstream	13720	20350	13510	20110	13000	32430	28830	13400	6732	2270	241	396	185	80	75
Upstream	13710	20500	13740	19810	13140	32440	28730	13260	6748	2257	248	414	185	101	61
Upstream	13420	19910	13480	19620	12790	31900	28180	13190	6621	2220	239	391	222	103	72
Upstream	13080	19580	13240	19590	12670	31790	27960	13040	6619	2232	236	433	212	104	69
Upstream	13330	19830	13330	19690	12850	32380	28350	13160	6561	2175	235	390	205	88	53
Upstream	12870	19460	13150	19010	12650	31610	27650	12830	6300	2239	273	387	210	96	69
Upstream	13230	19830	13440	19500	12610	31930	27660	13200	6311	2261	221	337	169	85	64
Upstream	13230	19560	13460	20070	12950	31420	30140	13440	6807	2327	266	405	210	98	68
Upstream-Bkg	3	2	3	3	0	3	4	1	0	0	0	0	0	0	0
Upstream-Bkg	2	4	0	0	2	2	0	2	0	0	0	0	0	0	0
Upstream-Bkg	2	2	0	1	0	0	0	1	0	0	0	0	0	0	0
Upstream-Bkg	2	3	0	0	1	1	0	0	0	0	0	0	0	0	0
Upstream-Bkg	6	9	1	5	2	3	0	2	0	0	0	0	0	0	0
Downstream-Bkg	0	0	2	1	0	0	0	0	0	0	0	0	0	0	0
Downstream-Bkg	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Downstream-Bkg	0	1	2	0	0	0	0	0	0	0	0	0	0	0	0
Downstream-Bkg	4	2	0	1	0	1	0	0	0	0	0	0	0	0	0
Downstream-Bkg	1	0	0	2	0	0	0	0	0	0	0	0	0	0	0
Downstream	13850	20230	13810	20300	13060	31520	26530	9412	2383	181	8	6	2	1	0
Downstream	13730	20060	13550	19830	12710	31140	26060	9510	2379	193	2	3	0	0	0
Downstream	13400	19710	13520	19710	12670	30920	25910	9175	2340	198	7	5	0	0	0
Downstream	13110	19180	13220	19230	12290	30170	25090	8999	2180	196	2	4	2	0	0
Downstream	13490	19690	13150	19630	12540	30580	25520	9213	2223	189	4	1	0	0	0
Downstream	12980	19240	12950	19140	12300	30240	24790	8920	2185	173	7	6	1	0	0
Downstream	13120	19370	12860	19050	12330	29920	24560	8836	2206	179	4	4	0	0	0
Downstream	12740	19150	13100	19000	12130	29910	24590	8962	2172	159	4	3	1	0	0
Downstream	12680	18800	12740	18950	12320	28930	25930	9380	2401	202	3	6	1	0	0
Downstream	12780	18820	12640	19150	11890	29310	26230	9338	2539	208	7	4	2	0	1
Downstream-Bkg	2	0	2	2	3	1	3	2	0	0	0	0	0	0	0
Downstream-Bkg	2	0	2	1	1	2	0	0	0	0	0	0	0	0	0
Downstream-Bkg	1	2	0	2	0	0	0	0	0	0	0	0	0	0	0
Downstream-Bkg	3	0	2	1	0	0	0	0	0	0	0	0	0	0	0
Downstream-Bkg	2	0	0	0	0	0	0	0	1	0	0	0	0	0	0
Meas. Penetration	0.98	0.97	0.97	0.98	0.96	0.94	0.89	0.69	0.35	0.08	0.02	0.01	0.00	0.00	0.00

#7, Polyester Bag Loaded

Particle Counts per Indicated OPC Channel (1.25-Minute Samples @ 7.1 L/min)

OPC Channel Number	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
Upstream-Bkg	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0
Upstream-Bkg	1	1	0	1	1	0	0	0	0	0	0	0	0	0	0
Upstream-Bkg	3	2	0	0	0	1	0	0	0	0	0	0	0	0	0
Upstream-Bkg	3	2	1	0	0	2	0	0	0	0	0	0	0	0	0
Upstream-Bkg	1	0	0	0	1	0	0	1	0	0	0	0	0	0	0
Upstream	14120	21050	14280	21210	13880	34470	30520	14240	7242	2362	257	430	206	98	70
Upstream	13750	20690	14160	20590	13450	33420	29060	13780	6932	2290	242	433	179	97	78
Upstream	14190	20610	13790	20520	13220	33520	29670	13790	6886	2420	259	390	194	109	71
Upstream	14150	21250	14090	20690	13320	34140	29630	14080	7042	2349	267	432	167	90	79
Upstream	13810	20730	13940	20380	13330	33920	29090	13870	7074	2256	260	450	220	93	69
Upstream	13620	20200	13560	20160	13300	32500	28580	13560	6870	2288	229	391	236	115	62
Upstream	13760	20430	13670	20250	13230	32350	30990	14150	7347	2442	297	428	247	107	57
Upstream	13850	20220	13250	20640	13480	32370	30700	14290	7260	2411	280	429	223	106	86
Upstream	13830	20540	13830	20610	13240	33300	29500	14010	6922	2443	257	418	208	87	71
Upstream	14010	20470	13690	20360	13410	32860	29570	13790	6888	2477	262	427	204	92	79
Upstream-Bkg	3	2	2	6	5	8	3	3	1	0	0	0	0	0	0
Upstream-Bkg	3	4	1	1	1	1	2	0	0	1	0	0	0	0	0
Upstream-Bkg	12	18	7	10	11	24	18	11	4	1	0	0	0	0	0
Upstream-Bkg	3	2	5	1	3	2	1	0	0	0	0	0	0	0	0
Upstream-Bkg	4	0	3	1	0	1	1	1	0	0	0	0	0	0	0
Downstream-Bkg	3	1	0	0	0	0	0	0	0	0	0	0	0	0	0
Downstream-Bkg	0	1	1	0	0	0	1	0	0	0	0	0	0	0	0
Downstream-Bkg	0	3	2	2	1	1	0	0	0	0	0	0	0	0	0
Downstream-Bkg	3	1	0	0	0	0	1	0	0	0	0	0	0	0	0
Downstream-Bkg	6	0	1	0	0	0	0	1	0	0	0	0	0	0	0
Downstream	13910	20550	13860	20090	12940	32380	26240	9972	2503	162	5	3	0	0	0
Downstream	13510	20690	13570	20170	13080	31520	26950	10230	2488	165	1	5	0	0	0
Downstream	13490	19920	13520	19890	12810	31280	26290	9875	2527	180	5	1	0	0	0
Downstream	13720	20280	13840	20040	12780	31610	26260	9862	2463	160	2	2	0	0	0
Downstream	13850	20150	13480	19840	12730	31710	26270	10140	2440	175	3	6	0	0	0
Downstream	13240	19490	13110	19810	12510	30130	27360	10410	2822	255	3	1	2	0	0
Downstream	13390	19530	13180	20180	12580	30470	27550	10600	2742	227	6	2	1	0	0
Downstream	13490	19820	13410	20230	13090	30630	28310	10500	2818	228	2	8	0	0	0
Downstream	13480	19640	13420	19690	12820	30940	26470	10000	2603	167	7	5	1	1	0
Downstream	13550	19890	13360	19770	12800	31050	26540	10090	2647	184	7	5	0	0	0
Downstream-Bkg	6	10	3	2	2	3	6	2	0	0	0	0	0	0	0
Downstream-Bkg	6	2	2	5	1	5	1	0	0	0	0	0	0	0	0
Downstream-Bkg	2	3	1	1	0	2	1	0	0	0	0	0	0	0	0
Downstream-Bkg	6	7	2	4	0	3	1	1	0	0	0	0	0	0	0
Downstream-Bkg	10	12	13	21	12	23	21	9	2	0	0	0	0	0	0
Meas. Penetration	0.98	0.97	0.97	0.97	0.96	0.94	0.90	0.73	0.37	0.08	0.02	0.01	0.00	0.00	0.00

#8, No Filter

Particle Counts per Indicated OPC Channel (1.25-Minute Samples @ 7.1 L/min)

OPC Channel Number	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
Upstream-Bkg	6	1	0	1	1	1	0	1	0	1	0	0	0	0	0
Upstream-Bkg	2	1	1	0	0	0	0	0	0	0	0	0	0	0	0
Upstream-Bkg	6	4	2	1	1	2	0	0	0	0	0	0	0	0	0
Upstream-Bkg	5	2	1	0	0	0	0	0	0	0	0	0	0	0	0
Upstream-Bkg	5	4	3	4	3	3	0	1	0	0	0	0	0	0	0
Upstream	14690	21640	14480	21240	13700	35220	29350	13880	6804	2293	272	439	215	101	78
Upstream	14490	21370	14180	21120	13810	34770	28740	13710	6671	2319	252	400	219	105	75
Upstream	14160	21570	14100	20530	13460	34630	28190	13690	6739	2203	289	378	214	107	65
Upstream	14050	21250	14100	20660	13550	34980	29250	13720	6717	2254	278	406	228	104	68
Upstream	14360	21130	14150	20790	13540	34390	29000	13660	6861	2365	271	433	242	103	69
Upstream	13820	20650	14010	20510	13160	33610	29000	13710	6646	2276	255	446	201	101	85
Upstream	14060	20630	14300	20630	13520	33800	29330	13730	6826	2341	271	439	240	96	73
Upstream	14250	20820	14400	21000	13470	34300	29340	13590	6999	2389	240	444	216	120	71
Upstream	14130	21460	14290	20850	13660	33930	29740	14140	6800	2408	268	447	211	117	83
Upstream	13570	20740	13960	20540	13320	33730	29080	13730	6804	2411	246	425	206	112	72
Upstream-Bkg	9	2	1	3	3	3	1	1	0	0	0	0	0	0	0
Upstream-Bkg	7	7	6	8	5	5	3	4	0	0	0	0	0	1	0
Upstream-Bkg	2	7	1	0	0	2	0	0	0	0	0	0	0	0	0
Upstream-Bkg	11	8	3	3	0	2	0	1	0	0	0	0	0	0	0
Upstream-Bkg	9	10	0	0	0	0	0	0	0	0	0	0	0	0	0
Downstream-Bkg	4	12	3	7	3	4	2	1	0	0	0	0	0	0	0
Downstream-Bkg	1	1	1	3	0	1	0	0	0	0	0	0	0	0	0
Downstream-Bkg	2	1	2	0	1	2	0	0	0	0	0	0	0	0	0
Downstream-Bkg	2	6	0	0	0	1	0	0	0	0	0	0	0	0	0
Downstream-Bkg	2	2	3	0	0	1	0	0	0	0	0	0	0	0	0
Downstream	14570	21470	14460	21200	13960	34950	29090	13960	6834	2223	259	377	204	106	64
Downstream	14460	21020	14440	20870	13600	34390	29210	13630	6629	2266	242	395	215	89	57
Downstream	14220	20920	14220	20550	13540	34730	28360	13740	6532	2109	256	387	219	98	67
Downstream	14060	20930	14120	20720	13390	34520	28670	13770	6572	2198	259	441	180	96	51
Downstream	14230	20670	14120	20680	13380	33720	28810	13450	6685	2151	235	415	185	105	60
Downstream	13780	20540	13890	20610	13620	33760	29330	13800	6785	2338	290	413	224	84	70
Downstream	14020	20890	14040	20470	13640	33600	29280	13840	6694	2217	269	412	232	109	70
Downstream	13670	20250	13670	20300	13180	33230	28650	13580	6702	2160	238	406	214	98	80
Downstream	14020	20840	14110	20570	13610	33850	29490	14000	6850	2271	257	420	209	111	72
Downstream	13960	20560	13810	20500	13400	33670	28830	13740	6696	2294	256	392	212	96	54
Downstream-Bkg	3	2	1	3	0	0	1	0	0	0	0	0	0	0	0
Downstream-Bkg	5	3	2	2	0	1	5	1	0	0	0	0	0	0	0
Downstream-Bkg	6	3	1	0	1	1	0	2	0	0	0	0	0	0	0
Downstream-Bkg	4	4	4	0	0	2	3	0	0	0	1	0	0	0	0
Downstream-Bkg	5	3	3	1	0	0	0	0	1	0	0	0	0	0	0
Meas. Penetration	1.00	0.99	0.99	0.99	1.00	0.99	1.00	1.00	0.99	0.96	0.97	0.95	0.96	0.93	0.87

#9, No Filter

Particle Counts per Indicated OPC Channel (1.25-Minute Samples @ 7.1 L/min)

OPC Channel Number	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
Upstream-Bkg	3	4	1	3	2	1	0	3	0	0	0	0	0	0	0
Upstream-Bkg	0	2	1	0	0	0	0	0	0	0	0	0	0	0	0
Upstream-Bkg	4	6	2	4	1	5	0	2	0	0	0	0	0	0	0
Upstream-Bkg	5	1	2	3	1	1	0	1	0	0	0	0	0	0	0
Upstream-Bkg	4	0	2	4	0	1	2	0	1	0	0	0	0	0	0
Upstream	14620	21900	14470	21580	13890	34910	29910	14270	6953	2404	249	418	201	122	72
Upstream	14540	21350	14340	21100	13860	34200	29390	13830	6961	2287	263	415	208	89	69
Upstream	14360	20920	13880	20780	13410	34030	29160	13790	6814	2324	255	380	215	105	58
Upstream	14190	21070	14140	21040	13500	33990	28920	13830	6928	2260	253	419	195	92	73
Upstream	14410	21090	14270	21170	13700	33710	29290	13920	6856	2226	262	413	216	85	75
Upstream	14160	21120	14230	20450	13360	33260	28920	13870	6623	2258	232	408	180	81	66
Upstream	13980	20840	14080	20610	13390	33350	28910	13580	6665	2308	244	412	180	96	75
Upstream	14420	20840	14240	20660	13330	33500	28920	13860	6747	2233	243	382	188	111	61
Upstream	14180	21260	14200	20470	13360	33510	28880	13810	6841	2239	280	409	193	100	51
Upstream	13880	20650	14030	20560	13300	32450	30300	14050	6953	2429	260	437	204	117	68
Upstream-Bkg	5	3	1	1	2	5	2	0	0	0	0	0	0	0	0
Upstream-Bkg	2	5	0	3	2	0	1	0	1	0	0	0	0	0	0
Upstream-Bkg	5	5	1	4	0	4	5	0	0	0	0	0	0	0	0
Upstream-Bkg	0	1	0	1	0	1	0	0	1	0	0	0	0	0	0
Upstream-Bkg	7	4	3	3	1	2	0	1	0	0	0	0	0	0	0
Downstream-Bkg	3	2	1	1	1	1	0	0	0	0	0	0	0	0	0
Downstream-Bkg	3	2	0	4	1	1	3	0	0	0	0	0	0	0	0
Downstream-Bkg	10	4	2	2	0	6	1	2	0	0	0	0	0	0	0
Downstream-Bkg	9	7	0	1	0	1	0	1	0	0	0	0	0	0	0
Downstream-Bkg	5	5	1	0	1	1	1	1	0	0	0	0	0	0	0
Downstream	14690	22030	14520	21270	13880	34900	30160	14430	7012	2351	278	429	207	111	72
Downstream	14580	21720	14570	21230	13970	34780	29890	14040	6811	2334	274	402	216	103	66
Downstream	14150	21040	14280	20760	13440	33830	29330	13920	6919	2338	236	433	222	109	59
Downstream	14640	21410	14340	21160	13820	34200	29730	14010	6937	2326	258	423	213	87	63
Downstream	14360	21410	14340	21140	13740	34110	29730	14000	6881	2334	288	421	211	103	56
Downstream	14180	20890	14060	21050	13370	33490	29110	13490	6746	2204	266	415	241	109	82
Downstream	13830	20550	13890	20480	13280	32820	28650	13460	6876	2184	246	418	213	91	57
Downstream	14240	20870	14040	20680	13440	33600	29120	13620	6915	2298	254	429	167	91	72
Downstream	14010	20560	14040	20540	13290	33390	29090	13500	6759	2314	284	416	199	115	75
Downstream	13880	20480	13890	20470	13230	32160	30280	13840	7149	2424	280	473	226	109	71
Downstream-Bkg	5	5	0	0	3	4	3	0	0	0	0	0	0	0	0
Downstream-Bkg	2	1	0	0	1	1	1	1	0	0	0	0	0	0	0
Downstream-Bkg	2	2	1	0	3	1	1	1	0	0	0	0	0	0	0
Downstream-Bkg	6	2	1	2	0	0	1	0	1	1	0	0	0	0	0
Downstream-Bkg	9	11	9	13	3	3	4	1	0	0	0	0	0	0	0
Meas. Penetration	1.00	1.00	1.00	1.00	1.00	1.00	1.01	1.00	1.01	1.01	1.05	1.04	1.07	1.03	1.01

#10, HEPA

Particle Counts per Indicated OPC Channel (1.25-Minute Samples @ 7.1 L/min)

OPC Channel Number	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
Upstream-Bkg	6	3	1	1	0	1	0	0	0	0	0	0	0	0	0
Upstream-Bkg	6	1	1	2	0	0	0	0	0	0	0	0	0	0	0
Upstream-Bkg	7	3	0	0	0	0	0	0	0	0	0	0	0	0	0
Upstream-Bkg	2	3	0	0	0	1	0	0	0	0	0	0	0	0	0
Upstream-Bkg	4	3	2	0	1	0	0	0	0	0	0	0	0	0	0
Upstream	13440	20300	13580	20020	12800	32560	28280	13260	6678	2256	236	437	209	117	67
Upstream	13120	19400	13060	19270	12680	31150	27070	12700	6414	2117	240	378	182	98	68
Upstream	13490	19790	13300	19770	12660	31420	27660	12840	6305	2202	252	408	213	108	54
Upstream	13430	19930	13510	19580	12790	31880	27920	13170	6389	2073	236	402	190	108	74
Upstream	13260	19680	13160	19250	12520	31480	27090	12780	6253	2171	256	397	195	100	47
Upstream	13350	19610	13390	19540	12700	31820	27440	12900	6284	2193	246	386	171	84	60
Upstream	13300	20020	13480	19710	12750	31970	28660	13280	6513	2237	284	432	201	106	65
Upstream	13190	19310	13100	19290	12580	30960	27750	12850	6486	2208	237	378	214	101	69
Upstream	13040	19720	13250	19430	12750	31640	27650	12940	6380	2145	246	418	196	94	75
Upstream	13470	19550	13300	19340	12630	31470	27620	12860	6359	2167	249	391	197	104	60
Upstream-Bkg	7	4	1	2	2	3	4	0	0	0	0	1	0	0	0
Upstream-Bkg	4	1	0	0	1	1	1	0	0	0	0	0	0	0	0
Upstream-Bkg	4	4	9	17	2	9	5	0	0	1	0	0	0	0	0
Upstream-Bkg	13	20	8	17	8	10	15	6	0	0	0	0	0	0	0
Upstream-Bkg	11	27	5	13	7	8	8	4	1	0	0	0	0	0	0
Downstream-Bkg	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0
Downstream-Bkg	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Downstream-Bkg	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Downstream-Bkg	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Downstream-Bkg	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Downstream	6	8	7	6	2	7	9	2	1	1	0	0	0	0	0
Downstream	3	5	2	8	5	13	6	3	3	0	0	0	0	0	0
Downstream	7	5	4	3	1	13	7	0	2	0	0	0	0	0	0
Downstream	6	8	7	8	8	9	12	3	1	0	0	0	0	0	0
Downstream	6	7	5	4	2	6	8	2	0	1	0	0	0	0	0
Downstream	6	11	6	3	3	14	6	3	1	0	0	0	0	0	0
Downstream	9	15	5	13	8	12	11	4	0	0	0	0	0	0	0
Downstream	9	9	6	7	8	7	9	3	1	0	0	0	0	0	0
Downstream	4	3	4	4	1	11	7	5	2	0	0	0	0	0	0
Downstream	5	6	13	2	7	7	8	4	0	0	0	0	0	0	0
Downstream-Bkg	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Downstream-Bkg	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Downstream-Bkg	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Downstream-Bkg	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Downstream-Bkg	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Meas. Penetration	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00

#11, Cardboard

Particle Counts per Indicated OPC Channel (1.25-Minute Samples @ 7.1 L/min)

OPC Channel Number	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
Upstream-Bkg	2	4	1	0	0	3	0	0	0	0	0	0	0	0	0
Upstream-Bkg	7	5	1	1	1	1	1	0	0	0	0	0	0	0	0
Upstream-Bkg	2	2	2	1	0	0	0	0	0	0	0	0	0	0	0
Upstream-Bkg	0	4	0	1	0	0	1	0	0	0	0	0	0	0	1
Upstream-Bkg	2	1	1	0	0	0	0	0	0	0	0	0	0	0	0
Upstream	12930	19440	13160	19080	12650	32380	26950	13260	6766	2259	246	411	218	116	76
Upstream	13030	19170	13220	19400	12760	32030	28530	13390	7059	2434	302	453	236	111	72
Upstream	12560	19190	13080	19230	12390	31390	27930	13160	6788	2407	267	481	231	135	78
Upstream	12800	19250	12990	19210	12580	31410	27720	13130	6801	2349	260	445	216	117	64
Upstream	12690	18580	12790	18920	12200	31260	26850	12830	6691	2292	271	458	252	111	68
Upstream	12490	18450	12570	18640	12200	30300	26800	12750	6448	2357	258	406	201	109	73
Upstream	12510	18590	12530	18790	12230	30690	27120	12900	6612	2224	259	414	214	116	66
Upstream	12420	18400	12310	19060	12270	30030	29060	13290	6821	2414	307	479	247	116	73
Upstream	12350	18240	12580	19020	12240	29750	28750	13150	6979	2650	291	482	252	121	90
Upstream	12690	18620	12700	18860	12450	30460	27350	12820	6535	2317	272	435	261	115	69
Upstream-Bkg	4	1	2	1	0	2	1	0	0	0	0	0	0	0	0
Upstream-Bkg	4	0	1	1	0	0	0	0	0	0	0	0	0	0	0
Upstream-Bkg	6	6	0	1	0	2	0	0	0	0	0	0	0	0	0
Upstream-Bkg	3	3	1	0	0	0	0	0	0	0	0	0	0	0	0
Upstream-Bkg	8	1	0	1	0	0	0	0	0	0	0	0	0	0	0
Downstream-Bkg	6	5	2	7	1	5	6	5	2	2	0	0	0	0	1
Downstream-Bkg	8	17	8	11	3	15	15	16	5	3	0	2	0	0	0
Downstream-Bkg	5	1	0	3	3	3	5	2	1	1	2	1	0	0	1
Downstream-Bkg	2	4	1	0	2	4	4	2	2	2	0	0	0	0	0
Downstream-Bkg	6	5	2	1	0	1	3	2	4	1	0	1	0	0	0
Downstream	13300	19940	13760	19960	13050	33130	27470	12980	6122	1843	183	223	87	27	29
Downstream	12710	19520	13370	19580	12880	32040	28250	13110	6448	1882	195	265	107	44	16
Downstream	12590	18760	13010	18970	12560	31380	27460	12530	6224	1926	183	241	110	45	18
Downstream	12430	18610	12780	18720	12370	31000	27010	12680	6099	1898	161	265	99	32	20
Downstream	12980	19310	13190	19170	12510	31790	27270	12810	6175	1950	198	232	107	35	19
Downstream	12420	18810	12760	18700	12050	30470	26780	12170	6048	1810	177	248	93	36	19
Downstream	12140	17990	12190	18800	12090	29190	28300	12580	6448	2084	216	276	105	50	27
Downstream	12310	18400	12560	19290	12160	30090	28730	12960	6563	2078	172	295	108	49	17
Downstream	12380	18270	12700	18930	12160	29640	28380	12740	6498	2095	212	285	107	45	31
Downstream	12250	18170	12590	18750	11910	29840	26670	12350	6032	1887	191	261	103	29	20
Downstream-Bkg	7	7	3	1	0	2	0	3	2	1	0	0	0	0	0
Downstream-Bkg	5	1	1	0	0	0	0	0	0	0	0	0	0	0	0
Downstream-Bkg	11	2	1	0	0	0	2	0	0	0	0	0	0	1	0
Downstream-Bkg	4	1	0	0	0	0	2	0	0	0	0	0	0	0	0
Downstream-Bkg	1	0	1	1	0	0	0	0	0	0	0	0	0	1	0
Meas. Penetration	0.99	1.00	1.01	1.00	1.00	1.00	1.00	0.97	0.93	0.82	0.69	0.58	0.44	0.33	0.29

#11, Cardboard Loaded

Particle Counts per Indicated OPC Channel (2-Minute Samples @ 7.1 L/min)

OPC Channel Number	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
Upstream-Bkg	2	4	1	1	0	1	1	0	0	0	0	0	0	0	0
Upstream-Bkg	2	3	0	0	0	0	0	1	0	0	0	0	0	0	0
Upstream-Bkg	4	1	0	0	0	0	0	0	0	0	0	0	0	0	0
Upstream-Bkg	2	3	0	0	0	0	0	0	0	0	0	0	0	0	0
Upstream-Bkg	3	3	0	0	1	0	0	0	0	0	0	0	0	0	0
Upstream	14020	20840	14210	21260	13620	34050	31570	14490	7703	2704	313	534	302	133	99
Upstream	13830	20580	14110	20820	13590	33400	31310	14400	7500	2694	322	522	278	155	91
Upstream	14010	20380	13840	20720	13560	33050	30680	14200	7591	2739	293	514	266	141	105
Upstream	13770	20600	14160	20980	13590	33550	31150	14330	7431	2736	318	475	302	143	72
Upstream	14060	20930	14080	21080	13490	33850	30970	14400	7436	2720	298	489	292	145	110
Upstream	14230	20860	14210	21000	13720	33910	30990	14440	7563	2692	319	509	238	133	61
Upstream	14260	20820	14220	20940	13420	33660	31130	14330	7491	2673	284	567	255	120	91
Upstream	13990	20910	14160	20730	13490	33350	30800	14350	7259	2630	308	519	280	134	96
Upstream	13980	20330	14110	21120	13690	33140	31620	14310	7549	2689	345	505	303	129	96
Upstream	13780	20420	13840	21160	13500	32600	31480	14270	7556	2683	317	533	276	128	87
Upstream-Bkg	3	4	3	0	0	2	1	0	1	0	0	0	0	0	0
Upstream-Bkg	0	3	1	1	1	1	0	0	0	0	0	0	0	0	0
Upstream-Bkg	1	2	1	3	0	1	1	0	0	0	0	0	0	0	0
Upstream-Bkg	3	2	0	0	0	0	0	0	0	0	0	0	0	0	0
Upstream-Bkg	3	3	0	0	0	1	0	0	0	0	0	0	0	0	0
Downstream-Bkg	2	3	0	0	1	0	0	0	0	0	0	0	0	0	0
Downstream-Bkg	5	4	0	1	1	1	0	0	0	1	0	0	0	0	0
Downstream-Bkg	1	0	0	0	0	1	1	0	0	0	0	0	0	0	0
Downstream-Bkg	1	3	1	0	0	0	0	0	0	0	0	0	0	0	0
Downstream-Bkg	1	3	1	1	0	0	0	0	0	0	0	0	0	0	0
Downstream	14190	20930	14360	20920	13830	33680	31170	14410	7531	2448	262	386	160	58	37
Downstream	13900	20460	13870	20790	13570	33030	30910	14270	7216	2500	247	365	173	67	32
Downstream	13760	20240	13510	20500	13180	32970	30470	13960	7130	2377	258	398	158	58	42
Downstream	14170	20900	14060	20880	13770	33860	31500	14460	7322	2498	235	403	180	61	36
Downstream	14150	20840	14340	21470	13710	33780	31340	14540	7289	2473	263	373	162	73	38
Downstream	14000	20480	14010	20930	13400	33040	30560	13860	7110	2334	245	368	152	52	37
Downstream	14300	20780	13830	21020	13420	33740	30870	14330	7289	2425	254	389	157	65	34
Downstream	13900	20500	13850	21010	13520	33140	31540	14520	7428	2536	266	393	158	89	29
Downstream	13930	20580	13380	20660	13380	32670	30870	14100	7398	2459	241	421	168	69	37
Downstream	14030	20670	14000	21040	13470	33090	31780	14250	7434	2587	274	337	175	66	37
Downstream-Bkg	2	7	1	2	0	2	1	0	0	0	0	0	0	0	0
Downstream-Bkg	3	4	0	0	0	1	3	0	0	0	0	0	0	0	0
Downstream-Bkg	3	2	0	0	0	0	0	0	0	0	0	0	0	0	0
Downstream-Bkg	2	4	0	1	0	0	1	0	1	0	0	0	0	0	0
Downstream-Bkg	1	3	0	0	1	0	0	0	0	0	0	0	0	0	0
Meas. Penetration	1.00	1.00	0.99	1.00	1.00	1.00	1.00	0.99	0.97	0.91	0.82	0.74	0.59	0.48	0.40

#12, Styrofoam

Particle Counts per Indicated OPC Channel (1.25-Minute Samples @ 7.1 L/min)

OPC Channel Number	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
Upstream-Bkg	9	5	3	4	0	1	1	0	0	0	0	0	0	0	0
Upstream-Bkg	7	4	2	2	0	2	1	0	0	0	0	0	0	0	0
Upstream-Bkg	2	4	2	2	0	3	0	2	0	0	0	0	0	0	0
Upstream-Bkg	11	5	10	6	3	9	3	2	0	0	0	0	0	0	0
Upstream-Bkg	20	15	10	13	13	11	8	7	2	0	0	0	0	0	0
Upstream	13880	20290	13750	20340	13110	32310	29420	13460	6464	2205	221	408	206	89	84
Upstream	13650	20040	13550	19920	12930	31610	28760	13260	6484	2242	274	414	203	105	54
Upstream	13710	20270	13480	20380	13130	31780	28420	13420	6563	2268	254	410	195	98	66
Upstream	13770	20070	13440	19820	12840	31770	28560	13300	6553	2211	221	400	213	88	56
Upstream	13750	20240	13630	19930	12770	31220	28940	13260	6527	2167	221	394	219	92	68
Upstream	13350	19700	13230	19750	12460	31000	27810	13100	6343	2158	230	384	187	115	57
Upstream	13330	19210	13330	19170	12360	30400	27480	12720	6308	2164	229	354	190	95	65
Upstream	13070	19040	12910	18970	12410	30140	27170	12950	6390	2143	246	382	199	86	71
Upstream	13160	19340	12820	18980	12260	30550	27520	12750	6243	2037	231	406	215	97	64
Upstream	13340	19470	13080	19150	12500	30720	27760	12750	6265	2168	238	354	219	119	60
Upstream-Bkg	5	11	5	8	4	5	5	3	1	0	0	0	0	0	0
Upstream-Bkg	7	6	1	3	2	6	3	3	0	1	0	0	0	0	0
Upstream-Bkg	2	7	3	4	0	1	0	1	0	0	0	0	0	0	0
Upstream-Bkg	6	2	3	3	5	5	2	1	0	0	0	0	0	0	0
Upstream-Bkg	9	7	5	3	1	4	3	2	0	0	0	0	0	0	0
Downstream-Bkg	6	6	2	1	5	2	1	0	0	0	0	0	0	0	0
Downstream-Bkg	6	4	1	3	1	1	0	1	0	0	0	1	0	0	0
Downstream-Bkg	10	8	5	6	2	6	3	1	1	0	0	0	0	0	0
Downstream-Bkg	19	6	4	3	4	7	3	1	1	1	0	0	0	0	0
Downstream-Bkg	12	5	4	9	0	4	1	3	0	0	0	0	0	0	0
Downstream	13740	19950	13700	19880	13050	32390	28950	13350	6119	1686	144	209	100	37	24
Downstream	13690	20130	13610	19890	13040	31900	28660	13130	5933	1631	179	243	111	34	22
Downstream	13540	19790	13400	19860	12900	31650	28420	12830	6011	1637	155	213	111	37	22
Downstream	13880	20340	13610	20010	12920	32040	28940	13200	6083	1739	156	220	97	52	26
Downstream	13550	19800	13540	19840	12890	31220	28230	13140	5837	1681	146	218	86	26	24
Downstream	13460	19420	13040	19400	12480	30630	27680	12510	5751	1544	138	207	96	31	19
Downstream	13360	19350	13040	19100	12350	30410	27450	12620	5862	1663	140	208	95	42	23
Downstream	13030	18890	12680	19130	12180	29850	27160	12430	5651	1562	131	222	89	43	19
Downstream	13190	18930	12870	19350	12320	30630	27540	12570	5846	1566	150	242	108	30	17
Downstream	13240	19490	13260	19390	12800	30650	27800	12770	5795	1632	160	187	85	46	21
Downstream-Bkg	6	3	1	3	1	2	3	1	0	0	0	0	0	0	0
Downstream-Bkg	5	4	2	7	1	8	4	2	1	0	0	0	0	0	0
Downstream-Bkg	10	12	9	8	3	16	11	3	2	1	0	0	0	0	0
Downstream-Bkg	4	5	2	0	2	5	3	0	0	0	0	0	0	0	0
Downstream-Bkg	8	6	2	0	1	1	0	0	0	0	0	0	0	0	0
Meas. Penetration	1.00	0.99	1.00	1.00	1.00	1.00	1.00	0.98	0.92	0.75	0.63	0.56	0.48	0.38	0.34

#12, Styrofoam Loaded

Particle Counts per Indicated OPC Channel (1.25-Minute Samples @ 7.1 L/min)

OPC Channel Number	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
Upstream-Bkg	15	12	3	0	2	1	1	0	0	0	0	0	0	0	0
Upstream-Bkg	4	10	7	1	0	5	3	4	0	0	0	0	0	0	0
Upstream-Bkg	2	6	4	0	0	1	1	0	0	0	0	0	0	0	0
Upstream-Bkg	4	2	1	1	2	0	0	0	0	0	0	0	0	0	0
Upstream-Bkg	2	3	0	0	0	0	0	0	0	0	0	0	0	0	0
Upstream	13490	20140	13340	19780	12740	31610	28350	13220	6568	2167	261	374	191	94	72
Upstream	13690	19620	13250	19600	12490	30990	28290	13250	6535	2154	246	388	202	83	71
Upstream	13660	19930	13230	19900	12900	31420	28550	13580	6606	2170	285	411	213	102	52
Upstream	13200	18930	12920	19200	12330	30190	28010	12700	6332	2123	201	358	175	80	50
Upstream	13760	19830	12910	19820	12600	31160	28480	13190	6575	2179	233	370	219	116	58
Upstream	13560	19860	13080	19650	12880	31450	28410	13360	6437	2210	282	364	182	91	60
Upstream	13550	19450	13340	19430	12620	31320	28490	13000	6630	2223	226	382	192	102	62
Upstream	13220	19290	13070	19210	12330	30470	27960	12880	6451	2115	216	368	180	92	48
Upstream	12720	18310	12040	17960	11810	28710	26150	12390	6257	2006	240	397	192	92	59
Upstream	13090	19530	13010	19510	12460	30460	27950	12900	6432	2183	230	400	191	106	62
Upstream-Bkg	4	4	1	0	3	1	2	0	0	0	0	0	0	0	0
Upstream-Bkg	3	4	2	4	2	0	2	0	0	0	0	0	0	0	0
Upstream-Bkg	3	1	0	3	0	0	0	0	0	0	0	0	0	0	0
Upstream-Bkg	0	2	0	1	0	0	0	0	0	0	0	0	0	0	0
Upstream-Bkg	0	3	0	0	0	1	0	0	0	0	0	0	0	0	0
Downstream-Bkg	2	4	1	3	1	5	1	2	0	0	0	0	0	0	0
Downstream-Bkg	0	3	0	1	0	0	1	0	0	0	0	0	0	0	0
Downstream-Bkg	4	2	3	2	0	3	0	1	0	0	0	0	0	0	0
Downstream-Bkg	2	1	2	0	0	0	1	1	0	0	0	0	0	0	0
Downstream-Bkg	2	2	1	2	0	1	2	0	0	0	0	0	0	0	0
Downstream	13740	20170	13260	20020	13050	31580	28760	13230	6270	1798	168	255	95	46	23
Downstream	13430	19920	13560	19700	12650	31390	28280	13240	6166	1767	159	233	112	53	21
Downstream	13620	19590	13310	19250	12400	30750	28190	12920	6069	1819	161	220	96	41	26
Downstream	13250	19300	13250	19850	12520	30800	28340	13020	6279	1826	170	251	103	32	19
Downstream	13420	19540	13320	19680	12660	30760	28260	13040	6286	1907	179	273	116	38	22
Downstream	13280	19150	12730	19540	12350	30500	27680	12650	6248	1794	174	224	108	40	28
Downstream	13310	19530	12980	19520	12550	30760	28280	12880	6335	1876	200	246	102	53	26
Downstream	12540	18110	12410	18240	11620	28350	26120	12300	5868	1728	150	226	97	31	26
Downstream	12960	18860	12670	18940	12080	29760	27150	12670	5884	1737	154	216	116	41	31
Downstream	13580	19370	13410	19800	12540	30580	27810	12820	6076	1792	166	234	105	62	27
Downstream-Bkg	3	4	0	2	0	2	0	0	0	0	0	0	0	0	0
Downstream-Bkg	6	1	1	0	0	1	0	1	0	0	0	0	0	0	0
Downstream-Bkg	3	0	0	1	0	3	0	0	0	0	0	0	0	0	0
Downstream-Bkg	0	3	1	2	1	1	1	0	0	0	0	0	0	0	0
Downstream-Bkg	4	3	1	0	1	0	0	0	0	0	0	0	0	0	0
Meas. Penetration	0.99	0.99	1.01	1.00	0.99	0.99	0.99	0.99	0.95	0.84	0.69	0.62	0.54	0.46	0.42

#13, Fiberglass

Particle Counts per Indicated OPC Channel (1.25-Minute Samples @ 7.1 L/min)

OPC Channel Number	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
Upstream-Bkg	15	23	17	19	7	35	32	17	4	0	0	0	0	0	0
Upstream-Bkg	4	3	1	0	1	0	0	0	0	0	0	0	0	0	0
Upstream-Bkg	3	2	0	2	0	2	0	0	0	0	0	0	0	0	0
Upstream-Bkg	3	2	0	3	0	0	1	0	0	0	0	0	0	0	0
Upstream-Bkg	4	2	0	1	0	0	1	0	0	0	0	0	0	0	0
Upstream	13870	20620	13720	20710	13510	32900	30750	14150	7374	2608	291	515	264	126	88
Upstream	14060	20920	14290	21140	13450	32920	31340	14340	7711	2628	293	512	295	136	91
Upstream	14280	20630	14010	20990	13560	33300	31300	14240	7423	2749	294	507	282	170	88
Upstream	13980	20940	13850	20950	13470	32880	30700	14360	7382	2628	326	538	250	141	91
Upstream	13830	20370	13730	20490	13370	32310	30660	13970	7413	2722	309	490	293	131	81
Upstream	13670	20370	13600	20580	13240	32320	30310	13990	7220	2640	325	521	262	118	79
Upstream	13460	19980	13820	20450	13030	32240	30770	13900	7351	2617	295	531	236	139	83
Upstream	13810	20280	13810	20390	13390	32490	30560	14180	7379	2675	316	519	281	130	105
Upstream	14170	20490	14110	21170	13450	33540	31350	14240	7540	2743	354	551	268	144	95
Upstream	14180	20900	14270	21430	13690	33660	31520	14420	7553	2697	325	539	295	135	90
Upstream-Bkg	8	3	0	0	0	0	1	2	1	0	0	0	0	0	0
Upstream-Bkg	4	7	4	7	0	4	4	1	0	0	0	1	0	0	0
Upstream-Bkg	3	2	2	2	1	0	0	1	0	0	0	0	0	0	0
Upstream-Bkg	1	0	2	2	1	0	4	0	1	1	0	0	0	0	0
Upstream-Bkg	3	4	0	0	3	0	2	0	0	0	0	0	0	0	0
Downstream-Bkg	5	3	3	0	1	1	1	0	0	0	0	0	0	0	0
Downstream-Bkg	2	4	0	1	0	0	0	0	0	0	0	0	0	0	0
Downstream-Bkg	2	6	2	0	0	0	3	0	0	0	0	0	0	0	0
Downstream-Bkg	1	2	2	0	0	0	1	0	0	0	0	0	0	0	0
Downstream-Bkg	5	4	2	2	1	3	0	1	0	0	0	0	0	0	0
Downstream	14380	21230	14240	21210	13570	33480	31240	13210	5610	1356	108	152	70	20	15
Downstream	13980	20670	14090	21360	13500	32910	30800	13010	5646	1391	119	138	63	22	13
Downstream	14370	20430	13980	21120	13390	32410	30530	12880	5463	1419	102	132	64	38	12
Downstream	13800	20330	14000	20650	13370	31830	30230	12860	5286	1331	139	145	59	16	14
Downstream	13760	19780	13490	20210	13070	32120	29590	12480	5360	1299	125	145	55	23	12
Downstream	13730	20120	13520	20590	13390	31970	29870	12870	5577	1343	106	139	48	25	15
Downstream	14190	20500	14070	20930	13250	32410	30480	13140	5522	1311	93	132	53	28	13
Downstream	14170	20540	14200	21300	13670	33090	30960	13100	5600	1341	95	142	57	22	16
Downstream	14160	20280	14120	21140	13520	32480	30560	13130	5406	1309	125	148	67	25	8
Downstream	14110	20370	13820	20940	13100	32350	30700	12810	5472	1386	112	155	76	21	15
Downstream-Bkg	6	3	1	0	4	2	2	1	1	0	0	0	0	0	0
Downstream-Bkg	5	3	2	0	1	0	3	1	2	0	0	0	0	0	0
Downstream-Bkg	3	3	0	0	0	1	0	1	0	0	0	0	0	0	0
Downstream-Bkg	4	2	2	1	0	4	1	1	0	0	0	0	0	0	0
Downstream-Bkg	6	4	0	1	0	1	0	1	0	0	0	0	0	0	0
Meas. Penetration	1.01	0.99	1.00	1.01	1.00	0.99	0.99	0.91	0.74	0.50	0.36	0.27	0.22	0.18	0.15

#13, Fiberglass Loaded

Particle Counts per Indicated OPC Channel (1.25-Minute Samples @ 7.1 L/min)

OPC Channel Number	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
Upstream-Bkg	2	6	1	2	0	4	1	0	0	0	0	0	0	0	0
Upstream-Bkg	5	2	0	2	0	1	2	0	0	0	0	0	0	0	0
Upstream-Bkg	5	1	1	2	2	3	0	0	0	0	0	0	0	0	0
Upstream-Bkg	1	1	0	1	0	1	3	0	0	0	0	0	0	0	0
Upstream-Bkg	1	4	1	1	0	1	1	0	0	0	0	0	0	0	0
Upstream	14310	20940	13890	21380	13840	33300	31840	14890	7845	2801	342	521	303	124	85
Upstream	13700	20240	13420	20530	13180	32220	30430	14060	7458	2700	311	469	285	137	92
Upstream	13560	20240	13530	20670	13050	32030	30160	13980	7482	2698	328	528	292	135	78
Upstream	13520	19790	13540	20100	12940	32090	30040	14190	7415	2661	305	529	270	126	83
Upstream	13430	19370	13150	19990	12540	31210	29380	13660	7271	2538	275	488	261	110	77
Upstream	13610	19920	13160	20100	12830	31780	30000	14010	7297	2591	291	484	253	122	77
Upstream	12960	19280	13120	19490	12340	30530	28890	13380	7102	2612	313	490	244	137	89
Upstream	13030	19250	12910	19220	12420	30620	28760	13300	7003	2504	277	495	289	102	89
Upstream	13030	18980	12880	19250	12150	29830	28050	13200	7061	2494	282	487	263	126	84
Upstream	13010	19090	12810	19390	12300	30170	28370	13260	7052	2467	298	500	253	138	72
Upstream-Bkg	5	2	2	4	1	2	5	0	0	0	1	0	0	0	0
Upstream-Bkg	3	2	1	0	1	0	4	1	1	0	0	0	0	0	0
Upstream-Bkg	9	11	2	11	4	9	6	6	2	0	0	0	0	0	0
Upstream-Bkg	1	0	2	2	0	0	0	0	0	0	0	0	0	0	0
Upstream-Bkg	5	6	1	1	1	2	2	0	0	0	0	0	0	0	0
Downstream-Bkg	1	1	0	1	0	1	0	0	0	0	0	0	0	0	0
Downstream-Bkg	2	3	0	0	0	0	1	0	0	0	0	0	0	0	0
Downstream-Bkg	3	4	2	1	0	2	2	0	0	0	0	0	0	0	0
Downstream-Bkg	4	3	0	1	0	1	0	0	0	0	0	0	0	0	0
Downstream-Bkg	2	2	2	1	1	2	0	0	1	0	0	0	0	0	0
Downstream	13630	19830	13560	20330	13100	31680	30170	12620	5266	1146	80	107	49	17	10
Downstream	13660	20050	13720	20670	13160	31720	30130	12860	5254	1160	101	105	35	16	3
Downstream	14070	20080	13690	20710	12960	31700	29960	13240	5135	1144	83	117	32	17	5
Downstream	13890	20290	13570	20390	13070	31850	29670	12920	5112	1175	86	119	44	11	6
Downstream	13660	19620	13260	19870	12480	30600	28960	12490	5033	1175	81	111	46	14	8
Downstream	13760	19530	13260	19920	12910	30860	29120	12600	5098	1109	79	115	43	10	8
Downstream	13370	19470	13140	19590	12630	30460	28730	12220	4942	1097	92	108	46	14	7
Downstream	13240	19060	12820	19510	12270	29820	28260	12090	4812	1025	78	92	33	14	7
Downstream	13040	19260	13020	19500	12260	30200	28600	12140	4908	1069	90	123	33	13	6
Downstream	13340	19160	12950	19480	12360	30100	28360	12310	4872	1139	70	108	46	9	7
Downstream-Bkg	4	3	0	0	2	0	2	1	0	0	0	0	0	0	0
Downstream-Bkg	7	4	1	0	0	0	4	0	0	0	0	0	0	0	0
Downstream-Bkg	2	1	0	1	2	1	0	0	0	0	0	0	0	0	0
Downstream-Bkg	4	3	1	0	1	0	1	0	0	0	0	0	0	0	0
Downstream-Bkg	0	1	0	0	0	1	1	2	0	0	0	0	0	0	0
Meas. Penetration	1.01	1.00	1.00	1.00	1.00	0.98	0.99	0.91	0.69	0.43	0.28	0.22	0.15	0.11	0.08

#14, Paper Mesh

Particle Counts per Indicated OPC Channel (1.25-Minute Samples @ 7.1 L/min)

OPC Channel Number	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
Upstream-Bkg	2	3	1	1	1	0	1	1	0	0	0	0	0	0	0
Upstream-Bkg	15	10	9	17	9	20	20	11	10	4	0	2	0	0	0
Upstream-Bkg	1	2	1	0	0	0	0	1	0	0	0	0	0	0	0
Upstream-Bkg	1	0	2	0	0	0	0	0	0	0	0	0	0	0	0
Upstream-Bkg	1	4	1	1	0	0	0	0	0	0	0	0	0	0	0
Upstream	14290	20760	14400	21140	13590	33260	31220	14630	7350	2758	326	504	292	129	84
Upstream	14030	20550	14060	21120	13220	33300	30710	14230	7450	2726	313	519	257	141	109
Upstream	13790	20460	13910	20910	13230	32300	30630	14030	7421	2628	306	475	284	146	103
Upstream	13710	20460	13650	20760	13240	32450	30360	14220	7399	2752	306	549	284	134	81
Upstream	13760	20040	13500	20370	12980	31670	29950	14010	7326	2626	354	496	271	138	83
Upstream	13540	19640	13280	20010	12760	31110	29650	13840	7248	2628	284	497	267	117	91
Upstream	13110	19270	13070	19390	12810	31110	28940	13400	7170	2579	303	471	286	122	93
Upstream	13690	20100	13440	20080	12950	31640	29550	13580	7215	2576	295	484	260	132	99
Upstream	13610	19580	13180	19610	12850	31080	29580	13660	7201	2582	321	521	255	131	84
Upstream	13210	19610	13260	19860	12630	30790	29250	13310	7013	2597	304	515	246	132	85
Upstream-Bkg	2	6	0	2	0	1	1	1	0	0	0	0	0	0	0
Upstream-Bkg	0	3	0	0	0	0	0	1	1	0	0	0	0	0	0
Upstream-Bkg	3	3	1	0	0	0	1	0	0	0	0	0	0	0	0
Upstream-Bkg	1	2	0	0	0	1	0	0	1	0	0	0	0	0	0
Upstream-Bkg	2	1	0	2	0	0	1	1	0	0	0	0	0	0	0
Downstream-Bkg	3	3	2	1	1	1	0	0	0	0	0	0	0	0	0
Downstream-Bkg	2	1	2	0	0	0	3	2	0	0	0	0	0	0	0
Downstream-Bkg	2	1	0	2	2	0	1	0	0	0	0	0	0	0	0
Downstream-Bkg	2	2	0	0	1	1	0	0	0	0	0	0	0	0	0
Downstream-Bkg	0	0	0	1	0	0	1	1	0	1	0	0	0	0	0
Downstream	14310	20570	13970	20530	13210	32190	29250	11320	3861	709	44	57	21	4	3
Downstream	13840	20230	13630	20310	12970	31220	28240	10980	3743	710	44	55	18	11	3
Downstream	14230	20410	13770	20800	13240	31990	28970	11110	3819	671	46	58	15	1	5
Downstream	14000	20360	13720	20590	13050	31490	28750	11270	3885	659	45	63	25	4	2
Downstream	13730	19950	13650	20040	12910	30950	28550	10770	3723	641	43	57	22	10	2
Downstream	13680	19800	13540	20320	12780	30950	28380	10900	3824	653	50	55	23	3	1
Downstream	13470	19470	13080	19680	12660	30530	28200	10960	3808	708	51	50	17	5	0
Downstream	13550	19460	13300	19890	12730	30480	27590	10560	3640	683	40	45	19	7	7
Downstream	13360	19380	13240	19560	12620	30370	27660	10770	3630	636	40	49	20	3	4
Downstream	13270	19270	13020	19420	12450	30010	27060	10500	3615	697	52	59	19	10	3
Downstream-Bkg	2	3	0	0	0	0	1	1	0	0	0	0	0	0	0
Downstream-Bkg	2	3	1	1	1	2	0	0	0	1	0	0	0	0	0
Downstream-Bkg	1	1	0	1	0	0	0	0	0	0	0	0	0	0	0
Downstream-Bkg	3	1	1	1	1	0	0	0	0	0	0	0	0	0	0
Downstream-Bkg	5	2	0	0	1	1	1	0	0	0	0	0	0	0	0
Meas. Penetration	1.01	0.99	0.99	0.99	0.99	0.97	0.94	0.79	0.52	0.26	0.15	0.11	0.07	0.04	0.03

#14, Paper Mesh Loaded

Particle Counts per Indicated OPC Channel (1.25-Minute Samples @ 7.1 L/min)

OPC Channel Number	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
Upstream-Bkg	3	3	2	0	0	0	0	0	0	0	0	0	0	0	0
Upstream-Bkg	4	3	3	1	0	0	0	0	1	0	0	0	0	0	0
Upstream-Bkg	7	1	2	0	1	0	0	0	0	0	0	0	0	0	0
Upstream-Bkg	7	5	0	0	0	0	0	1	1	0	0	0	0	0	0
Upstream-Bkg	7	1	1	0	0	0	0	0	0	0	0	0	0	0	0
Upstream	12880	18700	12690	19300	12250	29300	28430	13090	6831	2455	301	507	248	119	83
Upstream	12220	17980	11900	18110	11510	27760	26950	12510	6619	2337	267	435	241	99	72
Upstream	12450	17980	12240	18610	12070	28770	27470	12750	6733	2340	297	450	243	112	81
Upstream	12270	18160	12020	18140	11800	28650	27320	12520	6545	2378	277	453	225	110	70
Upstream	12230	17880	11950	17850	11730	28290	26790	12610	6652	2330	273	442	252	116	81
Upstream	12620	18330	12280	18780	11910	29070	27760	12540	6601	2309	242	432	273	102	67
Upstream	12190	17890	12020	18050	11410	28060	26650	12490	6458	2261	265	464	235	112	50
Upstream	12240	17830	12270	17920	11730	27920	27080	12430	6472	2271	272	387	283	105	61
Upstream	12170	17980	11970	18190	11400	28140	27000	12440	6507	2293	275	452	231	109	81
Upstream	12020	17540	11940	17850	11310	28140	26040	12150	6340	2313	266	407	244	108	74
Upstream-Bkg	7	5	1	2	1	2	3	1	1	0	0	0	0	0	0
Upstream-Bkg	9	3	5	1	0	0	0	1	1	0	0	0	0	0	0
Upstream-Bkg	4	1	0	1	1	0	1	0	0	0	0	0	0	0	0
Upstream-Bkg	4	3	0	0	0	0	2	0	0	0	0	0	0	0	0
Upstream-Bkg	5	4	0	0	0	1	3	0	0	0	0	0	0	0	0
Downstream-Bkg	4	2	0	0	1	0	0	1	0	0	0	0	0	0	0
Downstream-Bkg	2	2	0	0	0	0	0	0	0	0	0	0	0	0	0
Downstream-Bkg	5	3	1	1	0	0	1	0	0	0	0	0	0	0	0
Downstream-Bkg	6	4	2	1	1	0	0	0	0	0	0	0	0	0	0
Downstream-Bkg	6	5	1	1	0	3	1	0	0	0	0	0	0	0	0
Downstream	12680	18530	12570	18930	12080	28570	26440	9963	2922	409	18	25	9	2	1
Downstream	12800	18360	12300	18570	11790	28390	26170	9795	2914	396	26	19	3	0	0
Downstream	12350	17780	11990	18120	11540	27830	25290	9398	2754	362	28	16	2	2	2
Downstream	12520	17770	12080	18140	11590	27980	25350	9622	2759	394	19	16	5	1	0
Downstream	12520	17980	12230	18230	11480	27510	25660	9679	2788	368	18	19	7	2	0
Downstream	12270	17610	11920	18000	11310	27260	25270	9407	2778	416	19	20	4	0	1
Downstream	12840	18240	12100	18560	11760	28090	25710	9559	2848	356	19	16	8	3	1
Downstream	12430	17730	12080	18010	11390	27910	25700	9480	2790	388	19	23	1	1	0
Downstream	12170	17810	12040	17680	11230	27800	24720	9344	2699	362	21	21	6	0	0
Downstream	12360	17610	12100	17970	11460	27620	24830	9452	2753	345	21	11	6	0	1
Downstream-Bkg	6	6	2	0	0	2	1	0	0	0	0	0	0	0	0
Downstream-Bkg	9	6	1	1	1	0	1	0	0	0	0	0	0	0	0
Downstream-Bkg	6	3	1	2	0	0	2	0	1	0	0	0	0	0	0
Downstream-Bkg	7	4	1	0	0	0	0	0	0	0	0	0	0	0	0
Downstream-Bkg	7	2	1	2	0	1	1	0	0	0	0	0	0	0	0
Meas. Penetration	1.01	1.00	1.00	1.00	0.99	0.98	0.94	0.76	0.43	0.16	0.08	0.04	0.02	0.01	0.01

#15, Polyester Bag

Particle Counts per Indicated OPC Channel (1.25-Minute Samples @ 7.1 L/min)

OPC Channel Number	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
Upstream-Bkg	0	2	1	1	0	1	0	0	0	0	0	0	0	0	0
Upstream-Bkg	6	2	3	0	0	2	1	0	0	0	0	0	0	0	0
Upstream-Bkg	2	3	0	1	0	0	0	0	1	0	0	0	0	0	0
Upstream-Bkg	3	3	0	2	1	3	2	0	0	0	0	0	0	0	0
Upstream-Bkg	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Upstream	13730	20070	13270	19940	13020	31550	30100	13840	7244	2598	294	466	261	131	86
Upstream	13830	19870	13500	20310	13070	31760	30140	13840	7131	2543	328	492	290	123	85
Upstream	13620	19780	13470	20030	12820	31240	29360	13970	7109	2566	294	475	295	120	86
Upstream	13490	19810	13390	20270	12940	31160	29260	13780	6944	2499	280	477	267	98	87
Upstream	13440	19690	13320	20220	12870	31170	29380	13640	7346	2532	282	486	267	133	82
Upstream	13440	19620	13380	20220	12690	31630	29940	13840	7271	2550	261	447	284	128	73
Upstream	13180	19300	12790	19510	12590	29990	28960	13430	6886	2500	329	463	258	125	72
Upstream	13240	19670	13010	19760	12870	30500	29430	13520	7128	2459	276	511	282	126	77
Upstream	13380	19590	13140	19770	12360	30780	29140	13470	7088	2475	273	466	247	108	77
Upstream	13200	19070	13070	19170	12180	29680	28550	13330	6745	2389	275	469	245	119	79
Upstream-Bkg	4	1	2	0	2	3	0	0	1	0	0	0	0	0	0
Upstream-Bkg	2	2	0	2	0	1	1	1	0	0	0	0	0	0	0
Upstream-Bkg	2	3	1	3	0	0	1	0	0	0	0	0	0	0	0
Upstream-Bkg	4	1	1	2	0	1	1	0	1	0	0	0	0	0	0
Upstream-Bkg	2	3	0	0	1	1	0	0	0	0	0	0	0	0	0
Downstream-Bkg	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0
Downstream-Bkg	3	4	1	1	2	0	1	1	0	0	0	0	0	0	0
Downstream-Bkg	1	0	0	0	0	1	0	0	0	0	0	0	0	0	0
Downstream-Bkg	1	1	0	1	0	0	1	0	0	0	0	0	0	0	0
Downstream-Bkg	1	1	0	1	1	0	0	0	0	0	0	0	0	0	0
Downstream	13580	19790	13280	19980	12630	30130	27280	10560	3114	373	10	13	2	3	1
Downstream	13270	19110	13250	19250	12320	29400	26600	10360	3181	347	11	12	1	1	0
Downstream	13650	19980	13500	19920	12450	30450	26980	10330	3155	323	14	12	0	0	0
Downstream	13350	19190	13180	19520	12390	29690	26820	10210	3115	361	7	8	1	0	0
Downstream	13350	19130	12900	19480	12170	29150	26600	10090	3043	325	14	12	0	0	0
Downstream	13220	18650	12670	19080	11900	28700	26400	9927	3105	360	5	6	0	0	0
Downstream	13310	19170	12900	19270	12670	29140	26980	10190	3107	359	10	15	4	0	0
Downstream	13270	19090	12920	19360	12210	29560	25500	9664	2874	273	8	10	2	1	0
Downstream	13110	18810	12760	19090	12110	28820	26170	9850	3057	355	11	10	3	0	0
Downstream	13140	19090	12560	19230	12080	28800	26170	9884	2982	350	14	11	2	1	0
Downstream-Bkg	1	1	2	2	1	1	3	1	0	0	0	0	0	0	0
Downstream-Bkg	2	1	0	1	0	0	0	1	0	0	0	0	0	0	0
Downstream-Bkg	5	3	1	1	2	0	0	0	0	0	0	0	0	0	0
Downstream-Bkg	2	1	1	2	0	1	0	0	0	0	0	0	0	0	0
Downstream-Bkg	5	2	0	0	2	1	0	1	0	0	0	0	0	0	0
Meas. Penetration	0.99	0.98	0.98	0.97	0.96	0.95	0.90	0.74	0.43	0.14	0.04	0.02	0.01	0.00	0.00

#15, Polyester Bag Loaded

Particle Counts per Indicated OPC Channel (1.25-Minute Samples @ 7.1 L/min)

OPC Channel Number	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
Upstream-Bkg	3	3	1	0	0	0	0	0	0	0	0	0	0	0	0
Upstream-Bkg	6	2	0	2	1	0	1	0	0	0	0	0	0	0	0
Upstream-Bkg	7	3	0	1	0	0	0	0	0	0	0	0	0	0	0
Upstream-Bkg	8	7	1	0	1	0	0	0	0	0	0	0	0	0	0
Upstream-Bkg	6	3	0	0	0	0	0	0	0	0	0	0	0	0	0
Upstream	11810	17360	11880	17520	11240	28090	25310	12140	6091	2148	295	380	215	107	78
Upstream	12050	17450	11750	17350	11320	28100	25230	11780	6144	2091	235	391	195	107	75
Upstream	11830	17620	11980	17670	11340	28360	25340	12040	6205	2203	230	419	236	100	81
Upstream	11690	16840	11540	16860	10830	27250	24090	11490	5882	2058	257	435	192	111	72
Upstream	11410	16890	11190	16660	10900	26670	24550	11530	6035	2172	246	421	229	103	73
Upstream	11570	16740	11170	16630	10720	26790	24710	11470	6139	2116	263	443	221	97	62
Upstream	10990	16220	11210	16280	10490	26280	24210	11350	5961	2114	235	423	209	95	73
Upstream	11310	16560	11100	16420	10560	26140	24200	11420	5930	2185	237	374	209	93	60
Upstream	11210	16820	11150	16580	10790	26480	24400	11560	5972	2096	227	414	210	93	80
Upstream	11450	16030	11180	16600	10750	25690	25390	12010	6254	2290	259	431	216	106	86
Upstream-Bkg	3	3	2	0	0	3	2	0	1	0	0	0	0	0	0
Upstream-Bkg	4	2	0	3	1	0	0	1	1	0	0	0	0	0	0
Upstream-Bkg	7	3	0	0	1	0	0	0	0	0	0	0	0	0	0
Upstream-Bkg	6	6	0	0	1	0	0	0	0	0	0	0	0	0	0
Upstream-Bkg	4	3	0	2	0	2	0	0	0	0	0	0	0	0	0
Downstream-Bkg	6	6	0	0	0	0	0	0	0	0	0	0	0	0	0
Downstream-Bkg	4	3	2	0	1	1	0	0	0	0	0	0	0	0	0
Downstream-Bkg	2	1	0	0	0	0	0	0	0	0	0	0	0	0	0
Downstream-Bkg	3	1	0	2	1	0	0	0	0	0	0	0	0	0	0
Downstream-Bkg	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0
Downstream	11700	16870	11460	16830	10690	26460	22710	8958	2822	387	40	71	24	17	3
Downstream	11290	16380	11130	16330	10520	25760	21630	8520	2239	192	3	1	2	1	0
Downstream	11450	16670	11200	16380	10620	26210	22030	8343	2223	177	3	3	2	0	0
Downstream	11120	16170	11120	16180	10380	25250	22230	8583	2292	196	4	7	0	0	0
Downstream	11100	15960	10650	16060	10370	24820	21980	8352	2356	172	5	1	0	0	0
Downstream	10870	15680	10720	15870	10140	24490	21740	8053	2270	212	3	7	0	0	0
Downstream	10840	15910	10850	16060	10050	24720	21530	8179	2189	172	5	4	2	0	0
Downstream	11090	15910	10630	15830	10130	24100	21270	8147	2202	187	6	1	2	0	1
Downstream	11280	16160	10800	16160	10170	24820	21890	8162	2307	185	2	5	1	1	0
Downstream	11060	15740	10790	16420	10230	24160	23370	8732	2523	231	13	6	0	0	0
Downstream-Bkg	12	0	0	2	1	0	0	2	0	0	0	0	0	0	0
Downstream-Bkg	2	4	1	1	0	0	0	0	0	0	0	0	0	0	0
Downstream-Bkg	8	2	0	0	1	1	0	0	0	0	0	0	0	0	0
Downstream-Bkg	8	7	1	0	1	0	0	0	0	1	0	0	0	0	0
Downstream-Bkg	3	5	1	1	0	2	1	0	0	0	0	0	0	0	0
Meas. Penetration	0.97	0.96	0.96	0.96	0.95	0.93	0.89	0.72	0.39	0.10	0.03	0.03	0.02	0.02	0.01

#16, No Filter

Particle Counts per Indicated OPC Channel (1.25-Minute Samples @ 7.1 L/min)

OPC Channel Number	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
Upstream-Bkg	1	3	1	0	0	0	0	0	0	0	0	0	0	0	0
Upstream-Bkg	4	2	1	3	1	0	1	1	0	0	0	0	0	0	0
Upstream-Bkg	1	1	0	0	0	1	1	0	0	0	0	0	0	0	0
Upstream-Bkg	4	4	0	1	2	0	1	0	0	0	0	0	0	0	0
Upstream-Bkg	6	3	1	1	2	1	0	0	0	0	0	0	0	0	0
Upstream	11570	16900	11380	17220	10940	26950	25660	11710	6137	2278	265	449	225	117	78
Upstream	11720	16900	11400	17060	10900	26610	25940	11990	6338	2215	237	456	213	107	71
Upstream	11610	16600	11530	16860	11020	26760	25500	11790	6232	2230	260	459	222	115	69
Upstream	11220	16070	10800	16440	10530	25710	24470	11360	6084	2178	251	410	222	109	66
Upstream	11170	16320	11060	16600	10490	26060	24320	11450	5980	2183	235	407	224	94	69
Upstream	11150	16060	10700	16360	10400	25690	24410	11300	6124	2078	238	413	221	107	65
Upstream	10460	15450	10290	15440	10150	24270	23260	10970	5784	2029	246	407	223	112	64
Upstream	11240	16300	10940	16530	10640	25820	24760	11420	6241	2220	253	402	216	97	71
Upstream	11160	16140	10770	16180	10390	25630	24560	11250	5902	2178	251	424	239	103	84
Upstream	11270	16270	11150	16400	10650	25820	24720	11390	6097	2166	251	423	230	104	65
Upstream-Bkg	6	5	3	1	4	5	8	3	1	0	0	0	0	0	0
Upstream-Bkg	7	5	6	3	0	3	4	0	0	1	0	0	0	0	0
Upstream-Bkg	5	4	0	1	0	1	1	0	0	0	0	0	0	0	0
Upstream-Bkg	2	1	1	1	1	1	0	0	0	0	0	0	0	0	0
Upstream-Bkg	3	2	2	0	1	1	2	1	0	0	0	0	0	0	0
Downstream-Bkg	10	6	3	3	5	2	2	0	0	0	0	0	0	0	0
Downstream-Bkg	2	0	0	0	1	0	0	1	0	0	0	0	0	0	0
Downstream-Bkg	4	4	0	0	0	1	1	0	0	0	0	0	0	0	0
Downstream-Bkg	2	5	1	1	0	3	1	0	0	0	0	0	0	0	0
Downstream-Bkg	7	0	0	2	0	2	0	0	0	0	0	0	0	0	0
Downstream	11590	16930	11480	17440	11290	27120	25580	11800	6224	2235	277	421	207	97	44
Downstream	11260	16610	11220	16870	10880	26200	25140	11450	5989	2118	259	408	235	89	64
Downstream	11360	16700	11140	16980	11000	26420	25150	11630	6027	2236	231	402	228	112	75
Downstream	11270	16290	11090	16600	10530	25910	24810	11720	5979	2151	258	455	226	105	71
Downstream	11200	16120	10730	16190	10490	25730	24240	11340	5759	2124	244	372	189	101	61
Downstream	10630	15400	10190	15660	9988	24310	23360	10930	5673	1949	239	379	177	103	53
Downstream	10850	15930	10700	16180	10330	25130	23970	11090	5806	2068	239	438	220	97	61
Downstream	11300	16010	11050	16500	10650	26030	25040	11620	5940	2126	247	394	194	95	66
Downstream	11210	16210	11070	16550	10610	25780	24690	11310	6039	2228	261	430	218	105	54
Downstream	11120	16350	11040	16280	10790	25780	24280	11250	5948	2168	249	438	207	100	70
Downstream-Bkg	5	2	0	2	1	4	2	0	0	1	0	0	0	0	0
Downstream-Bkg	1	3	0	1	1	2	4	1	1	1	0	0	0	0	0
Downstream-Bkg	0	2	1	2	1	2	2	0	0	0	0	0	0	0	0
Downstream-Bkg	5	1	2	2	1	4	2	1	0	0	0	0	0	0	0
Downstream-Bkg	4	1	0	2	0	1	0	0	0	0	0	0	0	0	0
Meas. Penetration	0.99	1.00	1.00	1.00	1.00	1.00	0.99	1.00	0.97	0.98	1.01	0.97	0.94	0.94	0.88

#17, No Filter

Particle Counts per Indicated OPC Channel (1.25-Minute Samples @ 7.1 L/min)

OPC Channel Number	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
Upstream-Bkg	1	2	1	2	2	0	1	0	0	0	0	0	0	0	0
Upstream-Bkg	6	0	0	0	1	3	0	0	0	0	0	0	0	0	0
Upstream-Bkg	3	0	2	2	2	0	0	0	0	0	0	0	0	0	0
Upstream-Bkg	3	0	0	0	0	0	0	1	0	0	0	0	0	0	0
Upstream-Bkg	3	4	0	0	2	1	3	0	1	0	0	0	0	0	0
Upstream	12180	18090	11990	18290	11620	28590	26950	12700	6629	2349	316	489	236	130	93
Upstream	11980	17480	11880	17650	11410	28150	26220	12140	6496	2405	268	452	251	151	83
Upstream	11130	16240	10910	16210	10450	25700	24540	11320	6046	2260	267	425	237	96	60
Upstream	11520	16870	11350	16930	11020	26890	25270	11720	6318	2299	275	409	205	130	77
Upstream	11710	16830	11560	17400	11120	26970	25550	11850	6418	2269	252	435	229	107	87
Upstream	11950	16930	11520	17580	11310	27530	26080	12140	6351	2331	273	471	250	119	87
Upstream	11640	17110	11580	17280	11090	27070	25940	11980	6306	2321	253	465	217	143	87
Upstream	11460	16540	11350	16810	10790	26350	25200	11840	6200	2330	266	413	275	128	81
Upstream	11440	16510	11150	16670	10550	26360	25060	11640	6159	2273	236	433	220	114	63
Upstream	11080	16240	11020	16350	10660	26180	24600	11500	6028	2187	264	430	257	114	63
Upstream-Bkg	2	0	0	0	1	0	0	0	0	0	0	0	0	0	0
Upstream-Bkg	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Upstream-Bkg	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0
Upstream-Bkg	4	2	1	0	0	0	1	0	0	0	0	0	0	0	0
Upstream-Bkg	2	3	0	0	0	0	0	0	0	0	0	0	0	0	0
Downstream-Bkg	0	2	0	0	0	0	0	1	1	0	0	0	0	0	0
Downstream-Bkg	5	4	0	1	0	0	0	1	0	1	0	0	0	0	0
Downstream-Bkg	1	2	1	0	0	2	2	0	0	0	0	0	0	0	0
Downstream-Bkg	2	3	1	2	1	4	0	1	0	0	0	0	0	0	0
Downstream-Bkg	5	0	1	0	0	2	1	2	0	1	0	0	0	0	0
Downstream	12180	17610	12020	17590	11420	28640	26950	12660	6403	2417	277	476	222	121	55
Downstream	11370	16450	11130	16710	10570	26180	25140	11550	6076	2193	264	431	264	99	68
Downstream	11180	16290	11030	16300	10550	25900	24530	11530	5898	2219	252	401	229	113	74
Downstream	11250	16380	11220	16640	10510	26320	25180	11700	6152	2289	264	433	216	106	76
Downstream	11670	17190	11610	17500	11380	27180	25830	12170	6351	2329	290	467	232	113	61
Downstream	11370	16730	11340	17280	11010	26530	25860	11580	6373	2263	253	452	255	119	79
Downstream	11540	17260	11390	17180	10900	26930	25670	12150	6237	2314	259	451	226	106	73
Downstream	11610	16890	11220	17120	10910	26910	25410	11750	6253	2264	273	431	198	101	75
Downstream	11280	16320	11120	16570	10550	26250	24870	11670	5959	2258	243	448	247	98	59
Downstream	11260	16400	11140	16440	10580	26060	24640	11450	6096	2272	248	473	218	98	59
Downstream-Bkg	1	0	0	1	0	0	0	1	0	0	0	0	0	0	0
Downstream-Bkg	0	2	0	0	0	0	0	0	0	0	0	0	0	0	0
Downstream-Bkg	3	0	0	0	0	0	1	0	0	0	0	0	0	0	0
Downstream-Bkg	0	3	1	0	0	0	0	0	0	0	0	0	0	0	0
Downstream-Bkg	2	0	1	0	0	1	0	0	0	0	0	0	0	0	0
Meas. Penetration	0.99	0.99	0.99	0.99	0.99	0.99	0.99	0.99	0.98	0.99	0.98	1.01	0.97	0.87	0.87

#18, HEPA

Particle Counts per Indicated OPC Channel (1.25-Minute Samples @ 7.1 L/min)

OPC Channel Number	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
Upstream-Bkg	9	7	2	1	0	1	0	0	0	0	0	0	0	0	0
Upstream-Bkg	11	11	5	9	6	12	13	7	0	0	0	0	0	0	0
Upstream-Bkg	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Upstream-Bkg	2	0	1	1	0	0	0	0	0	0	0	0	0	0	0
Upstream-Bkg	13	13	10	17	6	17	19	9	5	0	0	1	0	0	0
Upstream	11800	17020	11530	17370	11180	27360	25940	12090	6338	2198	265	441	223	108	75
Upstream	11280	16510	11090	16710	10740	26480	24660	11640	6208	2192	261	414	230	121	76
Upstream	11300	16620	11190	16890	10760	26290	25020	11890	6194	2299	256	433	198	94	100
Upstream	11330	16510	11300	16570	10750	26090	25090	11270	6027	2239	273	415	243	132	68
Upstream	11480	17210	11650	17200	11240	27270	25400	11960	6340	2167	270	409	214	133	79
Upstream	11560	16640	11390	16970	10870	26860	25460	11620	6299	2192	256	390	231	73	84
Upstream	10690	15550	10700	15730	10090	24590	23390	10820	5696	2007	221	356	231	111	70
Upstream	10520	15250	10440	15390	9794	24030	22900	10580	5577	2019	220	389	186	106	63
Upstream	10410	14960	10350	15380	9823	23690	23840	10830	5799	2115	261	419	249	110	70
Upstream	10040	14950	10030	15410	9937	23560	23850	10840	5787	2120	235	388	235	100	65
Upstream-Bkg	4	3	1	6	4	7	3	2	1	1	0	0	0	0	0
Upstream-Bkg	2	1	1	0	0	0	1	2	1	0	0	0	0	0	0
Upstream-Bkg	4	1	0	0	2	0	1	1	0	1	0	0	0	0	0
Upstream-Bkg	1	3	1	1	1	2	1	0	0	0	0	0	0	0	0
Upstream-Bkg	1	1	0	0	0	2	0	0	1	0	0	0	0	0	0
Downstream-Bkg	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0
Downstream-Bkg	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Downstream-Bkg	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Downstream-Bkg	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Downstream-Bkg	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0
Downstream	6	5	2	4	3	6	5	1	3	0	0	0	0	0	0
Downstream	1	5	4	1	2	7	6	4	0	0	0	0	0	0	0
Downstream	2	7	2	5	0	9	8	3	0	0	0	0	0	0	0
Downstream	4	3	3	8	2	3	3	1	0	0	0	0	0	0	0
Downstream	8	3	5	3	2	11	3	4	1	0	1	0	0	0	0
Downstream	2	11	0	5	0	8	7	5	2	0	0	0	0	0	0
Downstream	2	5	4	4	3	5	5	2	1	0	0	0	0	0	0
Downstream	3	2	3	6	2	3	4	4	1	0	0	0	0	0	0
Downstream	0	3	3	1	3	11	5	2	0	0	0	0	0	0	0
Downstream	2	5	1	10	1	2	4	2	1	0	0	0	0	0	0
Downstream-Bkg	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Downstream-Bkg	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0
Downstream-Bkg	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Downstream-Bkg	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Downstream-Bkg	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Meas. Penetration	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000

#19, Cardboard

Particle Counts per Indicated OPC Channel (1.25-Minute Samples @ 7.1 L/min)

OPC Channel Number	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
Upstream-Bkg	3	3	0	2	0	3	1	0	0	0	0	0	0	0	0
Upstream-Bkg	2	2	0	0	0	0	1	2	1	0	0	0	0	0	0
Upstream-Bkg	1	0	0	0	0	1	0	0	0	0	0	0	0	0	0
Upstream-Bkg	0	1	1	0	0	1	1	0	0	0	0	0	0	0	0
Upstream-Bkg	1	1	1	0	0	2	1	0	0	0	0	0	0	0	0
Upstream	11120	16340	11000	16450	10230	25140	23630	11010	5804	2089	256	384	231	108	68
Upstream	11120	16240	10790	16450	10380	25420	23780	11280	5824	2119	240	379	195	121	65
Upstream	11200	15920	11080	16520	10620	25480	23740	11040	5787	2091	277	394	201	90	84
Upstream	10930	16510	11040	16310	10400	25460	23760	11120	5805	2047	251	371	217	97	73
Upstream	10920	15920	10820	15940	10330	24940	23190	11070	5815	2040	237	402	218	120	87
Upstream	11180	15850	10810	16200	10190	25160	23540	11090	5739	2011	245	372	207	99	61
Upstream	10920	15800	10630	15900	9993	24720	22970	10990	5514	2007	248	419	197	93	64
Upstream	11120	15910	10700	15760	10000	24810	23290	10960	5847	2054	238	392	213	101	60
Upstream	10860	15550	10600	15860	9997	24010	23760	11210	5820	2116	267	428	226	115	74
Upstream	10720	15420	10250	15690	9934	23540	23910	11240	5851	2177	258	394	239	105	81
Upstream-Bkg	1	0	0	0	0	1	2	0	0	0	0	0	0	0	0
Upstream-Bkg	0	2	2	1	1	0	1	1	0	0	0	0	0	0	0
Upstream-Bkg	2	1	1	1	0	0	1	0	0	0	0	0	0	0	0
Upstream-Bkg	0	2	0	0	0	0	0	0	0	0	0	0	0	0	0
Upstream-Bkg	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Downstream-Bkg	2	0	2	1	0	0	1	0	0	0	0	0	0	0	0
Downstream-Bkg	0	1	0	1	0	0	0	0	0	0	0	0	0	0	0
Downstream-Bkg	0	4	0	3	0	1	0	0	0	0	0	0	0	0	0
Downstream-Bkg	5	4	2	1	1	0	2	0	0	0	0	0	0	0	0
Downstream-Bkg	0	1	0	2	0	0	1	0	0	0	0	0	0	0	0
Downstream	11300	16480	10990	16360	10240	25360	23590	11010	5368	1605	159	248	104	42	28
Downstream	11060	15890	10800	16450	10390	24940	23520	10690	5287	1683	159	227	99	30	19
Downstream	11370	16290	11140	16600	10450	25380	23440	10810	5306	1610	143	223	96	31	32
Downstream	11120	16120	10710	15910	10200	25060	22850	10910	5277	1638	155	228	101	42	26
Downstream	11030	16220	10750	16150	10160	24930	23650	10880	5301	1699	185	214	106	27	35
Downstream	10970	15790	10640	15530	9883	24120	22500	10460	5104	1541	167	222	93	34	25
Downstream	11090	15820	10730	15780	10040	24520	22960	10680	5126	1614	138	261	109	45	30
Downstream	10970	15190	10330	15790	10020	23450	23610	10680	5391	1635	178	249	84	42	33
Downstream	10750	15210	10280	15780	9853	23490	23550	10860	5243	1683	175	239	121	60	23
Downstream	10700	15460	10320	15740	9962	23350	23740	10770	5446	1766	141	243	116	44	21
Downstream-Bkg	1	0	1	1	0	1	1	0	0	0	0	0	0	0	0
Downstream-Bkg	6	1	1	0	0	0	1	0	0	0	0	0	0	0	0
Downstream-Bkg	2	0	0	1	1	0	0	0	0	0	0	0	0	0	0
Downstream-Bkg	0	2	0	0	0	0	0	0	0	0	0	0	0	0	0
Downstream-Bkg	0	0	0	0	0	1	0	0	1	0	0	0	0	0	0
Meas. Penetration	1.00	0.99	0.99	0.99	0.99	0.98	0.99	0.97	0.91	0.79	0.64	0.60	0.48	0.38	0.38

#19, Cardboard Loaded

Particle Counts per Indicated OPC Channel (1.25-Minute Samples @ 7.1 L/min)

OPC Channel Number	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
Upstream-Bkg	2	1	1	2	0	0	0	0	0	0	0	0	0	0	0
Upstream-Bkg	0	0	0	1	0	0	0	0	0	1	0	0	0	0	0
Upstream-Bkg	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Upstream-Bkg	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0
Upstream-Bkg	3	0	0	0	0	2	0	0	0	0	0	0	0	0	0
Upstream	12140	17430	11590	17340	11050	27000	25610	12240	6277	2269	265	428	249	114	89
Upstream	11610	16880	11390	17100	10810	26700	25670	12030	6217	2365	264	447	243	119	90
Upstream	11560	16730	11310	16690	10730	26330	24980	11650	6140	2210	253	455	221	107	76
Upstream	11320	16670	11220	16810	10700	25670	24430	11570	5996	2240	271	417	225	119	64
Upstream	11450	16630	11360	16600	10580	25720	24830	11820	6012	2083	279	441	238	119	86
Upstream	11350	16500	10980	16700	10710	25130	25440	12030	6298	2241	266	433	293	125	92
Upstream	11850	16870	11400	17340	11020	26020	26570	12400	6527	2399	291	485	239	130	84
Upstream	11720	16850	11440	17300	10900	25900	26450	12340	6511	2338	287	458	253	146	84
Upstream	11720	17100	11480	17090	10830	25540	25380	11850	6224	2207	270	389	216	101	80
Upstream	11610	16780	11110	16730	10650	25830	24870	11830	5999	2115	241	428	206	120	90
Upstream-Bkg	1	4	0	0	0	3	1	1	1	0	0	0	0	0	0
Upstream-Bkg	3	0	1	0	0	0	0	0	0	1	0	0	0	0	0
Upstream-Bkg	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Upstream-Bkg	20	30	16	16	8	26	27	12	8	2	0	1	0	0	0
Upstream-Bkg	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Downstream-Bkg	1	1	0	1	0	0	0	0	0	0	0	0	0	0	0
Downstream-Bkg	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Downstream-Bkg	2	1	0	0	0	0	0	0	0	0	0	0	0	0	0
Downstream-Bkg	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Downstream-Bkg	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Downstream	11730	17020	11480	16990	10990	26890	25430	11870	6094	1942	217	314	147	50	33
Downstream	11610	16680	11150	16740	10590	25690	24670	11570	5946	1950	184	319	135	65	52
Downstream	11340	16260	10940	16120	10160	25460	24170	11460	5667	1878	201	287	147	56	27
Downstream	11450	16300	10930	16260	10250	25640	23890	11260	5592	1926	181	288	140	55	30
Downstream	11580	16850	11490	16890	10630	26290	24800	11780	5956	1908	154	296	141	66	27
Downstream	11580	16560	11250	17120	10760	25570	25710	12050	6116	2067	227	356	151	65	47
Downstream	11750	16630	11230	17110	10940	25530	26410	12230	6100	2063	228	358	156	58	37
Downstream	12000	16970	11600	17020	10730	26560	25410	12030	5866	1910	207	292	139	62	37
Downstream	11960	17240	11540	17370	10980	26750	25190	12020	6011	2014	199	299	145	53	41
Downstream	11650	16320	11360	16620	10750	25570	24560	11480	5636	1823	180	270	138	68	28
Downstream-Bkg	2	0	0	1	1	0	1	0	0	0	0	0	0	0	0
Downstream-Bkg	3	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Downstream-Bkg	1	0	2	1	0	0	0	0	0	0	0	0	0	0	0
Downstream-Bkg	1	0	0	2	1	1	4	1	0	0	0	0	0	0	0
Downstream-Bkg	1	0	1	0	1	0	0	0	0	0	0	0	0	0	0
Meas. Penetration	1.00	0.99	1.00	0.99	0.99	1.00	0.98	0.98	0.95	0.87	0.74	0.70	0.60	0.50	0.43

#20. Styrofoam

Particle Counts per Indicated OPC Channel (1.25-Minute Samples @ 7.1 L/min)

OPC Channel Number	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
Upstream-Bkg	2	1	1	0	0	0	0	0	0	0	0	0	0	0	0
Upstream-Bkg	3	0	0	1	0	0	0	0	0	0	0	0	0	0	0
Upstream-Bkg	2	1	0	0	0	0	0	0	0	0	0	0	0	0	0
Upstream-Bkg	0	1	0	2	0	0	0	0	0	0	0	0	0	0	0
Upstream-Bkg	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0
Upstream	11120	16240	11020	16690	10320	25920	23640	11350	5919	2127	225	375	219	111	66
Upstream	11280	16250	10840	16240	10380	25470	23400	11370	5788	2069	252	386	199	102	70
Upstream	10970	15760	10560	15430	10050	24950	22260	10710	5460	1890	231	342	196	92	65
Upstream	11030	16050	10960	15840	10310	25290	22290	10940	5554	1970	230	339	186	100	68
Upstream	10980	16040	10580	15510	10020	25220	21940	10600	5359	1959	208	378	191	93	50
Upstream	10580	15580	10490	15390	9915	24590	21510	10520	5374	1929	230	344	192	82	50
Upstream	10660	15300	10460	15690	10030	23870	24280	11030	5850	2050	249	431	210	109	70
Upstream	10540	15300	10350	15380	9659	23710	23210	10850	5764	2079	237	401	205	91	73
Upstream	10650	15640	10320	15180	9732	24530	22290	10720	5421	1931	228	357	186	91	60
Upstream	10700	15780	10740	15640	10030	24960	22140	10680	5658	1969	261	367	177	102	76
Upstream-Bkg	1	1	0	1	0	1	0	0	0	0	0	0	0	0	0
Upstream-Bkg	2	0	1	0	0	1	0	1	1	0	0	0	0	0	0
Upstream-Bkg	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0
Upstream-Bkg	2	2	0	0	0	0	0	0	0	0	0	0	0	0	0
Upstream-Bkg	4	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Downstream-Bkg	1	3	0	2	0	1	3	1	1	0	0	0	0	0	0
Downstream-Bkg	1	0	1	0	0	0	0	0	0	0	0	0	0	0	0
Downstream-Bkg	2	1	0	0	0	0	1	1	0	0	0	0	0	0	0
Downstream-Bkg	0	0	0	0	0	4	2	2	2	0	0	0	0	0	0
Downstream-Bkg	1	2	0	0	1	3	1	5	2	0	0	1	0	0	0
Downstream	11010	15870	10940	15890	10150	25110	23330	10780	5118	1491	132	213	85	37	21
Downstream	11110	16040	10870	16270	10230	25440	23470	10950	5224	1446	144	198	82	35	22
Downstream	11050	15920	10710	15650	10120	25130	22670	10450	4912	1344	123	201	78	37	23
Downstream	10730	15740	10490	15630	9926	24710	21800	10540	4792	1358	137	192	77	40	16
Downstream	10840	15720	10560	15460	10030	25200	21940	10070	4857	1358	131	176	89	26	28
Downstream	10540	15110	10040	15380	9764	23780	23040	10550	5124	1498	142	228	82	36	19
Downstream	10790	15280	10550	15730	9929	23850	23450	10660	5152	1464	148	211	85	50	22
Downstream	10840	15170	10520	15540	9895	24330	23450	10830	5175	1552	148	218	97	48	23
Downstream	10720	15650	10450	15290	9998	24770	22540	10420	4981	1379	124	220	80	41	20
Downstream	10510	15070	10260	14990	9555	23580	21610	10210	4674	1376	122	185	63	36	28
Downstream-Bkg	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Downstream-Bkg	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0
Downstream-Bkg	3	3	2	0	0	0	0	0	0	0	0	0	0	0	0
Downstream-Bkg	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Downstream-Bkg	0	0	0	0	1	1	1	0	1	0	0	0	0	0	0
Meas. Penetration	1.00	0.98	0.99	0.99	0.99	0.99	1.00	0.97	0.89	0.71	0.57	0.55	0.42	0.40	0.34

#20, Styrofoam Loaded

Particle Counts per Indicated OPC Channel (1.25-Minute Samples @ 7.1 L/min)

OPC Channel Number	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
Upstream-Bkg	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0
Upstream-Bkg	1	2	0	1	0	0	1	0	0	0	0	0	0	0	0
Upstream-Bkg	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Upstream-Bkg	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Upstream-Bkg	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Upstream	13180	19190	13020	19250	12120	30200	28600	13520	6850	2385	249	444	243	110	76
Upstream	13440	19500	13290	19670	12510	30590	29320	13970	7094	2487	317	526	259	108	77
Upstream	13360	19540	13130	19450	12630	30550	29430	13710	7046	2453	323	464	264	134	75
Upstream	13360	19540	13240	19440	12600	30630	29050	13480	6880	2466	273	433	263	113	81
Upstream	13150	19420	13020	19390	12490	30760	28410	13410	6739	2390	275	466	228	132	87
Upstream	13140	19270	13030	18840	12330	30280	28380	13270	6876	2412	262	447	231	135	71
Upstream	13270	19840	13150	19180	12420	30590	28060	13290	6633	2324	264	419	240	112	70
Upstream	13350	19580	13320	19250	12530	31010	28440	13700	6996	2368	265	465	242	107	77
Upstream	13470	19480	13210	19500	12760	31290	28710	13620	7004	2446	280	497	241	130	83
Upstream	13120	19050	12870	19290	12400	29370	30080	13710	6967	2562	282	501	261	126	86
Upstream-Bkg	0	0	0	0	1	1	1	0	0	0	0	0	0	0	0
Upstream-Bkg	0	0	2	0	0	1	0	0	1	0	0	0	0	0	0
Upstream-Bkg	0	0	1	0	1	1	0	0	0	0	0	0	0	0	0
Upstream-Bkg	0	2	1	0	0	0	0	0	0	0	0	0	0	0	0
Upstream-Bkg	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0
Downstream-Bkg	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Downstream-Bkg	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0
Downstream-Bkg	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0
Downstream-Bkg	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Downstream-Bkg	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0
Downstream	13140	19260	12900	19340	12450	30320	29260	13560	6587	2049	205	302	118	54	33
Downstream	12970	19110	12750	19190	12390	30200	29250	13430	6557	2014	187	285	141	43	31
Downstream	13240	19660	13190	19450	12590	30930	29170	13350	6647	2028	183	298	124	46	35
Downstream	13030	19290	12910	19140	12420	29830	28510	13120	6616	1927	194	265	123	50	27
Downstream	12960	19090	13110	19110	12440	30510	28320	13140	6373	2000	199	263	126	55	26
Downstream	13260	19390	12980	19590	12450	30830	28820	13410	6481	1925	194	257	120	41	29
Downstream	13380	19690	13220	19280	12450	30670	28110	13380	6429	1908	186	298	125	51	25
Downstream	13320	19880	13440	19540	12480	31450	28540	13420	6575	2034	189	268	121	41	34
Downstream	13390	19630	13490	19310	12760	31470	28440	13630	6621	1929	190	270	136	62	25
Downstream	12950	18990	13260	19380	12500	30020	30490	13830	6835	2121	189	294	128	53	31
Downstream-Bkg	0	1	0	1	0	0	1	0	0	0	0	0	0	0	0
Downstream-Bkg	0	1	0	1	0	1	1	0	0	0	0	0	0	0	0
Downstream-Bkg	0	0	0	1	0	0	1	0	0	0	0	0	0	0	0
Downstream-Bkg	0	0	0	0	0	0	1	1	0	0	0	0	0	0	0
Downstream-Bkg	0	1	0	0	0	0	1	0	0	0	0	0	0	0	0
Meas. Penetration	0.99	1.00	1.00	1.00	1.00	1.00	1.00	0.99	0.95	0.82	0.69	0.60	0.51	0.41	0.38

#21, Fiberglass

Particle Counts per Indicated OPC Channel (1.25-Minute Samples @ 7.1 L/min)

OPC Channel Number	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
Upstream-Bkg	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0
Upstream-Bkg	1	1	1	0	0	1	0	0	0	0	0	0	0	0	0
Upstream-Bkg	1	0	2	0	0	0	0	0	0	0	0	0	0	0	0
Upstream-Bkg	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0
Upstream-Bkg	3	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Upstream	13570	20280	13760	19710	12940	32650	27260	13220	6594	2270	269	484	233	133	68
Upstream	13380	19630	13330	19730	12560	31290	28400	13290	6756	2353	299	460	218	110	76
Upstream	13160	18850	13120	19280	12480	30660	28030	13030	6687	2422	288	446	260	121	90
Upstream	13130	19150	12880	19120	12220	30340	27060	12820	6615	2240	276	452	246	130	71
Upstream	12950	18950	12780	18770	12140	29810	26770	12870	6599	2321	285	460	222	110	75
Upstream	12430	18020	12330	18310	11700	28380	27860	12650	6773	2370	290	472	234	133	80
Upstream	12480	17940	12350	18500	11760	28260	27670	12850	6649	2370	287	456	275	116	93
Upstream	12300	17390	11810	18040	11480	27520	26870	12330	6496	2307	264	434	226	121	81
Upstream	12200	17510	12230	18040	11740	28120	27700	12730	6652	2431	314	437	237	102	84
Upstream	12200	17560	11990	17670	11060	28090	25510	12040	6131	2174	280	431	219	106	65
Upstream-Bkg	1	1	0	1	2	3	0	0	0	0	1	0	0	0	0
Upstream-Bkg	2	1	1	1	0	1	1	0	0	0	0	0	0	0	0
Upstream-Bkg	1	0	0	0	0	1	1	0	0	0	0	0	0	0	0
Upstream-Bkg	3	0	1	0	1	1	0	0	0	0	0	0	0	0	0
Upstream-Bkg	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0
Downstream-Bkg	8	15	2	2	1	1	0	0	0	0	0	0	0	0	0
Downstream-Bkg	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Downstream-Bkg	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0
Downstream-Bkg	0	3	0	0	0	0	0	0	0	0	0	0	0	0	0
Downstream-Bkg	1	0	0	0	1	1	0	0	0	0	0	0	0	0	0
Downstream	13720	19910	13440	19920	12710	31570	28430	12660	5169	1295	111	147	51	21	17
Downstream	13240	19540	13230	19540	12590	30820	27760	12140	5189	1242	107	159	57	25	8
Downstream	12920	19300	13140	19140	12290	30480	26810	11810	4896	1117	95	139	55	21	18
Downstream	13000	18940	12820	18670	12150	29700	26670	11550	4864	1241	96	126	41	16	6
Downstream	12850	18520	12830	18440	11960	29070	26130	11550	4893	1188	104	122	51	26	11
Downstream	12510	18070	12140	18290	11680	28150	27670	11890	5018	1243	105	147	65	22	19
Downstream	12480	17760	12110	18210	11770	27490	26610	11550	5036	1317	103	113	57	20	20
Downstream	12300	17850	12050	18500	11570	27730	27250	11710	5064	1315	126	165	68	24	15
Downstream	12130	17500	12000	18250	11180	27150	26410	11470	4966	1245	108	147	58	19	16
Downstream	12310	17990	11940	17760	11590	28010	25590	11390	4703	1159	106	138	55	15	8
Downstream-Bkg	2	3	0	1	1	1	1	0	0	0	0	0	0	0	0
Downstream-Bkg	2	2	1	0	0	0	0	0	0	0	0	0	0	0	0
Downstream-Bkg	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0
Downstream-Bkg	2	0	2	0	0	0	1	0	0	0	0	0	0	0	0
Downstream-Bkg	3	3	0	1	1	0	0	0	0	0	0	0	0	0	0
Meas Penetration	1.00	1.00	0.99	1.00	1.00	0.98	0.99	0.92	0.76	0.53	0.37	0.31	0.24	0.18	0.18

#21, Fiberglass Loaded

Particle Counts per Indicated OPC Channel (1.25-Minute Samples @ 7.1 L/min)

OPC Channel Number	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
Upstream-Bkg	14	13	12	15	14	15	11	9	4	3	2	0	0	0	0
Upstream-Bkg	3	0	3	4	0	0	0	0	0	0	0	0	0	0	0
Upstream-Bkg	2	4	1	0	0	0	0	0	0	0	0	0	0	0	0
Upstream-Bkg	3	2	0	1	1	0	0	0	0	0	0	0	0	0	0
Upstream-Bkg	8	7	2	5	1	1	2	1	3	0	0	0	0	0	0
Upstream	13090	19230	13060	19260	12360	30330	28140	13230	6650	2458	293	481	260	119	70
Upstream	13090	19310	12800	19290	12350	30050	28600	13270	6685	2395	298	452	234	87	80
Upstream	13130	19100	12880	18810	12130	29600	27860	12990	6631	2384	300	456	229	107	87
Upstream	12570	18470	12490	18420	11890	28990	27220	12490	6479	2240	267	450	225	111	76
Upstream	12660	18290	12460	18450	11660	29270	27100	12730	6391	2396	274	413	230	128	77
Upstream	12570	18460	12400	18400	11900	28980	27140	12550	6476	2249	268	453	198	104	71
Upstream	12490	18400	12300	18540	11920	29100	27070	12630	6428	2313	249	457	234	102	91
Upstream	12360	17950	12060	18090	11390	28130	26480	12170	6253	2249	270	426	262	107	74
Upstream	12140	17790	12150	18480	11960	28090	28330	12820	6581	2399	275	496	250	111	77
Upstream	12260	17680	11770	18410	11580	27550	27730	12600	6321	2423	310	443	246	126	83
Upstream-Bkg	1	5	1	0	0	2	1	0	0	0	0	0	0	0	0
Upstream-Bkg	6	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Upstream-Bkg	5	4	0	0	1	1	0	1	0	1	0	0	0	0	0
Upstream-Bkg	7	1	0	0	0	0	0	0	1	0	0	0	0	0	0
Upstream-Bkg	5	0	1	0	0	0	0	0	0	0	0	0	0	0	0
Downstream-Bkg	3	2	0	1	0	0	0	0	0	0	0	0	0	0	0
Downstream-Bkg	1	3	1	0	0	0	0	0	0	0	0	0	0	0	0
Downstream-Bkg	3	3	0	0	0	0	0	0	0	0	0	0	0	0	0
Downstream-Bkg	3	0	0	1	0	0	0	0	0	0	0	0	0	0	0
Downstream-Bkg	5	4	2	1	0	0	3	1	0	0	0	0	0	0	0
Downstream	13290	19370	13180	19760	12510	30500	28350	12400	5161	1140	85	103	46	17	5
Downstream	13030	19010	13030	19120	12170	29980	27400	11870	4851	1084	85	115	42	20	9
Downstream	13070	18700	12710	18840	12090	29770	27280	11950	4843	1081	80	103	34	10	10
Downstream	13200	18580	12570	18770	12420	29740	27530	11980	5043	1136	101	116	53	11	7
Downstream	12750	18590	12570	18710	12040	29440	27060	11850	4860	1108	88	111	44	19	8
Downstream	12420	18270	12300	18160	11650	28500	26440	11500	4669	1032	94	114	52	11	8
Downstream	12730	18530	12620	18520	12020	29080	26940	11650	4768	1096	75	118	37	23	9
Downstream	12430	17920	12230	18580	11620	28000	27750	11940	5012	1102	87	98	46	7	7
Downstream	12190	17780	12000	18390	11590	27550	27890	11830	5041	1214	89	107	43	13	7
Downstream	12250	17380	11890	17910	11390	27200	27160	11630	4788	1159	94	113	43	16	3
Downstream-Bkg	1	1	0	0	0	0	1	0	1	0	0	0	0	0	0
Downstream-Bkg	8	1	0	0	0	0	0	0	0	0	0	0	0	0	0
Downstream-Bkg	5	0	1	0	0	0	0	0	0	0	0	0	0	0	0
Downstream-Bkg	6	2	0	0	0	1	1	0	0	0	0	0	0	0	0
Downstream-Bkg	8	2	1	0	0	0	0	0	0	0	0	0	0	0	0
Meas. Penetration	1.01	1.00	1.01	1.00	1.00	1.00	0.99	0.93	0.76	0.47	0.31	0.24	0.19	0.13	0.09

#22, Paper Mesh

Particle Counts per Indicated OPC Channel (1.25-Minute Samples @ 7.1 L/min)

OPC Channel Number	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
Upstream-Bkg	6	0	0	0	0	0	1	0	0	0	0	0	0	0	0
Upstream-Bkg	4	2	1	0	0	0	0	1	0	0	0	0	0	0	0
Upstream-Bkg	5	3	0	0	0	2	0	0	0	0	0	0	0	0	0
Upstream-Bkg	4	2	1	0	0	1	0	0	0	0	0	0	0	0	0
Upstream-Bkg	4	1	0	1	0	0	0	0	0	0	0	0	0	0	0
Upstream	13120	19450	13090	19530	12560	30410	28330	13030	6589	2360	256	412	242	123	73
Upstream	13130	19190	12990	18620	12510	30030	27950	12730	6622	2313	276	441	243	99	67
Upstream	12860	18460	12720	18830	11940	29210	27560	12630	6360	2234	268	459	227	112	70
Upstream	12630	18310	12290	18210	11810	28620	26940	12650	6320	2205	255	407	239	110	63
Upstream	12360	18140	12510	18500	11650	28560	26870	12340	6435	2140	251	441	215	84	83
Upstream	12130	17590	12060	17770	11340	28210	26210	11960	6109	2083	245	366	211	115	61
Upstream	12100	17470	12060	17570	11280	27670	25880	12010	6060	2104	268	428	219	102	66
Upstream	12450	17960	12200	17950	11510	28130	26410	12060	6201	2152	255	399	213	100	75
Upstream	12510	18180	12080	17950	11580	28700	26640	12100	6288	2134	263	441	222	85	73
Upstream	12160	17830	12170	17820	11640	28250	26400	11840	6031	2257	246	400	211	102	62
Upstream-Bkg	2	5	0	0	0	1	2	0	0	0	0	0	0	0	0
Upstream-Bkg	5	3	0	0	0	0	0	0	0	0	0	0	0	0	0
Upstream-Bkg	3	2	0	0	0	2	0	0	0	0	0	0	0	0	0
Upstream-Bkg	4	3	1	0	0	1	0	0	0	0	0	0	0	0	0
Upstream-Bkg	7	1	0	0	0	0	0	0	0	1	0	0	0	0	0
Downstream-Bkg	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0
Downstream-Bkg	6	2	0	0	0	0	0	0	0	0	0	0	0	0	0
Downstream-Bkg	5	3	0	1	0	0	0	0	0	0	0	0	0	0	0
Downstream-Bkg	9	4	0	1	0	0	0	0	0	0	0	0	0	0	0
Downstream-Bkg	8	4	0	0	0	0	1	0	0	0	0	0	0	0	0
Downstream	13490	19310	13260	19450	12470	29860	26640	9988	3306	551	42	41	19	7	4
Downstream	13270	18840	12850	18830	11980	29220	26260	9889	3057	531	35	52	12	6	3
Downstream	12730	18440	12270	18590	11840	28250	25420	9409	3097	520	28	44	17	6	0
Downstream	12630	18130	12160	18310	11640	27970	25240	9449	3075	513	31	48	16	5	2
Downstream	12560	17870	12100	18080	11620	27670	24660	9458	3150	529	37	45	13	2	4
Downstream	12350	17530	11790	17500	11180	27010	24400	9183	3042	513	40	31	16	7	2
Downstream	12460	17850	12120	18040	11550	27800	25030	9393	3033	498	26	55	11	4	4
Downstream	12430	18000	12120	18000	11310	27640	24460	9464	3085	507	43	48	16	3	2
Downstream	12420	18330	12170	18010	11540	28020	25130	9532	3034	540	26	50	13	6	2
Downstream	12380	17770	12150	17880	11330	27260	24680	9289	2978	514	30	37	19	4	0
Downstream-Bkg	5	2	0	0	0	0	0	0	0	0	0	0	0	0	0
Downstream-Bkg	5	1	1	0	0	0	0	0	1	0	0	0	0	0	0
Downstream-Bkg	5	3	0	0	0	1	0	0	0	0	0	0	0	0	0
Downstream-Bkg	7	3	2	0	0	2	0	0	0	0	0	0	0	0	0
Downstream-Bkg	6	1	0	0	0	0	0	0	0	0	0	0	0	0	0
Meas. Penetration	1.01	1.00	0.99	1.00	0.99	0.98	0.94	0.77	0.49	0.24	0.13	0.11	0.07	0.05	0.03

#22, Paper Mesh Loaded

Particle Counts per Indicated OPC Channel (1.25-Minute Samples @ 7.1 L/min)

OPC Channel Number	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
Upstream-Bkg	4	2	2	0	1	0	0	0	0	0	0	0	0	0	0
Upstream-Bkg	3	0	0	2	0	0	0	0	0	0	0	0	0	0	0
Upstream-Bkg	4	1	0	1	0	0	0	0	0	0	0	0	0	0	0
Upstream-Bkg	3	3	0	1	0	0	0	0	0	0	0	0	0	0	0
Upstream-Bkg	4	4	0	0	0	0	0	0	0	0	0	0	0	0	0
Upstream	12370	18000	12280	18310	11650	28870	26840	12380	6275	2281	252	436	210	110	91
Upstream	12340	18060	12450	17780	11660	28120	26950	12440	6267	2313	241	441	222	118	82
Upstream	12420	17930	12450	18110	11740	28210	26800	12360	6303	2245	256	407	203	117	65
Upstream	12590	18180	12510	18280	11770	28760	26980	12490	6441	2247	263	419	223	108	60
Upstream	12190	17740	12070	17660	11470	27890	26460	12100	6332	2217	251	448	200	108	85
Upstream	11900	17420	11650	17420	11320	27730	25390	11960	6023	2250	264	424	235	106	67
Upstream	12380	17910	12090	17700	11220	27870	26230	12340	6333	2245	282	456	235	135	80
Upstream	12020	17520	11960	17530	11240	27510	25570	12100	6072	2201	261	413	227	105	60
Upstream	12270	17760	12010	17740	11260	27900	25870	12190	6161	2202	265	410	240	115	71
Upstream	11960	17590	11830	17660	11180	27690	25610	11980	6054	2138	251	418	228	109	72
Upstream-Bkg	7	5	1	0	0	1	0	0	0	0	0	0	0	0	0
Upstream-Bkg	2	2	0	3	1	1	3	0	0	0	0	0	0	0	0
Upstream-Bkg	7	3	0	2	0	1	0	0	0	0	0	0	0	0	0
Upstream-Bkg	11	2	1	2	0	0	0	0	0	0	0	0	0	0	0
Upstream-Bkg	2	2	1	3	0	0	0	0	0	0	0	0	0	0	0
Downstream-Bkg	4	3	0	0	0	0	0	0	0	0	0	0	0	0	0
Downstream-Bkg	5	2	0	0	1	0	0	0	0	0	0	0	0	0	0
Downstream-Bkg	7	1	0	0	2	0	1	0	0	0	0	0	0	0	0
Downstream-Bkg	7	1	0	1	0	0	0	0	0	0	0	0	0	0	0
Downstream-Bkg	1	1	0	1	1	0	0	0	0	0	0	0	0	0	0
Downstream	12790	18390	12360	18640	11730	28120	25310	8599	2136	256	10	9	1	2	1
Downstream	12630	18130	12200	18220	11530	28050	24880	8489	1984	224	7	8	2	1	0
Downstream	12620	18140	12240	18760	11630	28090	25190	8517	2126	266	9	11	2	0	0
Downstream	12590	17840	12280	17960	11590	27360	24560	8428	2047	230	9	9	6	0	0
Downstream	12320	17910	12030	17680	11240	27040	23950	8290	2095	245	16	8	7	0	0
Downstream	12350	17740	11940	17530	11170	27210	24250	8242	2033	226	6	11	2	2	0
Downstream	12250	17900	11920	18010	11350	27130	24500	8207	1968	204	4	8	4	1	0
Downstream	12360	17740	11850	17740	11190	27040	23680	8174	2037	233	10	2	3	2	0
Downstream	12250	17820	11770	17840	11130	27130	24290	8214	1941	226	16	11	6	1	0
Downstream	12370	17440	11840	17710	11040	26790	23780	7992	1973	217	12	12	2	0	0
Downstream-Bkg	1	4	1	1	0	1	0	0	0	0	0	0	0	0	0
Downstream-Bkg	7	2	0	1	0	1	1	0	0	0	0	0	0	0	0
Downstream-Bkg	5	3	1	0	0	1	0	0	0	0	0	0	0	0	0
Downstream-Bkg	6	2	0	0	0	4	0	0	0	0	0	0	0	0	0
Downstream-Bkg	2	1	2	1	0	1	0	0	0	0	0	0	0	0	0
Meas. Penetration	1.02	1.01	0.99	1.01	0.99	0.98	0.93	0.68	0.33	0.10	0.04	0.02	0.02	0.01	0.00

#23, Polyester Bag

Particle Counts per Indicated OPC Channel (1.25-Minute Samples @ 7.1 L/min)

OPC Channel Number	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
Upstream-Bkg	6	5	2	0	1	4	0	0	0	0	0	0	0	0	0
Upstream-Bkg	6	3	1	0	0	0	0	0	0	0	0	0	0	0	0
Upstream-Bkg	6	2	1	0	0	0	0	0	0	0	0	0	0	0	0
Upstream-Bkg	3	5	0	0	0	0	0	0	0	0	0	0	0	0	0
Upstream-Bkg	4	3	0	0	0	0	0	0	0	0	0	0	0	0	0
Upstream	11460	16680	11220	16880	10740	26440	24320	11430	5854	2031	275	391	222	99	66
Upstream	11710	16710	11280	16680	10740	26220	24080	11410	5786	2078	273	342	212	105	77
Upstream	11310	16310	11010	16320	10370	25460	23700	11310	5784	1979	245	357	178	125	59
Upstream	11080	16210	10800	16440	10260	25270	23140	10900	5707	1887	233	387	232	122	69
Upstream	11090	15810	10850	15920	10360	24990	22840	10720	5651	1988	213	396	193	82	80
Upstream	11000	16150	10730	16070	10380	25110	23430	10960	5510	2004	255	436	226	96	58
Upstream	11070	16280	10770	16390	10390	25280	23730	11020	5756	1973	252	422	213	98	62
Upstream	11530	16220	11140	16110	10680	26180	24030	11340	5808	2097	254	425	196	106	67
Upstream	11340	16380	10980	16380	10300	25580	23610	10820	5801	2053	242	396	213	110	63
Upstream	11530	16740	11210	16730	10790	26440	24650	11590	5867	2027	224	386	234	113	74
Upstream-Bkg	6	4	2	0	0	2	3	1	0	0	0	0	0	0	0
Upstream-Bkg	5	2	3	2	0	1	1	0	0	0	0	0	0	0	0
Upstream-Bkg	8	3	0	2	1	2	0	0	0	0	0	0	0	0	0
Upstream-Bkg	6	3	1	1	0	1	0	0	0	0	0	0	0	0	0
Upstream-Bkg	4	1	0	0	0	1	0	0	0	0	0	0	0	0	0
Downstream-Bkg	4	2	0	0	0	0	0	0	0	0	0	0	0	0	0
Downstream-Bkg	9	1	0	1	0	0	0	0	0	0	0	0	0	0	0
Downstream-Bkg	5	4	0	1	0	2	6	3	1	0	0	0	0	0	0
Downstream-Bkg	9	4	0	1	2	0	0	2	1	0	0	0	0	0	0
Downstream-Bkg	6	6	1	0	0	0	0	0	0	0	0	0	0	0	0
Downstream	11450	16360	11050	16580	10310	24740	22220	8788	2784	290	11	6	3	1	0
Downstream	11300	16010	11060	16190	10280	24570	21650	8674	2620	332	9	10	2	0	0
Downstream	11130	16120	10620	16070	9988	24380	21330	8601	2579	294	11	9	1	0	0
Downstream	10940	15440	10480	15630	9679	23770	21040	8388	2548	289	10	11	2	0	1
Downstream	10910	15550	10760	15620	9862	23520	21290	8303	2571	283	13	5	2	1	0
Downstream	10830	15570	10440	15700	10010	23570	21240	8282	2670	303	9	5	5	0	0
Downstream	10770	15540	10690	15780	9959	24230	21420	8564	2589	329	17	6	3	0	1
Downstream	11180	15820	10540	15860	10120	23950	21670	8410	2609	313	13	9	1	0	0
Downstream	11020	15630	10970	16050	10070	23950	21750	8756	2631	315	13	12	0	0	0
Downstream	11270	15930	10770	16200	10180	24130	21640	8543	2715	311	15	6	2	1	0
Downstream-Bkg	6	1	1	0	0	0	1	0	0	0	0	0	0	0	0
Downstream-Bkg	10	5	2	0	0	0	1	0	0	0	0	0	0	0	0
Downstream-Bkg	3	1	0	0	0	1	0	0	0	0	0	0	0	0	0
Downstream-Bkg	3	2	0	0	0	0	1	0	0	0	0	0	0	0	0
Downstream-Bkg	6	0	0	2	0	0	0	0	0	0	0	0	0	0	0
Meas. Penetration	0.98	0.97	0.98	0.97	0.96	0.94	0.91	0.77	0.46	0.15	0.05	0.02	0.01	0.00	0.00

#23, Polyester Bag Loaded

Particle Counts per Indicated OPC Channel (1.25-Minute Samples @ 7.1 L/min)

OPC Channel Number	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
Upstream-Bkg	2	1	2	0	0	0	0	0	0	0	0	0	0	0	0
Upstream-Bkg	6	4	0	0	0	0	0	0	0	0	0	0	0	0	0
Upstream-Bkg	9	7	0	0	1	1	0	0	0	0	0	0	0	0	0
Upstream-Bkg	8	3	0	1	1	0	0	0	0	0	0	0	0	0	0
Upstream-Bkg	5	1	0	0	0	0	0	0	0	0	0	0	0	0	0
Upstream	12150	17590	12050	17990	11490	28080	26370	11930	6097	2225	247	384	193	101	65
Upstream	11990	17360	11860	17340	10990	27120	25860	12010	6038	2102	244	388	207	105	62
Upstream	11890	17130	11590	17090	11010	26980	25310	11700	5895	2069	250	387	223	89	72
Upstream	11610	17060	11430	17100	10840	26430	25320	11510	5888	2084	263	384	203	104	82
Upstream	11470	16700	11040	16370	10610	25700	24200	11410	5842	2025	210	400	203	92	80
Upstream	11730	16740	11350	16960	10860	26280	24910	11460	5680	2015	248	386	198	75	70
Upstream	11510	16620	11080	16760	10620	25790	24700	11340	5742	2010	219	382	202	75	51
Upstream	11160	16380	11170	16500	10480	25600	24260	11050	5708	1970	212	367	182	84	56
Upstream	11190	16000	11070	16210	10370	25550	23750	10950	5586	2065	205	391	209	112	71
Upstream	11290	16460	11090	16710	10450	25320	24270	11080	5480	2000	215	390	164	106	67
Upstream-Bkg	7	4	2	0	0	2	2	1	1	0	0	0	0	0	0
Upstream-Bkg	7	6	0	2	1	4	1	1	1	0	0	0	0	0	0
Upstream-Bkg	2	3	0	0	1	0	1	0	1	0	0	0	0	0	0
Upstream-Bkg	3	1	1	0	1	0	0	0	0	0	0	0	0	0	0
Upstream-Bkg	6	1	1	1	0	1	0	2	0	0	0	0	0	0	0
Downstream-Bkg	7	0	0	1	0	0	0	0	0	0	0	0	0	0	0
Downstream-Bkg	4	4	1	1	0	1	0	1	0	0	0	0	0	0	0
Downstream-Bkg	4	2	1	0	2	0	0	1	0	0	0	0	0	0	0
Downstream-Bkg	9	4	2	0	0	1	1	0	0	0	0	0	0	0	0
Downstream-Bkg	5	8	1	1	0	1	0	0	0	0	0	0	0	0	0
Downstream	11950	16960	11370	17130	10540	25470	23340	9143	2618	208	4	4	0	0	0
Downstream	11690	16880	11440	17020	10630	25620	23240	8998	2615	210	3	6	0	0	1
Downstream	11650	16680	11280	16780	10570	25150	22900	8739	2541	230	1	4	0	0	0
Downstream	11620	16780	11490	16850	10400	25300	23390	8957	2579	239	6	5	0	0	0
Downstream	11040	16190	11070	16300	10120	24550	22460	8545	2410	231	0	0	0	0	0
Downstream	11280	16310	10990	16100	10280	24680	22480	8733	2485	204	5	3	1	0	0
Downstream	11440	16000	10920	16090	10150	24350	22120	8543	2389	199	3	3	0	0	0
Downstream	11250	16200	10830	16240	10320	24450	22240	8504	2558	232	4	3	1	2	0
Downstream	11410	15730	10850	15850	10010	24170	22030	8397	2500	197	7	3	1	0	0
Downstream	11260	16230	10880	16020	10160	24400	22200	8608	2487	221	3	2	2	0	0
Downstream-Bkg	8	4	0	2	0	1	3	0	0	0	0	0	0	0	0
Downstream-Bkg	5	2	2	0	0	1	1	1	0	0	0	0	0	0	0
Downstream-Bkg	4	1	0	1	1	0	1	0	0	0	0	0	0	0	0
Downstream-Bkg	1	2	3	3	0	2	2	0	0	0	0	0	0	0	0
Downstream-Bkg	1	5	1	0	1	2	1	0	0	0	0	0	0	0	0
Meas. Penetration	0.99	0.98	0.98	0.97	0.96	0.94	0.91	0.76	0.43	0.11	0.02	0.01	0.00	0.00	0.00

#23, Polyester Bag Loaded

Particle Counts per Indicated OPC Channel (1.25-Minute Samples @ 7.1 L/min)

OPC Channel Number	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
Upstream-Bkg	2	1	2	0	0	0	0	0	0	0	0	0	0	0	0
Upstream-Bkg	6	4	0	0	0	0	0	0	0	0	0	0	0	0	0
Upstream-Bkg	9	7	0	0	1	1	0	0	0	0	0	0	0	0	0
Upstream-Bkg	8	3	0	1	1	0	0	0	0	0	0	0	0	0	0
Upstream-Bkg	5	1	0	0	0	0	0	0	0	0	0	0	0	0	0
Upstream	12150	17590	12050	17990	11490	28080	26370	11930	6097	2225	247	384	193	101	65
Upstream	11990	17360	11860	17340	10990	27120	25860	12010	6038	2102	244	388	207	105	62
Upstream	11890	17130	11590	17090	11010	26980	25310	11700	5895	2069	250	387	223	89	72
Upstream	11610	17060	11430	17100	10840	26430	25320	11510	5888	2084	263	384	203	104	82
Upstream	11470	16700	11040	16370	10610	25700	24200	11410	5842	2025	210	400	203	92	80
Upstream	11730	16740	11350	16960	10860	26280	24910	11460	5680	2015	248	386	198	75	70
Upstream	11510	16620	11080	16760	10620	25790	24700	11340	5742	2010	219	382	202	75	51
Upstream	11160	16380	11170	16500	10480	25600	24260	11050	5708	1970	212	367	182	84	56
Upstream	11190	16000	11070	16210	10370	25550	23750	10950	5586	2065	205	391	209	112	71
Upstream	11290	16460	11090	16710	10450	25320	24270	11080	5480	2000	215	390	164	106	67
Upstream-Bkg	7	4	2	0	0	2	2	1	1	0	0	0	0	0	0
Upstream-Bkg	7	6	0	2	1	4	1	1	1	0	0	0	0	0	0
Upstream-Bkg	2	3	0	0	1	0	1	0	1	0	0	0	0	0	0
Upstream-Bkg	3	1	1	0	1	0	0	0	0	0	0	0	0	0	0
Upstream-Bkg	6	1	1	1	0	1	0	2	0	0	0	0	0	0	0
Downstream-Bkg	7	0	0	1	0	0	0	0	0	0	0	0	0	0	0
Downstream-Bkg	4	4	1	1	0	1	0	1	0	0	0	0	0	0	0
Downstream-Bkg	4	2	1	0	2	0	0	1	0	0	0	0	0	0	0
Downstream-Bkg	9	4	2	0	0	1	1	0	0	0	0	0	0	0	0
Downstream-Bkg	5	8	1	1	0	1	0	0	0	0	0	0	0	0	0
Downstream	11950	16960	11370	17130	10540	25470	23340	9143	2618	208	4	4	0	0	0
Downstream	11690	16880	11440	17020	10630	25620	23240	8998	2615	210	3	6	0	0	1
Downstream	11650	16680	11280	16780	10570	25150	22900	8739	2541	230	1	4	0	0	0
Downstream	11620	16780	11490	16850	10400	25300	23390	8957	2579	239	6	5	0	0	0
Downstream	11040	16190	11070	16300	10120	24550	22460	8545	2410	231	0	0	0	0	0
Downstream	11280	16310	10990	16100	10280	24680	22480	8733	2485	204	5	3	1	0	0
Downstream	11440	16000	10920	16090	10150	24350	22120	8543	2389	199	3	3	0	0	0
Downstream	11250	16200	10830	16240	10320	24450	22240	8504	2558	232	4	3	1	2	0
Downstream	11410	15730	10850	15850	10010	24170	22030	8397	2500	197	7	3	1	0	0
Downstream	11260	16230	10880	16020	10160	24400	22200	8608	2487	221	3	2	2	0	0
Downstream-Bkg	8	4	0	2	0	1	3	0	0	0	0	0	0	0	0
Downstream-Bkg	5	2	2	0	0	1	1	1	0	0	0	0	0	0	0
Downstream-Bkg	4	1	0	1	1	0	1	0	0	0	0	0	0	0	0
Downstream-Bkg	1	2	3	3	0	2	2	0	0	0	0	0	0	0	0
Downstream-Bkg	1	5	1	0	1	2	1	0	0	0	0	0	0	0	0
Meas. Penetration	0.99	0.98	0.98	0.97	0.96	0.94	0.91	0.76	0.43	0.11	0.02	0.01	0.00	0.00	0.00

#24, No Filter

Particle Counts per Indicated OPC Channel (1.25-Minute Samples @ 7.1 L/min)

OPC Channel Number	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
Upstream-Bkg	3	3	0	0	1	0	0	0	0	0	0	0	0	0	0
Upstream-Bkg	5	3	1	0	0	2	0	2	0	0	0	0	0	0	0
Upstream-Bkg	2	1	0	1	0	0	0	0	1	0	0	0	0	0	0
Upstream-Bkg	2	3	0	0	0	0	0	0	0	0	0	0	0	0	0
Upstream-Bkg	5	3	1	3	0	0	0	0	0	0	0	0	0	0	0
Upstream	12190	17860	12120	17970	11540	28020	26780	12370	6210	2202	248	402	244	100	74
Upstream	12030	17480	11940	17400	11060	27490	25410	12120	6137	2112	240	407	228	96	75
Upstream	11940	17530	11740	17250	11120	27470	25340	11900	6194	2145	245	374	221	123	64
Upstream	11540	16490	11210	17180	10610	25470	25690	11760	6227	2190	227	382	223	117	73
Upstream	11390	16680	11370	16870	10860	25860	25940	11870	6056	2218	274	413	216	101	72
Upstream	11230	16750	11190	16310	10430	25900	24140	11280	5659	2044	244	394	217	97	67
Upstream	11420	16940	11180	16620	10630	26320	24680	11410	5824	2095	233	388	213	88	55
Upstream	11630	16820	11570	16970	10780	26410	24820	11490	5828	2022	253	398	191	107	70
Upstream	11190	16010	10730	16410	10420	24760	25400	11450	5777	2258	245	421	212	102	78
Upstream	11050	16020	10860	16470	10340	24160	25370	11350	5944	2181	257	421	199	105	75
Upstream-Bkg	8	3	2	0	1	3	2	2	0	1	0	1	0	0	0
Upstream-Bkg	3	5	3	0	2	3	2	0	0	0	0	0	0	0	0
Upstream-Bkg	5	2	1	2	1	4	0	0	0	0	0	0	0	0	0
Upstream-Bkg	4	5	2	1	0	4	4	0	0	0	0	0	0	0	0
Upstream-Bkg	7	1	2	1	0	0	1	0	0	0	0	0	0	0	0
Downstream-Bkg	4	3	0	0	1	0	0	0	0	0	0	0	0	0	0
Downstream-Bkg	8	6	0	0	1	0	0	0	0	0	0	0	0	0	0
Downstream-Bkg	8	4	0	0	0	0	0	0	0	0	0	0	0	0	0
Downstream-Bkg	5	5	1	0	0	0	2	0	0	0	0	0	0	0	0
Downstream-Bkg	2	1	0	0	0	0	1	0	3	0	0	0	0	0	0
Downstream	11950	17900	11970	17690	11310	27710	26470	12150	6217	2232	272	412	243	110	79
Downstream	12150	17700	11940	17690	11220	27750	26030	12120	6157	2206	250	375	201	103	73
Downstream	11920	17350	11600	17480	11070	26320	26670	12330	6162	2369	248	372	214	107	63
Downstream	11480	16770	11230	17040	10710	25830	25910	12030	6179	2235	260	475	225	128	80
Downstream	11330	16220	11290	16900	10810	25460	25620	11790	6065	2126	282	425	243	106	82
Downstream	11610	16650	11520	16870	10770	26330	24610	11540	5956	1997	246	391	229	101	64
Downstream	11610	16880	11400	16660	10830	26380	24530	11340	5903	2150	247	396	219	95	60
Downstream	11220	16590	11230	16660	10590	25870	24400	11260	5659	2011	248	386	199	93	62
Downstream	11080	16070	11080	16290	10550	24420	25340	11500	5920	2112	247	398	227	110	70
Downstream	10950	16080	10740	16170	10390	23920	24960	11410	5885	2189	265	411	236	110	79
Downstream-Bkg	8	3	2	3	0	1	2	1	0	0	0	0	0	0	0
Downstream-Bkg	4	4	5	4	1	2	3	0	0	0	0	0	0	0	0
Downstream-Bkg	10	10	0	1	2	1	2	0	1	0	0	0	0	0	0
Downstream-Bkg	5	0	1	1	2	3	0	0	0	0	0	0	0	0	0
Downstream-Bkg	5	3	1	0	0	0	0	3	0	0	0	0	0	0	0
Meas. Penetration	1.00	1.00	1.00	1.00	1.00	0.99	1.00	1.00	1.00	1.01	1.04	1.01	1.03	1.03	1.01

TECHNICAL REPORT DATA
(Please read Instructions on the reverse before completing)

1. REPORT NO. EPA-600/R-97-011	2.	3. RECIPIENT'S ACCESSION NO.
4. TITLE AND SUBTITLE Fractional Penetration of Paint Overspray Arrestors		5. REPORT DATE February 1997
		6. PERFORMING ORGANIZATION CODE
7. AUTHOR(S) Charles H. Darvin		8. PERFORMING ORGANIZATION REPORT NO.
9. PERFORMING ORGANIZATION NAME AND ADDRESS See Block 12		10. PROGRAM ELEMENT NO.
		11. CONTRACT/GRANT NO. NA (Inhouse)
12. SPONSORING AGENCY NAME AND ADDRESS **EPA, Office of Research and Development Air Pollution Prevention and Control Division Research Triangle Park, NC 27711**		13. TYPE OF REPORT AND PERIOD COVERED Final;
		14. SPONSORING AGENCY CODE **EPA/600/13**

15. SUPPLEMENTARY NOTES Project Officer is Charles H. Darvin, Mail Drop 61, 919/541-7633. Tests performed by J. Hanlet and D. Smith of Research Triangle Institute (RTP, NC 27709) under EPA Cooperative Agreement CR 817083.

16. ABSTRACT The report describes the development of fractional penetration curves for liquid droplet penetration of overspray arrestors for discrete droplet diameters from 0.3 to 10 micrometers. (NOTE: Fine particulate are particles with diameters of 10 micrometers or less.) These data points were obtained for two conditions: (1) for a clean arrestor, and (2) for an arrestor coated with paint. The paint was applied to the arrestor by spraying high solids baking enamel from a spray gun directed at the paint overspray arrestor with the air flowing at a face velocity of 120 fpm (0.61 m/sec). Paint overspray arrestors tested can be grouped into three generic designs. This work demonstrated that, for the conditions of the tests, the behavior of the paint overspray arrestor is peculiar to the design of the arrestor. The program also defined the efficiency of the test method used to define the fractional penetration. The results indicate that, with the five different arrestor systems tested, the 50% cutoff diameter ranged from 3 to 7 micrometers. The two-stage polyester bag system showed the smallest cutoff diameter at about 3 micrometers. The inertial separator system designs exhibited the greatest cutoff level at about 7 micrometers.

17. KEY WORDS AND DOCUMENT ANALYSIS

a. DESCRIPTORS	b. IDENTIFIERS/OPEN ENDED TERMS	c. COSATI Field/Group
Pollution	Pollution Prevention	13B
Spray Painting	Stationary Sources	13H
Filters	Fractional Penetration	14G
Drops (Liquids)	Overspray Arrestors	07D
Penetration		

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