

US EPA ARCHIVE DOCUMENT

# Environmental Technology Verification Report

Paint Overspray Arrestor  
Columbus Industries  
SL-46B

US EPA ARCHIVE DOCUMENT

Prepared by



Research Triangle Institute

Under a Cooperative Agreement with



U.S. Environmental Protection Agency

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# **Environmental Technology Verification Report**

## **Paint Overspray Arrestor**

### **Columbus Industries SL-46B**

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EPA Cooperative Agreement CR 826152-01-2

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March 2000

**Notice**

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### Availability of Verification Statement and Report

Copies of the public Verification Statement and Verification Report are available from the following:

1. **Research Triangle Institute**

P.O. Box 12194

Research Triangle Park, NC 27709-2194

Web site: <http://etv.rti.org/apct/index.html>

or <http://www.epa.gov/etv> (*click on partners*)

2. **USEPA / APPCD**

MD-4

Research Triangle Park, NC 27711

Web site: <http://www.epa.gov/etv/library.htm> (*electronic copy*)

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### Abstract

Paint overspray arrestors (POAs) were evaluated by the Air Pollution Control Technology (APCT) pilot of the Environmental Technology Verification (ETV) Program. The performance factor verified was the particle filtration efficiency as a function of size for particles smaller than 10  $\mu\text{m}$ . The APCT ETV Program developed a generic verification protocol for testing filtration efficiency that is based on EPA Method 319. The protocol was developed by RTI, reviewed by a technical panel of experts, and approved by EPA. The protocol addresses several issues that Method 319 does not cover, including periodic testing, acquisition of POAs for testing, and product definition. A Test/Quality Assurance Plan was prepared which addresses the test procedure and quality assurance and quality control requirements for obtaining verification data of sufficient quantity and quality to satisfy the data quality objectives.

RTI performed tests on Columbus Industries's SL-46B during the period August 31-September 2, 1999. Filter efficiencies were determined. For ready comparison, the filtration efficiency requirements of the National Emission Standards for Hazardous Air Pollutants (NESHAP) are tabulated with the test results. The results indicate that the SL-46B met the NESHAP requirements for existing sources.

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**List of Abbreviations and Acronyms**

APCT	Air Pollution Control Technology
APPCD	Air Pollution Prevention and Control Division
ASME	American Society of Mechanical Engineers
cfm	cubic feet per minute
cm	centimeter
Diam.	Diameter
DQO	data quality objective
EPA	U.S. Environmental Protection Agency
ETV	Environmental Technology Verification
fpm	feet per minute
ft <sup>3</sup>	cubic foot
g	gram
Geo.	geometric
HEPA	high efficiency particulate air
ID	inside diameter
in.	inch
kW	kilowatt
L	liter
mL	milliliter
mm	millimeter
m/s	meters per second
NESHAP	National Emission Standards for Hazardous Air Pollutants
OPC	optical particle counter
Pa	pascal
POA	paint overspray arrestor
PSL	polystyrene latex
QA	quality assurance
RTI	Research Triangle Institute
s or sec	second
µm or um	micrometer

### Acknowledgments

RTI acknowledges the support of all those who helped plan and conduct the verification activities. In particular, we would like to thank Ted Brna, EPA Project Manager, and Paul Groff, EPA Quality Manager, of EPA's National Risk Management Research Laboratory in Research Triangle Park, NC. Finally we would like to acknowledge the assistance and participation of Mike Haufe of Columbus Industries.

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## SECTION 1 INTRODUCTION

The U. S. Environmental Protection Agency (EPA) has created the Environmental Technology Verification (ETV) Program to facilitate the deployment of innovative or improved technologies through performance verification and information dissemination. The ETV Program is intended to assist and inform those involved in the design, distribution, permitting, and purchase of environmental technologies.

The U.S. EPA's partner in the Air Pollution Control Technology (APCT) Program is Research Triangle Institute (RTI). The APCT Program, with the full participation of the technology developer, develops plans, conducts tests, collects and analyzes data, and reports findings. The evaluations are conducted according to a rigorous protocol and quality assurance and quality control oversight. The APCT Program verifies the performance of commercial-ready technologies used to control air pollutant emissions, with an emphasis on technologies for controlling particulate matter, volatile organic compounds, nitrogen oxides, and hazardous air pollutants. The Program develops standardized verification protocols and test plans, conducts independent testing of technologies, and prepares verification test reports and statements for broad dissemination.

## SECTION 2 VERIFICATION TEST DESCRIPTION

The paint overspray arrestor was tested in accordance with the APCT "Generic Verification Protocol for Paint Overspray Arrestors"<sup>1</sup> and the "Test/QA Plan for Paint Overspray Arrestors."<sup>2</sup> This protocol incorporates all requirements of EPA Method 319: Determination of Filtration Efficiency for Paint Overspray Arrestors. Method 319<sup>3</sup> is part of the National Emission Standards for Hazardous Air Pollutants (NESHAP) for Aerospace Manufacturing and Rework Facilities.<sup>4</sup> The protocol also includes requirements for quality management, quality assurance, procedures for product selection, auditing of the test laboratories, and reporting format.

Filtration efficiency was computed from aerosol concentrations measured upstream and downstream of an arrestor installed in a laboratory test rig. The aerosol concentrations upstream and downstream of the arrestors were measured with an aerosol analyzer that simultaneously counts and sizes the particles in the aerosol stream. The aerosol analyzer covered the particle diameter size range from 0.3 to 10  $\mu\text{m}$  in a series of contiguous sizing channels. Each sizing channel covered a narrow range of particle diameters. For example, channel 1 covered from 0.3 to 0.4  $\mu\text{m}$ , channel 2 from 0.4 to 0.5  $\mu\text{m}$ , and channel 15 from 7 to 10  $\mu\text{m}$ . Using the ratio of the downstream to upstream particle counts for each channel, the filtration efficiency was computed for each of the sizing channels.

The upstream and downstream aerosol measurements were made while a test aerosol was injected into the air stream upstream of the arrestor [ambient aerosol is first removed from the upstream air with high efficiency particulate air (HEPA) filters on the inlet of the test rig]. This test aerosol spanned the particle

size range from 0.3 to 10  $\mu\text{m}$  and provided a sufficient upstream concentration in each of the sizing channels to allow calculation of filtration efficiencies up to 99%.

The following series of tests were performed at a face velocity of 120 fpm (0.61 m/s):

- C Three arrestors were tested using a liquid-phase aerosol challenge,
- C Three arrestors were tested using a solid-phase aerosol challenge,
- C “No-filter” control tests (one performed prior to each arrestor test),
- C One HEPA filter control test, and
- C One reference filter control test.

The test series is exhibited in Table 5. Additional details on the test procedure are provided in Appendix A.

**TABLE 5. TEST SERIES**

RTI Test No.	TYPE OF TEST				Challenge Aerosol
	No-Filter	Test Arrestor	HEPA Filter	Reference Filter	
08319905	X				Solid-Phase
08319906				X	
09019901	X				
09019902		X			
09019903	X				
09019904		X			
09019905	X				
09019906		X			
08319904			X		
09019907	X				Liquid-Phase
09019908		X			
09029902	X				
09029903		X			
09029904	X				
09029905		X			

## 2.1 SELECTION OF PAINT OVERSPRAY ARRESTORS FOR TESTING

The test arrestors (SL-46B) were supplied to the test laboratory directly from the manufacturer (Columbus Industries) with a letter signed by Donald Christopher, Director of Sales, attesting that the 12 arrestors were selected at random in an unbiased manner from a stock of over 100 similar arrestors.

### SECTION 3 DESCRIPTION OF ARRESTOR

As shown in Figure 1 (page iii), the Columbus SL-46B is a 2-pocket bag filter with nominal dimensions of 24 x 24 x 15 in. (0.61 x 0.61 x 0.38 m). The arrestor has an internal frame, and the filter media color is white upstream and blue downstream. The individual arrestors are not labeled, but the box has a label stating the company name and model number. There is no label indication of the flow direction or filter orientation, so the industry standard orientation with the bags extended horizontally in the direction of the airflow and the individual bags side-by-side, as opposed to stacked vertically, was used in the tests.

### SECTION 4 VERIFICATION OF PERFORMANCE

#### 4.1 QUALITY ASSURANCE

The verification tests were conducted in accordance with an approved Test/Quality Assurance (QA) Plan.<sup>2</sup> The EPA Quality Manager conducted an independent assessment of the test laboratory in August 1999 and found that the test laboratory was being operated as specified in the Test/QA Plan. Additionally, APCT Quality Assurance staff have reviewed the results of this test and have found that the results meet data quality objectives in the Test/QA Plan. Certificates of Calibration for the optical particle counter and the airflow reference devices are provided in Appendix B.

#### 4.2 RESULTS

Tables 6 and 7 and Figures 2 through 5 summarize the fractional filtration efficiency measurements for the solid- and liquid-phase tests. Upstream and downstream particle count data for each test are provided in Appendix C.

The initial (new condition) pressure drop across each test arrestor at the 120 fpm (0.61 m/s) test velocity [for a flowrate of 480 cfm (0.23 m<sup>3</sup>/s)] is shown in Table 8. The pressure drop across the tested arrestors was 0.05 in. H<sub>2</sub>O (12 Pa) for each of the six arrestors tested.

Tables 1-4 (page iv) present the filtration efficiency requirements of the Aerospace NESHAP and the corresponding efficiencies measured for the tested arrestor system. The test results indicate that the tested arrestor met the requirements listed in Tables 1 and 2 for existing sources but not those listed in Tables 3 and 4 for new sources.

### 4.3 LIMITATIONS AND APPLICATIONS

This verification report addresses two aspects of paint overspray arrestor performance: filtration efficiency and pressure drop. Users of this technology may wish to consider other performance parameters such as service life and cost when selecting a paint overspray arrestor for their use.

In accordance with the generic verification protocol, this Verification Statement is applicable to paint overspray arrestors manufactured between the publication date of the Verification Statement and 12 months thereafter.

As stated in Section 1.3 of Method 319<sup>3</sup>, "for a paint arrestor system or subsystem which has been tested by this method, adding additional filtration devices to the system or subsystem shall be assumed to result in an efficiency of at least that of the original system without additional testing."

### SECTION 5 REFERENCES

1. Generic Verification Protocol for Paint Overspray Arrestors, Research Triangle Institute, Research Triangle Park, NC, August 1999.
2. Test/QA Plan for Paint Overspray Arrestors, Research Triangle Institute, Research Triangle Park, NC, February 1999.
3. Method 319: Determination of Filtration Efficiency for Paint Overspray Arrestors. *Code of Federal Regulations*, Appendix A to 40 CFR Part 63.
4. National Emission Standards for Hazardous Air Pollutants for Aerospace Manufacturing and Rework Facilities. *Code of Federal Regulations*, Title 40, Part 63, Subpart GG (40 CFR 63.741).

TABLE 6. SUMMARY OF SOLID-PHASE TEST RESULTS

		Filtration Efficiency (%) at Indicated Size Range														
OPC Channel Number		1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
Min. Diam. (um)		0.45	0.59	0.73	0.80	1.02	1.44	1.86	2.28	2.85	3.13	4.25	5.66	7.07	7.77	9.88
Max. Diam. (um)		0.59	0.73	0.80	1.02	1.44	1.86	2.28	2.85	3.13	4.25	5.66	7.07	7.77	9.88	14.10
Geo. Mean Diam (um)		0.52	0.66	0.77	0.90	1.21	1.64	2.06	2.55	2.98	3.65	4.91	6.33	7.41	8.76	11.81
Columbus SL-46B Bag Filter																
Run #1	09019902	42	46	50	53	59	64	70	76	81	85	92	96	98	98	99
Run #2	09019904	42	46	50	53	58	64	70	75	81	85	91	96	97	98	99
Run #3	09019906	39	43	47	50	56	61	67	73	79	83	90	95	98	98	98
Average		41	45	49	52	57	63	69	75	80	84	91	96	98	98	99
Interpolated Efficiency Values (%) for Existing Source Criteria:																
	2.60 um (> 10% required):	75														
	5.00 um (> 50% required):	92														
	8.10 um (> 90% required):	98														
Interpolated Efficiency Values (%) for New Source Criteria:																
	0.70 um (> 75% required):	46														
	1.10 um (> 85% required):	56														
	2.50 um (> 95% required):	74														
HEPA Filter Control Test (applicable to both solid and liquid phase conditions)																
Run #1	08319904	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100
Reference Filter QA Test																
Current	08319906	-2	-1	-1	0	0	1	2	6	11	18	39	67	79	87	93
Baseline	08279902	-1	1	1	3	3	3	5	8	12	20	41	66	77	86	92
Difference		-2	-1	-1	-3	-3	-2	-3	-1	-1	-1	-2	1	2	0	1
Acceptable (<10)		yes	yes	yes	yes	yes	yes	yes	yes	yes	yes	yes	yes	yes	yes	yes
"No Filter" Control Tests																
		Penetration For Each Size Range														
Run #1	09019901	1.01	1.01	1.00	1.01	1.02	1.00	1.01	0.99	0.99	0.99	0.99	0.99	0.95	0.95	0.93
Run #2	09019903	1.00	1.00	0.99	1.01	1.01	1.01	1.01	0.99	0.99	1.00	0.99	1.00	0.97	0.99	0.97
Run #3	09019905	1.01	1.02	1.01	1.01	1.02	1.00	1.01	1.00	1.01	1.01	1.00	0.99	1.02	0.95	0.93

TABLE 7. SUMMARY OF LIQUID- PHASE TEST RESULTS

OPC Channel Number	Filtration Efficiency (%) at Indicated Size Range															
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	
Min. Diam. (um)	0.28	0.37	0.47	0.52	0.66	0.94	1.22	1.51	1.88	2.07	2.83	3.77	4.71	5.18	6.60	
Max. Diam. (um)	0.37	0.47	0.52	0.66	0.94	1.22	1.51	1.88	2.07	2.83	3.77	4.71	5.18	6.60	9.43	
Geo. Mean Diam (um)	0.32	0.418	0.49	0.58	0.78	1.07	1.36	1.68	1.97	2.42	3.26	4.21	4.94	5.85	7.89	
Columbus SL-46B Bag Filter																
Run #1	09019908	32	34	35	36	41	47	52	61	67	72	80	90	94	95	98
Run #2	09029903	30	32	34	35	39	45	51	59	66	71	79	89	93	96	98
Run #3	09029905	29	31	33	33	39	45	50	58	65	70	79	88	94	95	97
Average		30	33	34	35	40	45	51	59	66	71	80	89	94	95	98
Interpolated Efficiency Values (%) for Existing Source Criteria:																
	2.20 um (> 10% required):	68														
	4.10 um (> 50% required):	88														
	5.70 um (> 90% required):	95														
Interpolated Efficiency Values (%) for New Source Criteria:																
	0.42 um (> 65% required):	33														
	1.00 um (> 80% required):	44														
	2.00 um (> 95% required):	66														
"No Filter" Control Tests																
		Penetration For Each Size Range														
Run #1	09019907	1.00	1.00	1.00	0.99	1.01	1.00	0.99	1.00	1.00	1.00	1.01	1.02	1.04	0.93	0.97
Run #2	09029902	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.01	1.03	1.04	1.06	1.01	1.03
Run #3	09029904	1.00	1.00	1.00	1.00	1.00	1.01	0.99	0.98	0.98	0.98	1.01	0.99	1.06	0.98	0.98



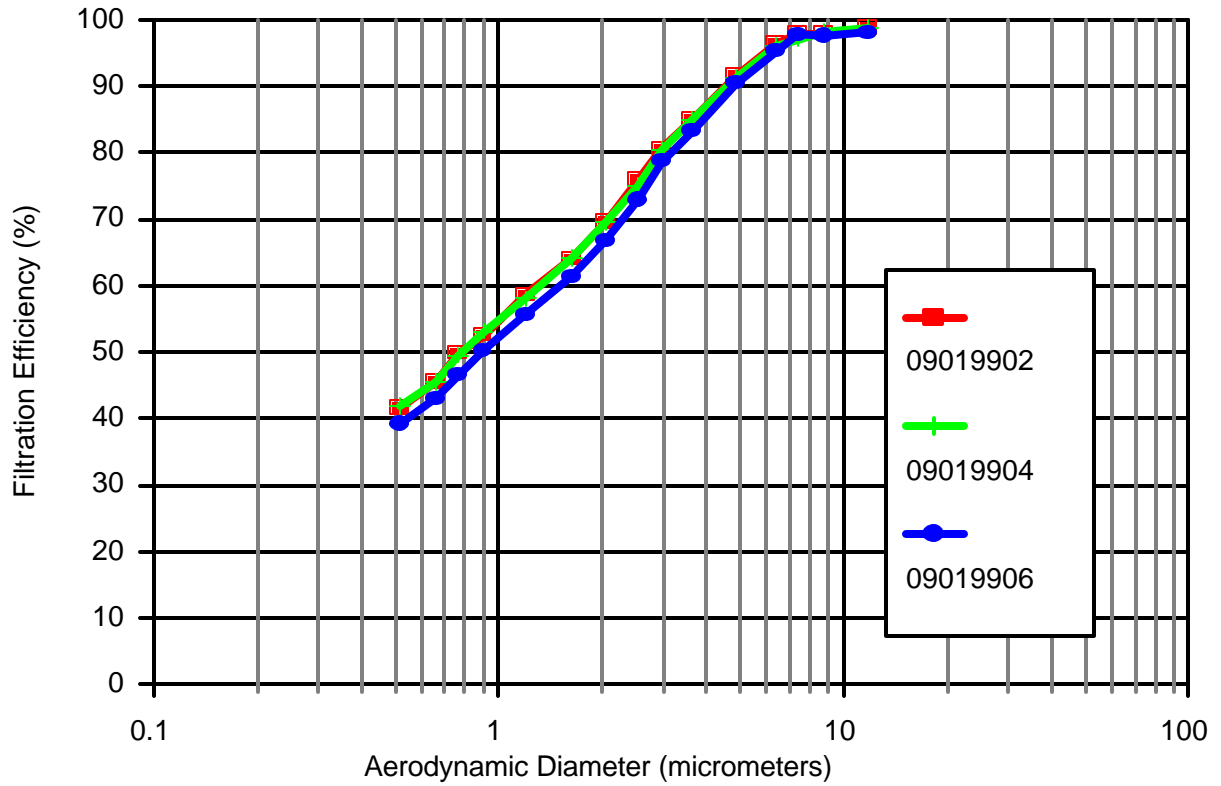


Figure 2. Triplicate solid-phase particle removal efficiency curves for Columbus SL-46B paint overspray arrestor.

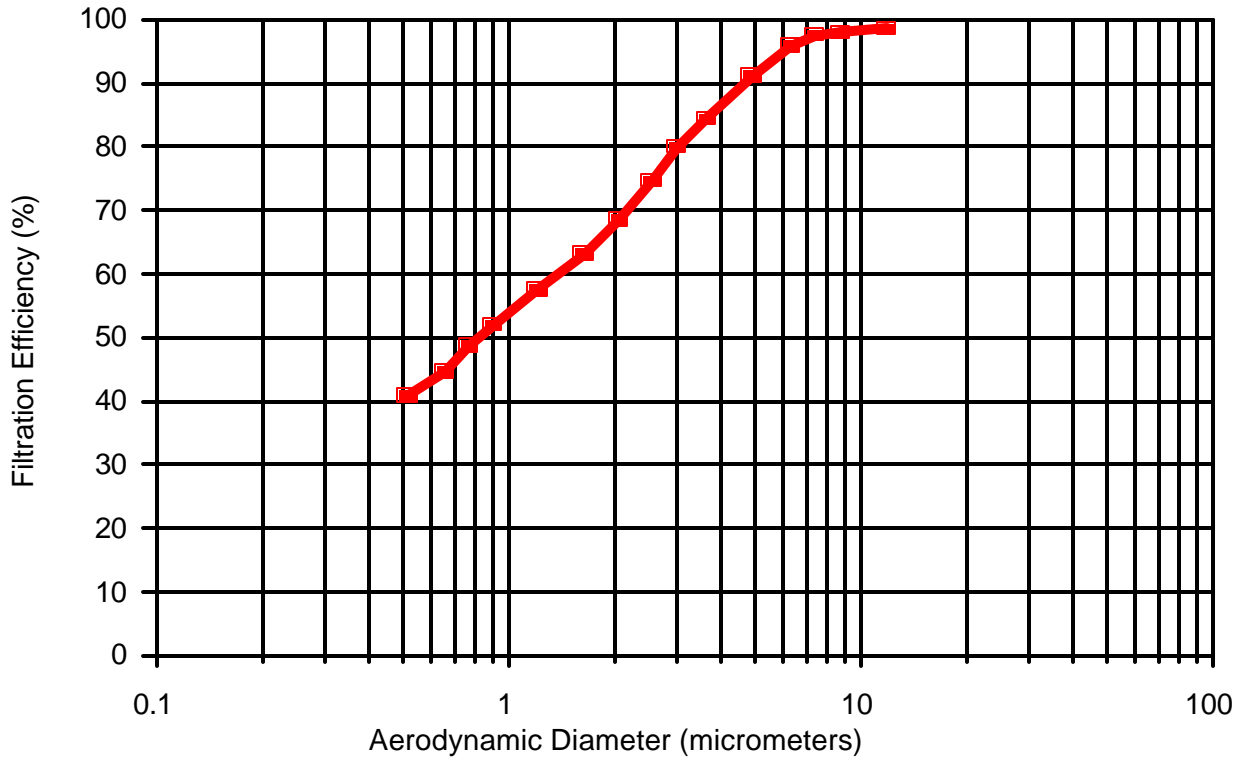


Figure 3. Average of the solid-phase particle removal efficiency curves for Columbus SL-46B paint overspray arrestor.

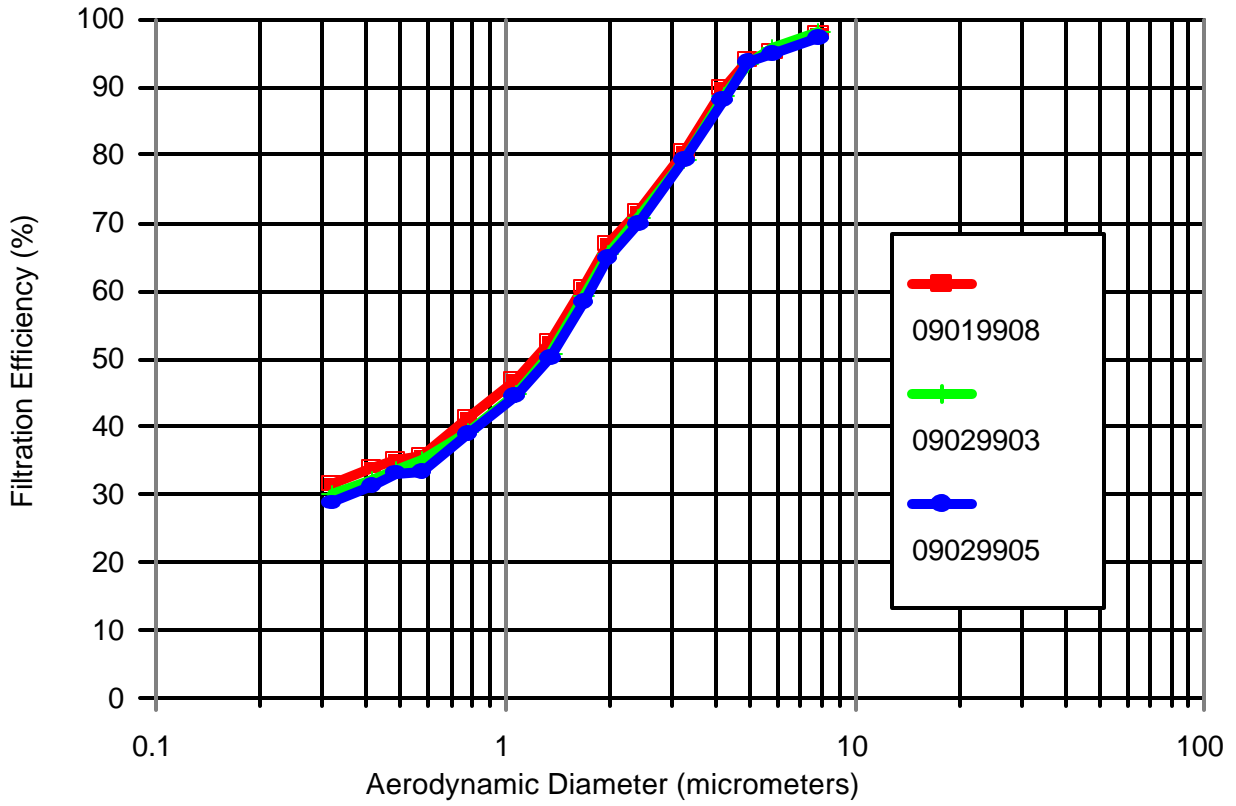


Figure 4. Triplicate liquid-phase particle removal efficiency curves for Columbus SL-46B paint overspray arrestor.

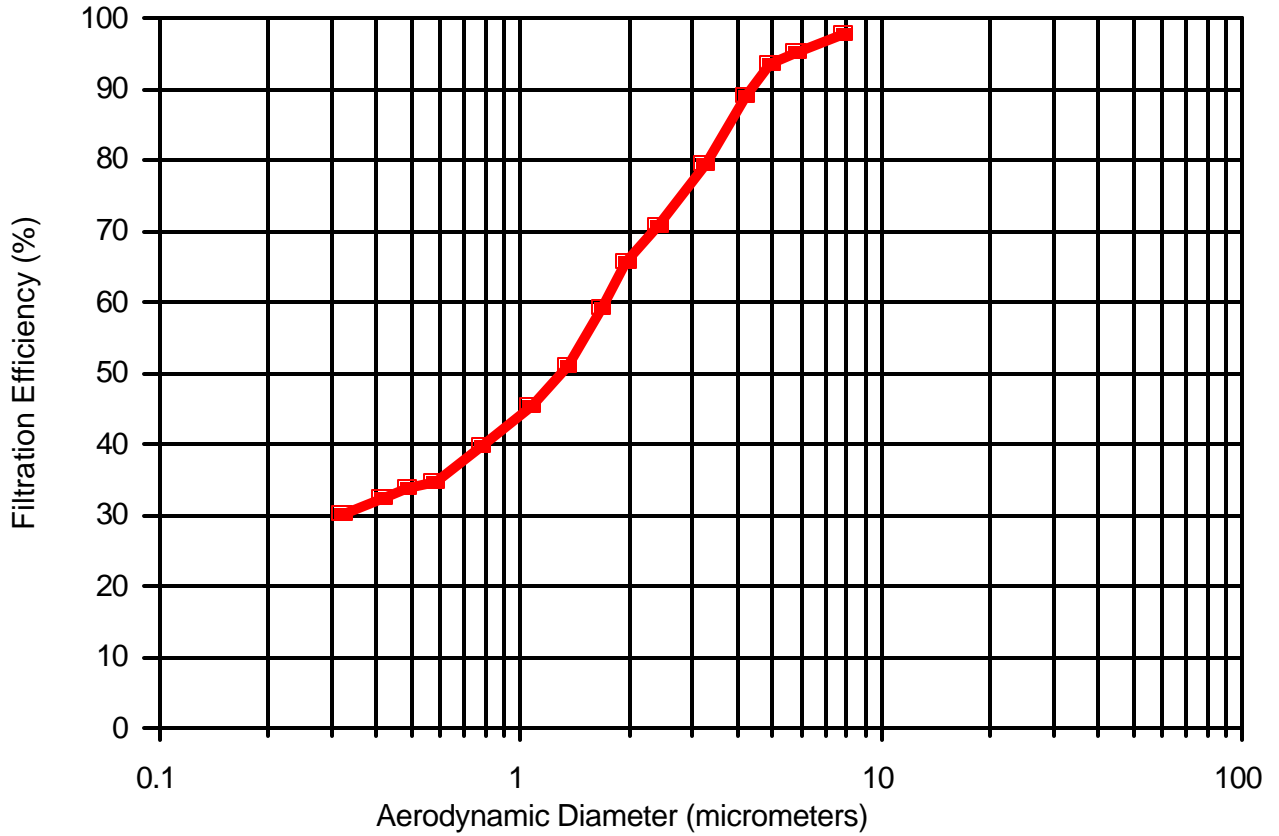


Figure 5. Average of the liquid-phase particle removal efficiency curves for Columbus SL-46B paint overspray arrestor.

**TABLE 4**  
**SUMMARY OF PRESSURE DROP MEASUREMENTS**

Test No.	Initial Pressure Drop (inch H <sub>2</sub> O)	Initial Pressure Drop (Pa)
09019902	0.05	12
09019904	0.05	12
09019906	0.05	12
09019908	0.05	12
09029903	0.05	12
09029905	0.05	12

**TABLE 5. EXISTING SOURCES\***  
**LIQUID-PHASE CHALLENGE AEROSOL PARTICLES**

<b>Aerodynamic particle diameter range, <math>\mu\text{m}</math></b>	<b>Filtration efficiency requirement, %</b>	<b>Filtration efficiency achieved, %</b>
> 5.7	> 90	95
> 4.1	> 50	88
> 2.2	> 10	68

**TABLE 6. EXISTING SOURCES\***  
**SOLID-PHASE CHALLENGE AEROSOL PARTICLES**

<b>Aerodynamic particle diameter range, <math>\mu\text{m}</math></b>	<b>Filtration efficiency requirement, %</b>	<b>Filtration efficiency achieved, %</b>
> 8.1	> 90	98
> 5.0	> 50	92
> 2.6	> 10	75

**TABLE 7. NEW SOURCES\***  
**LIQUID-PHASE CHALLENGE AEROSOL PARTICLES**

<b>Aerodynamic particle diameter range, <math>\mu\text{m}</math></b>	<b>Filtration efficiency requirement, %</b>	<b>Filtration efficiency achieved, %</b>
> 2.0	> 95	66
> 1.0	> 80	44
> 0.42	> 65	33

**TABLE 8. NEW SOURCES\***  
**SOLID-PHASE CHALLENGE AEROSOL PARTICLES**

<b>Aerodynamic particle diameter range, <math>\mu\text{m}</math></b>	<b>Filtration efficiency requirement, %</b>	<b>Filtration efficiency achieved, %</b>
> 2.5	> 95	74
> 1.1	> 85	56
> 0.70	> 75	46

\* A new source is any affected source that commenced construction after October 29, 1996. An existing source is any affected source that is not new.

## Appendix A

### DESCRIPTION OF THE TEST RIG AND METHODOLOGY

#### TEST DUCT

The tests were conducted in RTI's air cleaner test facility (Figure A-1). The test rig's ducting was primarily of 24 x 24 in. (0.61 x 0.61m) cross section and made of 14-gauge stainless steel. The blower is rated at 15 hp (11 kW) with a flow capacity of 3000 cfm (1.4 m<sup>3</sup>/s) at 13 in. H<sub>2</sub>O (3200 Pa). The inlet and outlet filter banks consist of two 24 x 24 x 2 in. (0.61 x 0.61 x 0.05 m) prefilters and two 24 x 24 x 12 in. (0.61 x 0.61 x 0.30 m) high efficiency particulate air (HEPA) filters rated at 2000 cfm (0.9 m<sup>3</sup>/s) each. The system operates at positive pressure to minimize infiltration of room air.

To mix the test aerosol with the air stream, an orifice plate and mixing baffle were located immediately downstream of the aerosol injection point and upstream of the test arrestor. An identical orifice plate and mixing baffle were added after the 180° bend. The latter downstream orifice served two purposes. It straightened out the flow after going around the bend, and it mixed any aerosol that penetrated the air cleaning device. Mixing the penetrating aerosol with the air stream is necessary to obtain a representative downstream aerosol measurement.

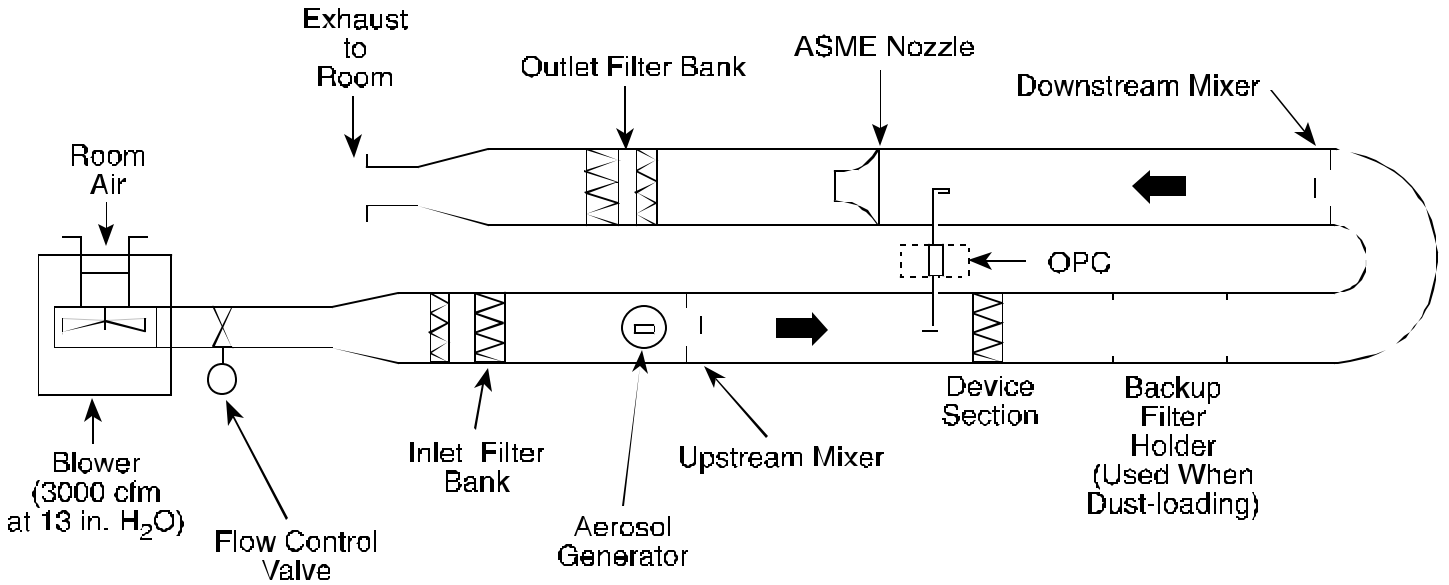
#### AIRFLOW

Airflow was measured with a 4.00 in. (0.102 m) ID American Society of Mechanical Engineers (ASME) flow nozzle. The nominal velocity through the arrestor was computed by dividing the volumetric flow by the nominal face area of the device. Airflow was manually controlled by a 14 in. (0.36 m) diameter butterfly valve.

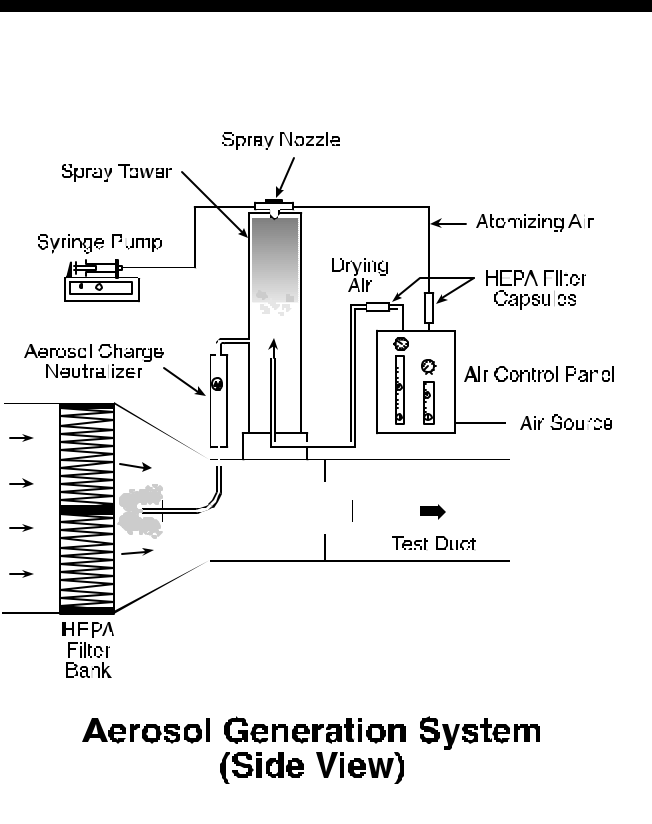
#### OPTICAL PARTICLE COUNTER (OPC)

Aerosol concentrations were measured with a Climet Instruments Model 226 OPC. This OPC uses a white-light illumination source and has a wide collection angle for the scattered light. The OPC's sampling rate was 0.25 cfm (0.00012 m<sup>3</sup>/s).

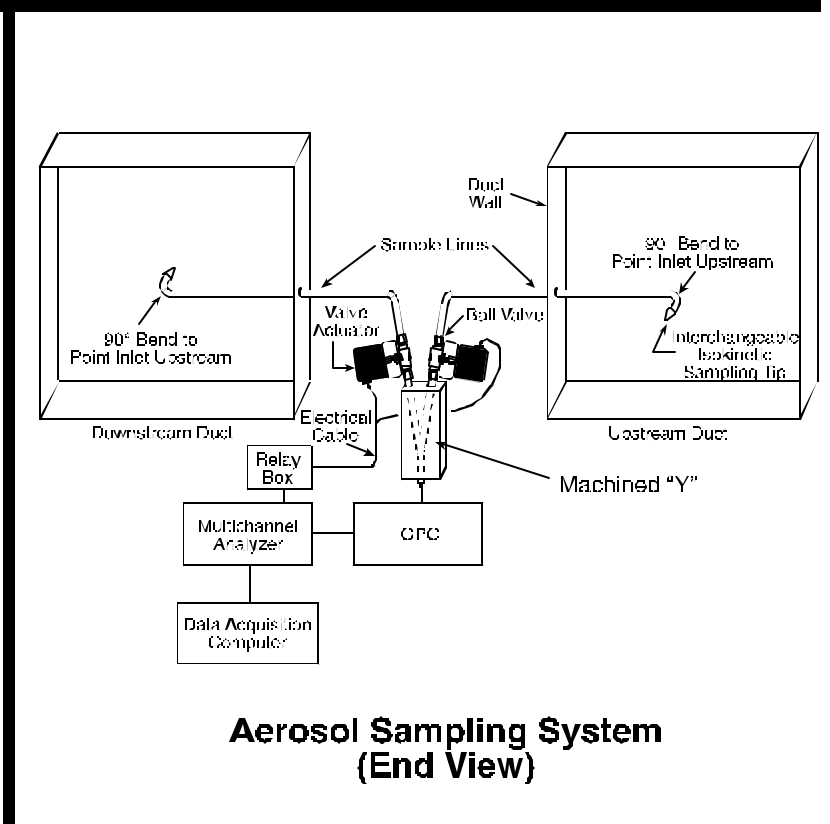
The output of the OPC was input to a Climet Instruments Model 8040 multichannel analyzer equipped with Model 05872005 and 05872006 input boards. These boards provide 16 sizing channels covering the range from 0.3 to 10 µm. The 8040 was also equipped with a Model CI-298 sequential interface board. This interface provides a contact closure at the end of each sample and also provides a 15-sec delay in particle counting after each sample. The contact closure was used to control the operation of electromechanical valve actuators in the upstream and downstream sample lines. The 15-sec delay allows time for the new sample to be acquired.



Overview of Test Duct Configuration (Top View)



Aerosol Generation System (Side View)



Aerosol Sampling System (End View)

Figure A-1. Schematic illustration of the fractional efficiency test rig.



## AEROSOL GENERATION

Two types of challenge aerosols were used: liquid- and solid-phase. The selection of liquid- or solid-phase challenge aerosol particles is important because, for some types of paint arrestors, significantly different filtration efficiencies will be achieved depending upon the phase of the challenge aerosol particles. (This is due to particle "bounce" associated with solid-phase particles.) The liquid-phase challenge aerosol is oleic acid, a non-toxic, low-volatility liquid. The solid-phase aerosol is potassium chloride (KCl) generated from an aqueous solution. KCl was selected as the solid-phase aerosol because of its relatively high water solubility, high deliquescence humidity (85% relative humidity), known crystalline structure (facilitates complete drying), and low toxicity. The KCl solution was prepared by combining 0.66 lb (300 g) of KCl with 0.035 ft<sup>3</sup> (1 L) of distilled water. Both oleic acid and KCl are compatible with accurate measurement by the OPC.

The oleic acid or the KCl solution was nebulized using a two-fluid (air and liquid) air atomizing nozzle (Spray Systems 1/4 J siphon spray nozzle) as illustrated in Figure A-1 (aerosol generation system). The nozzle was positioned at the top of a 12 in. (0.30 m) diameter, 51 in. (1.3 m) tall transparent acrylic spray tower. The tower served two purposes. It allowed the salt droplets to dry by providing an approximate 40 sec mean residence time, and it allowed larger-sized particles (of either KCl or oleic acid) to fall out of the aerosol. After generation, the aerosol passed through a TSI Model 3054 aerosol neutralizer (Kr-85 radioactive source) to neutralize any electrostatic charge on the aerosol (electrostatic charging is an unavoidable consequence of most aerosol-generation methods).

The KCl solution or oleic acid was fed to the atomizing nozzle at 1.2 mL/min by means of a pump. Varying the operating air pressure of the generator allows control of the output aerosol concentration.

## AEROSOL SAMPLING SYSTEM

The aerosol sampling lines were 0.55 in. (14 mm) ID stainless steel lines and used gradual bends [radius of curvature = 2.25 in. (57 mm)] when needed. These dimensions were chosen to minimize particle losses in the sample lines. A custom-made "Y" fitting connected the upstream and downstream lines to the OPC. The two branches of the "Y" merged gradually to minimize particle loss in the intersection of the "Y" due to centrifugal or impaction forces.

Immediately above the "Y," electrically actuated ball valves were installed in each branch (Parker Model EA Electro-Mechanical Valve Actuator). The opening and closing of the valves were automatically controlled by the OPC's sequential sampling interface board. The valves take approximately 2 sec to complete an opening or closing maneuver.

Isokinetic sampling nozzles of the appropriate entrance diameter were placed on the ends of the sample probes to maintain isokinetic sampling for all the test flow rates.

## TEST PROCEDURES

The aerosol penetration of the test device was calculated from the average of 10 upstream and 10 downstream samples taken sequentially (i.e., one upstream, one downstream, one upstream, one downstream, . . . until 10 each were obtained). This sequential sampling scheme was selected to minimize the effect of aerosol generator variability. Each sample was 2 minutes in duration. The sampling also included background upstream and downstream measurements at the beginning and end of each test. The test sequence was as follows:

1. Warm up OPC and install proper sample tips for isokinetic sampling.
2. Install air cleaner test device and bring test duct to desired flow rate.
3. With the aerosol generator off, obtain one measurement each of the upstream and downstream background particle counts.
4. Turn on the aerosol generator and allow it to run for a minimum of 10 minutes to stabilize.
5. After the stabilization period, obtain 10 upstream and 10 downstream particle counts using a repeated upstream-downstream sampling sequence until 10 each are obtained.
6. Turn off the aerosol generator. Wait 10 minutes, then obtain one additional upstream and downstream background measurement.

## CONTROL TESTS

In addition to evaluating the test arrestor, 0 and 100% penetration control tests and a reference filter control test were conducted to ensure that reliable measurements are obtained. The 100% penetration test was a relatively stringent test of the adequacy of the overall duct, sampling, measurement and aerosol generation system. These tests were performed as normal penetration tests except that the paint arrestor was not used. A perfect system would yield a measured penetration of 1 at all particle sizes. Deviations from 1 can occur due to particle losses in the duct, differences in the degree of aerosol uniformity (i.e., mixing) at the upstream and downstream probes, and differences in particle-transport efficiency in the upstream and downstream sampling lines. Results from the 100% penetration tests were used during data analysis to correct penetration measurements obtained during the arrestor tests.

The 0% penetration test was performed by using a HEPA filter rather than a paint arrestor. This test confirmed the adequacy of the instrument response time and sample line lag. The 0% penetration test was performed on a monthly basis.

The reference filter control test consisted of performing a solid-phase efficiency test on the same filter during each ETV test. The reference filter data from each test were compared to the original, baseline reference filter data to determine if there was any substantial change in the test system between the tests.

## DATA ANALYSIS

### *Nomenclature*

- P = Penetration corrected for  $P_{100}$  value
- D = Downstream particle count
- $D_b$  = Downstream background count
- U = Upstream particle count
- $U_b$  = Upstream background count
- $P_{100}$  = 100% penetration value determined from the control tests
- Overbar: denotes arithmetic mean of quantity

Analysis of each test involves the following quantities:

- !  $P_{100}$  value for each sizing channel from the blank (no-filter) test,
- ! 2 upstream background values,
- ! 2 downstream background values,
- ! 10 upstream values with aerosol generator on, and
- ! 10 downstream values with aerosol generator on.

Using the values associated with each sizing channel, the penetration associated with each particle sizing channel was calculated as:

$$P = \{(\bar{D} - \bar{D}_b) / (\bar{U} - \bar{U}_b)\} / P_{100} .$$

Filtration efficiency was then calculated as:

$$\text{Filtration Efficiency (\%)} = 100 (1 - P).$$

### DEFINITION OF PARTICLE DIAMETER

Over the 0.3 to 10  $\mu\text{m}$  diameter size range, the "aerodynamic" particle diameter is often of more significance than the physical diameter (as measured by the OPC) relative to aerosol filtration and aerosol deposition within the human respiratory tract. The aerodynamic diameter ( $D_{\text{Aero}}$ ) is related to the physical diameter ( $D_{\text{Physical}}$ ) by:

$$D_{\text{Aero}} = D_{\text{Physical}} \sqrt{\frac{\rho_{\text{Particle}}}{\rho_o} \frac{CCF_{\text{Physical}}}{CCF_{\text{Aero}}} \frac{1}{X}}$$

where

$\rho_{\text{Particle}}$  is the density of the particle in  $\text{g/cm}^3$ .

$\rho_o$  is unit density of 1  $\text{g/cm}^3$ .

$CCF_{\text{Physical}}$  is the Cunningham Correction Factor at  $D_{\text{Physical}}$ .

$CCF_{\text{Aero}}$  is the Cunningham Correction Factor at  $D_{\text{Aero}}$ .

$X$  is the dynamic shape factor.

Note: due to the interdependence of  $D_{\text{aero}}$  and  $CCF_{\text{Aero}}$ , the equation is solved iteratively.

For oleic acid droplets having a density of 0.89  $\text{g/cm}^3$  and being spherical ( $X = 1$ ), the aerodynamic diameter will be about 6% smaller than the measured diameter.

KCl has a density of 1.98  $\text{g/cm}^3$ . The KCl particles form from the evaporation of aqueous solution droplets. Because KCl has an inherent cubic crystalline structure, it is expected that the KCl particles will be cubic or relatively compact cubic clusters; however, their actual shape, or range of shapes, is unknown. Because the shape factor is unknown, the shape factor for KCl is assigned a value of 1 and the diameter is termed the "nominal" aerodynamic diameter.

The aerodynamic diameters associated with the 15 OPC sizing channels are tabulated in Table A-1 for oleic acid and KCl. Also listed is the physical diameter size range for each channel based on the manufacturer's calibration curve using monodisperse polystyrene latex (PSL) spheres.

**Table A-1. Physical and Aerodynamic Sizing Channels  
for the Calibration and Test Aerosols**

	Particle Diameter Size Range ( $\mu\text{m}$ )*		
	PSL	OLEIC ACID	KCl
OPC Channel Number	Physical Diameter	Aerodynamic Diameter	Nominal Aerodynamic Diameter
1	0.3 - 0.4	0.28 - 0.37	0.45 - 0.59
2	0.4 - 0.5	0.37 - 0.47	0.59 - 0.73
3	0.5 - 0.55	0.47 - 0.52	0.73 - 0.80
4	0.55 - 0.7	0.52 - 0.66	0.80 - 1.02
5	0.7 - 1.0	0.66 - 0.94	1.02 - 1.44
6	1.0 - 1.3	0.94 - 1.22	1.44 - 1.86
7	1.3 - 1.6	1.22 - 1.51	1.86 - 2.28
8	1.6 - 2	1.51 - 1.88	2.28 - 2.85
9	2 - 2.2	1.88 - 2.07	2.85 - 3.13
10	2.2 - 3	2.07 - 2.83	3.13 - 4.25
11	3 - 4	2.83 - 3.77	4.25 - 5.66
12	4 - 5	3.77 - 4.71	5.66 - 7.07
13	5 - 5.5	4.71 - 5.18	7.07 - 7.77
14	5.5 - 7	5.18 - 6.60	7.77 - 9.88
15	7 - 10	6.60 - 9.43	9.88 - 14.1

\*The particle diameter size ranges are defined as greater than the indicated lower limit and less than or equal to the indicated upper limit.

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**APPENDIX B**  
**Certificates of Calibration**

# Certificate of Traceability

**8500D-II THERMOANEMOMETER**

Model No. 8500D-II      Serial No. 3810      Part No. 634493200

Certificate Number: 1946      Date: 28-Oct-88      P.O. 00328      Order/RMA: 104638  
 Customer Number:

*The following standards and equipment were used as references for this calibration.*

Tested By	Date Tested	Inst. No.	Cal. Due	Calibration Standards Information	
				MI ST Test Numbers	Customer Number
LOZADA	10/23/88	747	4/9/00	259340; 257602; 258905; 258659; 262222; 811255622	
		746	4/3/00	811255622; 811280176	
		922	5/9/00	538723847-58	
		881	11/10/88	811257079 ; 247770 ; 253406 ; 811255474 ; 253669 U3N22730C ; Chem. Const. ; 254227 ; 811256730 ; 811251992 ; 251971 ; 811251741 ; 811253662 ; 811256210 ; 811802 ; 536259947-58 ; ;	
		857	5/9/00		
		784	3/18/09		
		888	2/21/00	811256765 ; 251971 ; 811259004-88 ; 811257773 ; 255216 ; ;	
		359	11/12/88	P-8531A ; P-8531B ; 38128 ; 25-1160 ; 255332 ;	
		326	2/9/90	P-8531A ; P-8531B ; 38128 ; 254160 ; 255009 ;	
		319	11/12/88	P-8531A ; P-8531B ; 38128 ; 25-1160 ; 255332 ;	
		321	12/11/88	856257123-56 ; ;	

Alnor Instrument Company hereby certifies that the above designated equipment was found to meet or exceed manufacturing specifications. Their calibration is traceable to the National Institute of Standards and Technology (NIST) or related physical constants. This policy and procedures used comply with MIL-STD-4655A. This certificate shall not be reproduced except in full, without the written consent of Alnor.

Reviewed by: 

Date: 28-Oct-88

**ALNOR**  
**A T S P C o m p a n y**  
 Alnor Instrument Company  
 7555 N. Under Avenue, Skokie, IL 60077  
 Tel. 847-577-3500 Fax. 847-677-3539





FILE NO. 040FB:001-19  
PAGE 1 OF 1

LETTER OF CERTIFICATION  
LAMINAR FLOW ELEMENT

CUSTOMER NAME: RESEARCH TRIANGLE INST  
CUSTOMER ORDER NUMBER: 00161  
MERIAM ORDER NUMBER: 772900

Meriam Instrument certifies that the completed LFE unit has been calibrated and correlated at several points of flow rate using a Meriam Standard, which is controlled per the calibration system requirements of ANSI Z540-1 and traceable to the National Institute of Standards and Technology. The collective uncertainty of the measurement standards has a 1:1 ratio to the acceptable tolerance for the flow rate being calibrated.

The total rss uncertainty of the completed laminar flow unit is +/- .72 % of reading.

CUSTOMER ID NO.: 013716

MODEL NO.: 50MH10-8 SERIAL NO.: 758860-K1

FLOW CURVE/TABLE NO.: 30624

DATE OF CALIBRATION 11-11-1998 BY GEORGE ROBOTKAY

AS RECEIVED CONDITION:  In Tolerance  Out of Tolerance  NA

AS LEFT CONDITION :  In Tolerance  Out of Tolerance  NA

CALIBRATION INTERVAL: TO BE DETERMINED BY CUSTOMER BASED ON USAGE OF LFE.

FLOW STANDARD SERIAL NO.	DATE OF LAST CAL	DATE OF NEXT CAL
WMMC2-6	JAN 1998	JAN 1999

The LFE unit listed hereon has been successfully calibrated in accordance with Meriam Instrument Procedure A-35822.

Michael V. [Signature]  
QUALITY ASSURANCE INSPECTOR  
MERIAM INSTRUMENT

Jack Weigand [Signature]  
QUALITY ASSURANCE MANAGER  
MERIAM INSTRUMENT

**CLIMET INSTRUMENTS COMPANY**

1320 WEST COLTON AVE., REDLANDS, CA 92374 • PHONE: (909) 793-2788 • FAX: (909) 793-1738

**CERTIFICATE OF CALIBRATION****INSTRUMENT CALIBRATED**MODEL: 226 aerosol particle counter, S/N 61882CONTROL NUMBER: LCS23102DATE CALIBRATED: 8/19/99 NEXT CALIBRATION: 2/19/2000RECOMMENDED CALIBRATION INTERVAL: 6 monthsL. Sparks  
CALIBRATED BYJohn R. Guster  
APPROVED BY**TRACEABILITY STATEMENT**

This instrument has been calibrated in accordance with ISO 10012-1/ANSI Z540-1 (which replaces MIL-STD-45662A) and relevant portions of Federal Standards 209, ASTM F-50, F322, and F328.

Temperature and Relative Humidity are not controlled during calibration because of the wide operating range of the instrument. The operating limits of this instrument are:

TEMPERATURE: 30°F TO 122°F  
HUMIDITY: 0-100%, non-condensing

All test equipment used in the calibration of Climet Instruments' products is calibrated at six-month intervals by an outside calibration service. Calibration certificates for each piece of test equipment are on file at Climet; copies will be supplied if requested.

Calibration traceability to a National Measurement Standard (NMS) is established by using mono-disperse latex spheres as a calibration standard. These spheres are sized by methods traceable, by lot number, to the National Institute of Science and Technology.



**APPENDIX C**  
**Fractional Efficiency Data Sheets**

Key to notation used in the following tables:

Diam.:	Particle Diameter (µm)
Geo.:	Geometric
U. Bckgrnd:	The upstream background particle counts measured with the aerosol generator off.
Upstream:	The upstream particle counts measured with the aerosol generator on.
D. Bckgrnd:	The downstream background particle counts measured with the aerosol generator off.
Downstream:	The downstream particle counts measured with the aerosol generator on.
Meas. Penetration:	The penetration computed as:

$$\text{Meas. Penetration} = \frac{(\text{Downstream} \& \text{D. Bckgrnd})}{(\text{Upstream} \& \text{U. Bckgrnd})}$$

P100 Correction Values:	Penetration values measured with no filter in the test section. These values are used to correct subsequent penetration measurements for particle losses within the test duct and sampling system.
Corrected Penetration:	The measured penetration corrected by the P100 values:

$$\text{Corrected Penetration} = \frac{\text{Meas. Penetration}}{\text{P100 Correction Values}}$$

Corrected Efficiency (%):	100 x ( 1 - Corrected Penetration )
DQO	Data Quality Objective

Test No. 08319905  
 No Filter  
 Solid-Phase

Particle Counts per Indicated OPC Channel (1-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)	0.45	0.59	0.73	0.80	1.02	1.44	1.86	2.28	2.85	3.13	4.25	5.66	7.07	7.77	9.88
Max. Diam. (um)	0.59	0.73	0.80	1.02	1.44	1.86	2.28	2.85	3.13	4.25	5.66	7.07	7.77	9.88	14.10
Geo. Mean Diam (um)	0.52	0.66	0.77	0.90	1.21	1.64	2.06	2.55	2.98	3.65	4.91	6.33	7.41	8.76	11.81

ENTER DATA BELOW

U. Bckgrnd	1	01	08-31-1999	14:59:10	01:00	0	0	0	0	0	0	0	0	0	0	0				
Upstream	1	01	08-31-1999	15:07:03	01:00	10370	15750	4882	8816	13400	7912	10600	11080	2687	5886	3247	1096	196	308	194
Upstream	1	01	08-31-1999	15:09:33	01:00	10380	15600	4987	8793	13390	8106	10450	11180	2714	5835	3378	1149	175	312	187
Upstream	1	01	08-31-1999	15:12:03	01:00	10650	15730	5131	8807	13620	8191	10410	11140	2703	5916	3441	1095	220	308	229
Upstream	1	01	08-31-1999	15:14:33	01:00	10640	16030	5129	9227	13960	8221	10840	11250	2735	6029	3499	1168	194	326	183
Upstream	1	01	08-31-1999	15:17:03	01:00	10940	15800	5085	9056	13800	8412	10710	11460	2730	5849	3369	1160	211	300	225
Upstream	1	01	08-31-1999	15:19:33	01:00	10460	15910	4990	8819	13480	8162	10660	11340	2675	5885	3334	1184	223	316	219
Upstream	1	01	08-31-1999	15:22:03	01:00	9885	15090	4634	8351	12910	7824	10120	10980	2655	5778	3492	1254	196	331	206
Upstream	1	01	08-31-1999	15:24:33	01:00	10230	15730	5097	8913	13650	8061	10460	11550	2877	6122	3603	1303	213	336	248
Upstream	1	01	08-31-1999	15:27:03	01:00	10340	15290	4868	8967	13670	8102	10290	11450	2900	6002	3546	1285	233	348	257
Upstream	1	01	08-31-1999	15:29:33	01:00	10450	15610	5053	8870	13840	8021	10460	11430	2948	6074	3621	1313	209	346	200
U. Bckgrnd	1	01	08-31-1999	15:42:22	01:00	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0

ENTER DATA BELOW

D. Bckgrnd	2	01	08-31-1999	15:00:25	01:00	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0
Downstream	2	01	08-31-1999	15:08:18	01:00	10520	15630	4955	8923	13290	7829	10390	11140	2589	5884	3388	1109	190	273	196
Downstream	2	01	08-31-1999	15:10:48	01:00	10410	15920	5153	8849	13720	8127	10640	11150	2634	5853	3460	1092	163	261	194
Downstream	2	01	08-31-1999	15:13:18	01:00	10990	16090	5044	9325	14270	8277	10840	11300	2719	5760	3360	1095	189	292	220
Downstream	2	01	08-31-1999	15:15:48	01:00	10960	16240	4987	9458	14370	8519	11050	11440	2738	6018	3505	1128	177	313	176
Downstream	2	01	08-31-1999	15:18:18	01:00	10690	16090	5177	9203	14030	8425	10860	11440	2787	6088	3573	1191	190	318	179
Downstream	2	01	08-31-1999	15:20:48	01:00	10230	15400	5015	8934	13730	8106	10560	11250	2788	5840	3443	1185	206	312	170
Downstream	2	01	08-31-1999	15:23:18	01:00	10510	15800	5018	9089	13930	8090	10720	11710	2934	6293	3773	1245	215	329	219
Downstream	2	01	08-31-1999	15:25:48	01:00	10360	15250	4938	9070	13860	8239	10880	11370	2908	6085	3805	1246	195	357	213
Downstream	2	01	08-31-1999	15:28:18	01:00	10770	16080	5300	9429	14420	8570	11160	11940	3042	6307	3813	1236	190	302	195
Downstream	2	01	08-31-1999	15:30:48	01:00	10740	16000	4976	9378	14570	8515	11020	11730	2848	6242	3800	1295	210	380	200
D. Bckgrnd	2	01	08-31-1999	15:43:37	01:00	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

Meas. Penetration	1.02	1.01	1.01	1.03	1.03	1.02	1.03	1.01	1.01	1.02	1.04	0.98	0.93	0.97	0.91
P100 correction values	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Corrected Penetration	1.02	1.01	1.01	1.03	1.03	1.02	1.03	1.01	1.01	1.02	1.04	0.98	0.93	0.97	0.91
Corrected Efficiency (%)	-2	-1	-1	-3	-3	-2	-3	-1	-1	-2	-4	2	7	3	9

Data Acceptance Criteria:

Total Challenge Counts for Each Channel:	104345	156540	49856	88619	135720	81012	105000	112860	27624	59376	34530	12007	2070	3231	2148
Data Quality Objective:	> 500	> 500	> 500	> 500	> 500	> 500	> 500	> 500	> 500	> 500	> 500	> 500	> 500	> 500	> 500
Does this meet DQO:	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes

Standard Deviation of Penetration for Each Channel :	0.04	0.03	0.04	0.04	0.04	0.04	0.03	0.03	0.06	0.04	0.07	0.09	0.11	0.12	0.13
Data Quality Objective:	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.30	<0.30	<0.30	<0.30	<0.30	<0.30
Does this meet DQO:	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes

Maximum observed particle concentration (#/cc):	18.6
Data Quality Objective: max. allowable conc. (#/cc):	< 23
Does this meet the DQO:	Yes, (applies to all channels)

Test No. 08319906

Reference  
Solid-Phase

Particle Counts per Indicated OPC Channel (1-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)	0.45	0.59	0.73	0.80	1.02	1.44	1.86	2.28	2.85	3.13	4.25	5.66	7.07	7.77	9.88
Max. Diam. (um)	0.59	0.73	0.80	1.02	1.44	1.86	2.28	2.85	3.13	4.25	5.66	7.07	7.77	9.88	14.10
Geo. Mean Diam (um)	0.52	0.66	0.77	0.90	1.21	1.64	2.06	2.55	2.98	3.65	4.91	6.33	7.41	8.76	11.81

ENTER DATA BELOW

U. Bckgrnd	1 01 08-31-1999 16:01:17 01:00	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Upstream	1 01 08-31-1999 16:07:52 01:00	10590	15890	4992	9003	14010	8197	10810	11670	2947	6204	3693	1230	205	333
Upstream	1 01 08-31-1999 16:10:22 01:00	10350	15700	4968	9027	13760	8112	10590	11780	2925	6142	3670	1252	220	323
Upstream	1 01 08-31-1999 16:12:52 01:00	10460	15650	4878	9084	13900	8106	10640	11690	2967	6164	3834	1322	234	394
Upstream	1 01 08-31-1999 16:15:22 01:00	10350	15330	5022	8885	13930	8075	10710	11400	2914	6112	3671	1260	227	364
Upstream	1 01 08-31-1999 16:17:52 01:00	10700	16170	5099	9369	14080	8326	10950	11860	3024	6389	3722	1300	248	346
Upstream	1 01 08-31-1999 16:20:22 01:00	10600	15710	4930	9030	14010	8355	10650	11700	2716	6141	3597	1231	187	365
Upstream	1 01 08-31-1999 16:22:52 01:00	9249	13520	4393	7789	12080	7181	9241	9778	2342	5126	2979	1065	172	318
Upstream	1 01 08-31-1999 16:25:22 01:00	10430	15870	5043	8905	13770	8287	10760	11190	2926	5931	3408	1176	186	329
Upstream	1 01 08-31-1999 16:27:52 01:00	10190	15450	4923	8870	13380	8016	10410	11140	2664	5821	3481	1092	207	305
Upstream	1 01 08-31-1999 16:30:22 01:00	10440	15640	5192	8973	13470	7918	10440	11100	2711	5689	3379	1191	196	309
U. Bckgrnd	1 01 08-31-1999 16:38:25 01:00	0	0	0	0	0	0	0	0	0	1	0	0	0	0

ENTER DATA BELOW

D. Bckgrnd	2 01 08-31-1999 16:02:32 01:00	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Downstream	2 01 08-31-1999 16:09:07 01:00	10050	15320	4863	8668	13330	7849	10220	10480	2546	4932	2226	394	42	35
Downstream	2 01 08-31-1999 16:11:37 01:00	10140	15350	4966	8820	13230	7761	10150	10640	2541	5013	2306	433	45	52
Downstream	2 01 08-31-1999 16:14:07 01:00	12710	15630	5014	8844	13410	7850	10250	10670	2538	5144	2226	431	43	52
Downstream	2 01 08-31-1999 16:16:37 01:00	10270	15390	5107	9116	14040	8151	10620	10950	2559	5089	2380	485	59	55
Downstream	2 01 08-31-1999 16:19:07 01:00	10520	15600	5023	9316	14400	8195	10420	11090	2613	4967	2290	450	42	40
Downstream	2 01 08-31-1999 16:21:37 01:00	10350	15940	4966	9177	14410	8255	10440	10850	2671	5110	2196	417	46	50
Downstream	2 01 08-31-1999 16:24:07 01:00	10680	16040	5091	9104	13980	8201	10540	10560	2455	4705	2127	410	28	42
Downstream	2 01 08-31-1999 16:26:37 01:00	10440	15620	5081	8880	13510	7863	10290	10600	2326	4720	2009	354	55	45
Downstream	2 01 08-31-1999 16:29:07 01:00	10380	15420	4900	8743	13410	7843	10150	10260	2382	4638	2018	339	41	38
Downstream	2 01 08-31-1999 16:31:37 01:00	10280	15420	4773	8711	13270	7808	10130	10140	2449	4489	1856	345	44	40
D. Bckgrnd	2 01 08-31-1999 16:39:40 01:00	0	0	0	0	0	0	0	0	0	0	0	0	0	0

Meas. Penetration	1.02	1.01	1.01	1.00	1.00	0.99	0.98	0.94	0.89	0.82	0.61	0.33	0.21	0.13	0.07
P100 correction values	1.02	1.01	1.01	1.03	1.03	1.02	1.03	1.01	1.01	1.02	1.04	0.98	0.93	0.97	0.91
Corrected Penetration	1.01	0.99	0.99	0.97	0.97	0.97	0.95	0.92	0.88	0.80	0.59	0.34	0.23	0.14	0.08
Corrected Efficiency (%)	-1	1	1	3	3	3	5	8	12	20	41	66	77	86	92

Data Acceptance Criteria:

Total Challenge Counts for Each Channel:	103359	154930	49440	88935	136390	80573	105201	113308	28136	59719	35434	12119	2082	3386	2254
Data Quality Objective:	> 500	> 500	> 500	> 500	> 500	> 500	> 500	> 500	> 500	> 500	> 500	> 500	> 500	> 500	> 500
Does this meet DQO:	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes

Standard Deviation of Penetration for Each Channel :	0.08	0.05	0.05	0.05	0.06	0.05	0.05	0.06	0.08	0.06	0.06	0.05	0.05	0.02	0.03
Data Quality Objective:	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.30	<0.30	<0.30	<0.30	<0.30	<0.30
Does this meet DQO:	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes

Maximum observed particle concentration (#/cc):	18.4
Data Quality Objective: max. allowable conc. (#/cc):	< 23
Does this meet the DQO:	Yes, (applies to all channels)

Test No. 09019901  
 No Filter  
 Solid-Phase

Particle Counts per Indicated OPC Channel (1-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)	0.45	0.59	0.73	0.80	1.02	1.44	1.86	2.28	2.85	3.13	4.25	5.66	7.07	7.77	9.88
Max. Diam. (um)	0.59	0.73	0.80	1.02	1.44	1.86	2.28	2.85	3.13	4.25	5.66	7.07	7.77	9.88	14.10
Geo. Mean Diam (um)	0.52	0.66	0.77	0.90	1.21	1.64	2.06	2.55	2.98	3.65	4.91	6.33	7.41	8.76	11.81

ENTER DATA BELOW

U. Bckgrnd	1	01	09-01-1999	09:04:01	01:00	0	0	0	0	0	0	0	0	0	0	0				
Upstream	1	01	09-01-1999	09:10:37	01:00	10810	16630	5286	9389	14050	8572	10940	11600	2752	6039	3691	1175	174	306	235
Upstream	1	01	09-01-1999	09:13:07	01:00	11670	17540	5507	9976	15260	8778	11600	11940	2854	6289	3684	1203	225	326	206
Upstream	1	01	09-01-1999	09:15:37	01:00	11490	17310	5388	9765	14990	8941	11460	11850	2773	6070	3561	1205	211	313	178
Upstream	1	01	09-01-1999	09:18:07	01:00	11580	17260	5626	9945	14960	8931	11700	11890	2764	6275	3723	1218	193	323	184
Upstream	1	01	09-01-1999	09:20:37	01:00	11180	16950	5413	9457	14320	8469	11240	11530	2797	5991	3594	1190	189	307	211
Upstream	1	01	09-01-1999	09:23:07	01:00	10840	16370	5130	9292	13860	8436	10850	11310	2669	5841	3559	1198	184	360	234
Upstream	1	01	09-01-1999	09:25:37	01:00	10450	15400	4977	8999	13710	8169	10650	11360	2746	6010	3617	1349	254	329	228
Upstream	1	01	09-01-1999	09:28:07	01:00	11130	16310	5295	9515	14440	8711	11140	12070	2992	6312	3978	1427	242	410	239
Upstream	1	01	09-01-1999	09:30:37	01:00	10400	15580	5122	9108	13830	8474	10690	11320	2811	6035	3628	1303	204	340	231
Upstream	1	01	09-01-1999	09:33:07	01:00	10590	15970	5066	9260	14530	8462	10850	11570	2774	6309	3810	1369	227	349	241
U. Bckgrnd	1	01	09-01-1999	09:43:23	01:00	1	1	0	1	3	1	3	0	0	1	0	0	0	0	0

ENTER DATA BELOW

D. Bckgrnd	2	01	09-01-1999	09:05:16	01:00	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Downstream	2	01	09-01-1999	09:11:52	01:00	11700	17400	5640	9967	15130	8870	11480	11950	2864	6137	3756	1230	216	307	176
Downstream	2	01	09-01-1999	09:14:22	01:00	12070	17680	5530	10090	15210	9180	11590	11840	2754	6169	3624	1188	184	290	200
Downstream	2	01	09-01-1999	09:16:52	01:00	11360	17260	5470	9883	15160	8870	11670	11620	2715	6018	3485	1208	181	295	191
Downstream	2	01	09-01-1999	09:19:22	01:00	11450	17220	5338	9764	14850	8817	11530	11560	2727	6071	3611	1179	170	309	195
Downstream	2	01	09-01-1999	09:21:52	01:00	11280	16890	5421	9385	14280	8397	11190	11520	2645	5827	3549	1205	204	310	204
Downstream	2	01	09-01-1999	09:24:22	01:00	11010	16180	5291	8995	14020	8279	10860	11070	2719	5726	3447	1203	201	296	179
Downstream	2	01	09-01-1999	09:26:52	01:00	10830	16190	5488	9489	14690	8578	11160	11820	2901	6452	3892	1313	229	330	226
Downstream	2	01	09-01-1999	09:29:22	01:00	10590	16000	4980	9238	14350	8470	10990	11470	2911	6233	3728	1322	212	350	224
Downstream	2	01	09-01-1999	09:31:52	01:00	10410	15430	4918	9142	14080	8232	10570	11090	2735	5885	3621	1329	199	349	212
Downstream	2	01	09-01-1999	09:34:22	01:00	10670	15970	4945	9317	14480	8543	10940	11380	2793	6062	3749	1323	201	343	224
D. Bckgrnd	2	01	09-01-1999	09:44:38	01:00	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

Meas. Penetration	1.01	1.01	1.00	1.01	1.02	1.00	1.01	0.99	0.99	0.99	0.99	0.99	0.99	0.99	0.95	0.95	0.93
P100 correction values	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Corrected Penetration	1.01	1.01	1.00	1.01	1.02	1.00	1.01	0.99	0.99	0.99	0.99	0.99	0.99	0.99	0.95	0.95	0.93
Corrected Efficiency (%)	-1	-1	0	-1	-2	0	-1	1	1	1	1	1	1	1	5	5	7

Data Acceptance Criteria:

Total Challenge Counts for Each Channel:	110140	165320	52810	94706	143950	85943	111120	116440	27932	61171	36845	12637	2103	3363	2187
Data Quality Objective:	> 500	> 500	> 500	> 500	> 500	> 500	> 500	> 500	> 500	> 500	> 500	> 500	> 500	> 500	> 500
Does this meet DQO:	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes

Standard Deviation of Penetration for Each Channel :	0.06	0.06	0.06	0.05	0.05	0.05	0.05	0.03	0.04	0.04	0.05	0.09	0.15	0.11	0.13
Data Quality Objective:	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.30	<0.30	<0.30	<0.30	<0.30	<0.30	<0.30
Does this meet DQO:	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes

Maximum observed particle concentration (#/cc):	19.4
Data Quality Objective: max. allowable conc. (#/cc):	<23
Does this meet the DQO:	Yes, (applies to all channels)

Test No. 09019902  
 Arrestor  
 Solid-Phase

Particle Counts per Indicated OPC Channel (1-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)	0.45	0.59	0.73	0.80	1.02	1.44	1.86	2.28	2.85	3.13	4.25	5.66	7.07	7.77	9.88
Max. Diam. (um)	0.59	0.73	0.80	1.02	1.44	1.86	2.28	2.85	3.13	4.25	5.66	7.07	7.77	9.88	14.10
Geo. Mean Diam (um)	0.52	0.66	0.77	0.90	1.21	1.64	2.06	2.55	2.98	3.65	4.91	6.33	7.41	8.76	11.81

ENTER DATA BELOW

U. Bckgrnd	1	01	09-01-1999	09:58:40	01:00	1	1	0	1	0	0	0	0	0	0	0				
Upstream	1	01	09-01-1999	10:05:14	01:00	10290	15710	4881	8697	12990	7763	10320	10660	2521	5489	3300	1106	203	286	195
Upstream	1	01	09-01-1999	10:07:44	01:00	10350	16000	5039	8832	13520	8139	10610	10910	2452	5567	3356	1161	192	313	206
Upstream	1	01	09-01-1999	10:10:14	01:00	10650	15830	5008	8973	13460	8005	10710	10910	2500	5668	3420	1205	185	314	231
Upstream	1	01	09-01-1999	10:12:44	01:00	10670	15790	4953	8854	13470	8136	10450	10500	2408	5550	3300	1126	191	291	199
Upstream	1	01	09-01-1999	10:15:14	01:00	10590	16010	5038	9021	13780	8359	10640	10980	2466	5741	3453	1124	183	312	234
Upstream	1	01	09-01-1999	10:17:44	01:00	10650	15500	4993	8867	13410	8037	10510	10840	2426	5547	3330	1148	195	285	212
Upstream	1	01	09-01-1999	10:20:14	01:00	8385	12720	4116	7259	11070	6717	8656	9230	2268	4835	3029	1097	169	300	203
Upstream	1	01	09-01-1999	10:22:44	01:00	10450	15360	4915	8867	13610	8190	10410	11100	2706	5899	3611	1191	211	313	243
Upstream	1	01	09-01-1999	10:25:14	01:00	10400	15150	4943	8915	13380	8041	10420	10900	2574	5731	3494	1233	205	353	217
Upstream	1	01	09-01-1999	10:27:44	01:00	10040	15500	4915	8663	13510	8149	10430	10990	2674	5781	3506	1283	199	330	224
U. Bckgrnd	1	01	09-01-1999	10:35:36	01:00	1	0	0	0	0	1	0	0	1	0	0	0	0	0	0

ENTER DATA BELOW

D. Bckgrnd	2	01	09-01-1999	09:59:55	01:00	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0
Downstream	2	01	09-01-1999	10:06:29	01:00	6091	8570	2462	4101	5445	2882	3223	2564	450	815	240	42	4	10	1
Downstream	2	01	09-01-1999	10:08:59	01:00	6300	8730	2629	4191	5807	2954	3249	2607	490	839	289	61	1	3	2
Downstream	2	01	09-01-1999	10:11:29	01:00	6083	8489	2399	4215	5508	2887	3147	2476	478	799	277	45	4	4	2
Downstream	2	01	09-01-1999	10:13:59	01:00	6035	8447	2382	4027	5277	2683	3154	2415	414	739	249	31	3	3	0
Downstream	2	01	09-01-1999	10:16:29	01:00	5930	8301	2380	4087	5590	2773	3052	2464	442	790	235	30	3	5	5
Downstream	2	01	09-01-1999	10:18:59	01:00	6001	8309	2333	4054	5439	2820	3022	2375	422	791	250	32	3	4	3
Downstream	2	01	09-01-1999	10:21:29	01:00	6145	8507	2545	4240	5553	2984	3207	2687	549	916	304	46	7	7	3
Downstream	2	01	09-01-1999	10:23:59	01:00	5854	8343	2518	4114	5603	2933	3262	2623	533	891	307	51	4	5	6
Downstream	2	01	09-01-1999	10:26:29	01:00	6106	8119	2484	4205	5628	2902	3135	2680	556	851	337	43	3	10	2
Downstream	2	01	09-01-1999	10:28:59	01:00	5921	8222	2438	4236	5616	2847	3139	2652	475	849	294	33	5	6	0
D. Bckgrnd	2	01	09-01-1999	10:36:51	01:00	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0

Meas. Penetration	0.59	0.55	0.50	0.48	0.42	0.36	0.31	0.24	0.19	0.15	0.08	0.04	0.02	0.02	0.01
P100 correction values	1.01	1.01	1.00	1.01	1.02	1.00	1.01	0.99	0.99	0.99	0.99	0.99	0.95	0.95	0.93
Corrected Penetration	0.58	0.54	0.50	0.47	0.41	0.36	0.30	0.24	0.19	0.15	0.08	0.04	0.02	0.02	0.01
Corrected Efficiency (%)	42	46	50	53	59	64	70	76	81	85	92	96	98	98	99

Data Acceptance Criteria:

Total Challenge Counts for Each Channel:	102475	153570	48801	86948	132200	79536	103156	107020	24995	55808	33799	11674	1933	3097	2164
Data Quality Objective:	> 500	> 500	> 500	> 500	> 500	> 500	> 500	> 500	> 500	> 500	> 500	> 500	> 500	> 500	> 500
Does this meet DQO:	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes

Standard Deviation of Penetration for Each Channel :	0.04	0.04	0.03	0.03	0.03	0.02	0.02	0.02	0.02	0.01	0.01	0.01	0.01	0.01	0.01
Data Quality Objective:	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.30	<0.30	<0.30	<0.30	<0.30	<0.30
Does this meet DQO:	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes

Maximum observed particle concentration (#/cc):	17.7
Data Quality Objective: max. allowable conc. (#/cc):	< 23
Does this meet the DQO:	Yes, (applies to all channels)

US EPA ARCHIVE DOCUMENT

Test No. 09019903  
 No Filter  
 Solid-Phase

Particle Counts per Indicated OPC Channel (1-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)	0.45	0.59	0.73	0.80	1.02	1.44	1.86	2.28	2.85	3.13	4.25	5.66	7.07	7.77	9.88
Max. Diam. (um)	0.59	0.73	0.80	1.02	1.44	1.86	2.28	2.85	3.13	4.25	5.66	7.07	7.77	9.88	14.10
Geo. Mean Diam (um)	0.52	0.66	0.77	0.90	1.21	1.64	2.06	2.55	2.98	3.65	4.91	6.33	7.41	8.76	11.81

ENTER DATA BELOW

U. Bckgrnd	1	01	09-01-1999	10:48:48	01:00	1	2	0	0	0	0	0	0	0	0	0
Upstream	1	01	09-01-1999	10:54:10	01:00	11000	16170	5096	9168	14340	8401	10890	11250	2705	5960	3559
Upstream	1	01	09-01-1999	10:56:40	01:00	10540	15750	5095	9015	13800	8283	10790	11170	2700	5924	3720
Upstream	1	01	09-01-1999	10:59:10	01:00	10500	15770	5096	9028	13780	8070	10450	11260	2617	5899	3524
Upstream	1	01	09-01-1999	11:01:40	01:00	10650	15850	5147	8844	13570	8032	10290	11070	2710	5631	3520
Upstream	1	01	09-01-1999	11:04:10	01:00	10750	15920	5040	8978	13740	8220	10540	11230	2664	5892	3509
Upstream	1	01	09-01-1999	11:06:40	01:00	10590	15760	4962	9061	13680	8242	10580	11130	2816	5989	3490
Upstream	1	01	09-01-1999	11:09:10	01:00	10940	15870	4998	9096	13950	8259	10760	11420	2770	6047	3708
Upstream	1	01	09-01-1999	11:11:40	01:00	10710	15890	5009	9114	13840	8200	10600	11470	2953	5930	3598
Upstream	1	01	09-01-1999	11:14:10	01:00	10800	16140	5168	9281	14300	8225	10840	11400	2674	6042	3732
Upstream	1	01	09-01-1999	11:16:40	01:00	10650	15900	5088	9104	13670	8254	10410	11560	2691	5865	3629
U. Bckgrnd	1	01	09-01-1999	11:26:58	01:00	0	0	0	0	0	0	0	0	0	0	0

ENTER DATA BELOW

D. Bckgrnd	2	01	09-01-1999	10:50:03	01:00	0	0	0	1	0	0	1	0	0	0	0
Downstream	2	01	09-01-1999	10:55:25	01:00	10970	16390	5241	9466	14380	8570	11110	11060	2566	5944	3453
Downstream	2	01	09-01-1999	10:57:55	01:00	10570	15880	4931	8914	14080	8385	10680	11170	2664	5853	3569
Downstream	2	01	09-01-1999	11:00:25	01:00	10720	15620	5025	8916	13340	8068	10460	10940	2670	5898	3519
Downstream	2	01	09-01-1999	11:02:55	01:00	10870	15810	5161	9278	13650	8384	10610	11390	2671	5822	3496
Downstream	2	01	09-01-1999	11:05:25	01:00	10990	16070	5133	9201	13980	8236	10800	11190	2754	5935	3490
Downstream	2	01	09-01-1999	11:07:55	01:00	10530	15810	4908	9025	13760	8181	10500	11110	2685	5834	3540
Downstream	2	01	09-01-1999	11:10:25	01:00	10990	16310	5197	9297	14310	8610	10950	11310	2785	6093	3621
Downstream	2	01	09-01-1999	11:12:55	01:00	10690	15850	4908	9039	14220	8397	10700	11160	2681	5766	3586
Downstream	2	01	09-01-1999	11:15:25	01:00	10660	15770	4626	9078	13950	8263	10680	11320	2730	5911	3634
Downstream	2	01	09-01-1999	11:17:55	01:00	10600	15460	5007	9056	13900	8098	10460	11280	2731	5968	3648
D. Bckgrnd	2	01	09-01-1999	11:28:13	01:00	0	0	0	1	0	0	0	0	0	0	0

Meas. Penetration	1.00	1.00	0.99	1.01	1.01	1.01	1.01	0.99	0.99	1.00	0.99	1.00	0.97	0.99	0.97
P100 correction values	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Corrected Penetration	1.00	1.00	0.99	1.01	1.01	1.01	1.01	0.99	0.99	1.00	0.99	1.00	0.97	0.99	0.97
Corrected Efficiency (%)	0	0	1	-1	-1	-1	-1	1	1	0	1	0	3	1	3

Data Acceptance Criteria:

Total Challenge Counts for Each Channel:	107130	159020	50699	90689	138670	82186	106150	112960	27300	59179	35989	12458	2079	3401	2305
Data Quality Objective:	> 500	> 500	> 500	> 500	> 500	> 500	> 500	> 500	> 500	> 500	> 500	> 500	> 500	> 500	> 500
Does this meet DQO:	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes

Standard Deviation of Penetration for Each Channel :	0.02	0.02	0.04	0.02	0.03	0.03	0.03	0.02	0.04	0.03	0.03	0.06	0.06	0.11	0.08
Data Quality Objective:	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.30	<0.30	<0.30	<0.30	<0.30	<0.30
Does this meet DQO:	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes

Maximum observed particle concentration (#/cc):	18.4
Data Quality Objective: max. allowable conc. (#/cc):	< 23
Does this meet the DQO:	Yes, (applies to all channels)

US EPA ARCHIVE DOCUMENT

Test No. 09019904  
 Arrestor  
 Solid-Phase

Particle Counts per Indicated OPC Channel (1-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)	0.45	0.59	0.73	0.80	1.02	1.44	1.86	2.28	2.85	3.13	4.25	5.66	7.07	7.77	9.88
Max. Diam. (um)	0.59	0.73	0.80	1.02	1.44	1.86	2.28	2.85	3.13	4.25	5.66	7.07	7.77	9.88	14.10
Geo. Mean Diam (um)	0.52	0.66	0.77	0.90	1.21	1.64	2.06	2.55	2.98	3.65	4.91	6.33	7.41	8.76	11.81

ENTER DATA BELOW

U. Bckgrnd	1	01	09-01-1999	11:42:36	01:00	0	0	0	1	1	0	0	0	0	0	0	0	0		
Upstream	1	01	09-01-1999	11:50:26	01:00	10940	16320	5102	9421	14200	8497	10870	11250	2678	5937	3546	1238	214	355	234
Upstream	1	01	09-01-1999	11:52:56	01:00	10560	16210	5178	9009	13620	8304	10590	10950	2787	5807	3578	1209	211	321	237
Upstream	1	01	09-01-1999	11:55:26	01:00	10340	15530	4816	8749	13250	8007	10490	10710	2617	5767	3423	1116	210	319	234
Upstream	1	01	09-01-1999	11:57:56	01:00	10400	15600	5019	8967	13560	8179	10560	10780	2548	5649	3473	1138	209	343	240
Upstream	1	01	09-01-1999	12:00:26	01:00	10260	15380	4993	8840	13350	7815	10390	10910	2581	5704	3529	1268	191	356	238
Upstream	1	01	09-01-1999	12:02:56	01:00	10060	15260	4790	8630	13210	7664	10180	10550	2536	5468	3354	1165	191	327	220
Upstream	1	01	09-01-1999	12:05:26	01:00	9895	14710	4744	8428	13260	7832	9842	10670	2710	5859	3566	1300	206	357	263
Upstream	1	01	09-01-1999	12:07:56	01:00	10180	15190	4846	8764	13600	7853	10310	10960	2746	5951	3657	1263	206	383	242
Upstream	1	01	09-01-1999	12:10:26	01:00	10100	14960	4871	8861	13340	8022	10350	11150	2770	6018	3889	1329	210	355	257
Upstream	1	01	09-01-1999	12:12:56	01:00	10080	15260	4999	8801	13590	8034	10270	11120	2813	6082	3689	1312	258	385	258
U. Bckgrnd	1	01	09-01-1999	12:20:50	01:00	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0

ENTER DATA BELOW

D. Bckgrnd	2	01	09-01-1999	11:43:51	01:00	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Downstream	2	01	09-01-1999	11:51:41	01:00	6073	8539	2494	4150	5658	2879	3182	2589	484	813	262	30	10	4	2
Downstream	2	01	09-01-1999	11:54:11	01:00	6153	8634	2596	4280	5910	2963	3317	2771	536	911	314	43	4	5	6
Downstream	2	01	09-01-1999	11:56:41	01:00	6234	8667	2606	4208	5709	2967	3285	2726	477	868	311	42	4	6	2
Downstream	2	01	09-01-1999	11:59:11	01:00	5967	8374	2508	4081	5486	2896	3211	2679	490	849	265	43	9	3	2
Downstream	2	01	09-01-1999	12:01:41	01:00	6104	8274	2471	4031	5665	2856	3100	2581	463	826	262	54	3	4	1
Downstream	2	01	09-01-1999	12:04:11	01:00	5941	8366	2292	4071	5441	2881	2999	2522	491	804	260	41	1	5	3
Downstream	2	01	09-01-1999	12:06:41	01:00	5876	8121	2295	4086	5734	2801	3148	2673	516	927	317	53	3	6	0
Downstream	2	01	09-01-1999	12:09:11	01:00	5783	8174	2376	4221	5719	2846	3104	2676	568	850	320	51	7	8	0
Downstream	2	01	09-01-1999	12:11:41	01:00	5957	8340	2441	4253	5696	2933	3307	2750	571	961	348	57	8	12	4
Downstream	2	01	09-01-1999	12:14:11	01:00	5930	8512	2518	4297	5899	3025	3210	2841	549	955	361	60	9	7	8
D. Bckgrnd	2	01	09-01-1999	12:22:05	01:00	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0

Meas. Penetration	0.58	0.54	0.50	0.47	0.42	0.36	0.31	0.25	0.19	0.15	0.08	0.04	0.03	0.02	0.01
P100 correction values	1.00	1.00	0.99	1.01	1.01	1.01	1.01	0.99	0.99	1.00	0.99	1.00	0.97	0.99	0.97
Corrected Penetration	0.58	0.54	0.50	0.47	0.42	0.36	0.30	0.25	0.19	0.15	0.09	0.04	0.03	0.02	0.01
Corrected Efficiency (%)	42	46	50	53	58	64	70	75	81	85	91	96	97	98	99

Data Acceptance Criteria:

Total Challenge Counts for Each Channel:	102815	154420	49358	88470	134980	80207	103852	109050	26786	58242	35704	12338	2106	3501	2423
Data Quality Objective:	> 500	> 500	> 500	> 500	> 500	> 500	> 500	> 500	> 500	> 500	> 500	> 500	> 500	> 500	> 500
Does this meet DQO:	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes

Standard Deviation of Penetration for Each Channel :	0.02	0.02	0.03	0.02	0.01	0.01	0.01	0.01	0.02	0.01	0.01	0.01	0.02	0.01	0.01
Data Quality Objective:	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.30	<0.30	<0.30	<0.30	<0.30	<0.30
Does this meet DQO:	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes

Maximum observed particle concentration (#/cc):	18.2
Data Quality Objective: max. allowable conc. (#/cc):	< 23
Does this meet the DQO:	Yes, (applies to all channels)

US EPA ARCHIVE DOCUMENT

Test No. 09019905

No Filter

Solid-Phase

Particle Counts per Indicated OPC Channel (1-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)	0.45	0.59	0.73	0.80	1.02	1.44	1.86	2.28	2.85	3.13	4.25	5.66	7.07	7.77	9.88
Max. Diam. (um)	0.59	0.73	0.80	1.02	1.44	1.86	2.28	2.85	3.13	4.25	5.66	7.07	7.77	9.88	14.10
Geo. Mean Diam (um)	0.52	0.66	0.77	0.90	1.21	1.64	2.06	2.55	2.98	3.65	4.91	6.33	7.41	8.76	11.81

ENTER DATA BELOW

U. Bckgrnd	1	01	09-01-1999	13:16:06	01:00	0	0	0	0	0	0	0	0	0	0	0				
Upstream	1	01	09-01-1999	13:22:40	01:00	10440	15790	5120	8990	13900	8194	10690	11170	2613	5746	3503	1214	165	374	205
Upstream	1	01	09-01-1999	13:25:10	01:00	10570	16020	5153	9077	13900	8284	10770	11150	2667	5912	3554	1239	200	317	212
Upstream	1	01	09-01-1999	13:27:40	01:00	10590	15990	5024	9087	13560	8432	10640	11070	2750	5982	3498	1250	212	372	238
Upstream	1	01	09-01-1999	13:30:10	01:00	10640	16010	4966	8961	13990	8386	10750	11290	2676	5858	3530	1249	204	303	231
Upstream	1	01	09-01-1999	13:32:40	01:00	10660	15370	5005	8759	13540	8048	10580	10810	2637	5785	3497	1170	203	322	238
Upstream	1	01	09-01-1999	13:35:10	01:00	10310	15470	5090	8688	13420	8007	10390	10700	2537	5424	3401	1197	175	305	253
Upstream	1	01	09-01-1999	13:37:40	01:00	9261	14080	4546	8093	12410	7298	9392	10090	2526	5510	3437	1184	194	347	242
Upstream	1	01	09-01-1999	13:40:10	01:00	10240	15630	5099	8982	13890	8171	10500	11300	2854	6007	3809	1344	217	355	256
Upstream	1	01	09-01-1999	13:42:40	01:00	10400	15520	4953	9102	13990	8271	10690	11680	2818	6313	3741	1358	223	387	255
Upstream	1	01	09-01-1999	13:45:10	01:00	10360	15350	5041	8996	13700	8178	10400	11200	2765	6007	3666	1359	225	392	244
U. Bckgrnd	1	01	09-01-1999	13:58:01	01:00	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

ENTER DATA BELOW

D. Bckgrnd	2	01	09-01-1999	13:17:21	01:00	2	0	0	0	0	1	0	0	0	0	0	0	0	0	0
Downstream	2	01	09-01-1999	13:23:55	01:00	10680	16160	5077	9008	14040	8313	10780	11250	2558	5863	3548	1224	206	305	202
Downstream	2	01	09-01-1999	13:26:25	01:00	10510	15820	5013	8921	13830	8179	10590	10980	2695	5827	3485	1235	225	339	209
Downstream	2	01	09-01-1999	13:28:55	01:00	10480	15770	5053	8934	13920	8037	10900	11100	2672	5828	3530	1181	188	298	172
Downstream	2	01	09-01-1999	13:31:25	01:00	10440	15890	4912	8923	13460	8095	10380	10730	2605	5773	3411	1205	171	342	211
Downstream	2	01	09-01-1999	13:33:55	01:00	10450	15770	5151	8994	13580	8109	10540	10980	2704	5731	3480	1184	210	324	219
Downstream	2	01	09-01-1999	13:36:25	01:00	10500	15840	5051	8854	13550	7980	10490	10870	2625	5745	3475	1164	188	290	228
Downstream	2	01	09-01-1999	13:38:55	01:00	10590	15880	5011	9257	14220	8366	10770	11370	2729	6094	3817	1338	233	338	223
Downstream	2	01	09-01-1999	13:41:25	01:00	10370	15380	5040	9038	14360	8191	10310	11050	2803	5940	3686	1310	216	352	243
Downstream	2	01	09-01-1999	13:43:55	01:00	10420	15680	5123	9021	14040	8100	10760	11540	2826	6141	3661	1294	209	374	270
Downstream	2	01	09-01-1999	13:46:25	01:00	10380	15390	4969	8907	13690	8094	10470	11020	2832	5952	3535	1299	219	341	239
D. Bckgrnd	2	01	09-01-1999	13:59:16	01:00	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0

Meas. Penetration	1.01	1.02	1.01	1.01	1.02	1.00	1.01	1.00	1.01	1.01	1.00	0.99	1.02	0.95	0.93
P100 correction values	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Corrected Penetration	1.01	1.02	1.01	1.01	1.02	1.00	1.01	1.00	1.01	1.01	1.00	0.99	1.02	0.95	0.93
Corrected Efficiency (%)	-1	-2	-1	-1	-2	0	-1	0	-1	-1	0	1	-2	5	7

Data Acceptance Criteria:

Total Challenge Counts for Each Channel:	103471	155230	49997	88735	136300	81269	104802	110460	26843	58544	35636	12564	2018	3474	2374
Data Quality Objective:	> 500	> 500	> 500	> 500	> 500	> 500	> 500	> 500	> 500	> 500	> 500	> 500	> 500	> 500	> 500
Does this meet DQO:	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes

Standard Deviation of Penetration for Each Channel :	0.04	0.04	0.04	0.04	0.04	0.04	0.04	0.04	0.05	0.05	0.05	0.08	0.14	0.12	0.13
Data Quality Objective:	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.30	<0.30	<0.30	<0.30	<0.30	<0.30
Does this meet DQO:	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes

Maximum observed particle concentration (#/cc):	18.1
Data Quality Objective: max. allowable conc. (#/cc):	< 23
Does this meet the DQO:	Yes, (applies to all channels)

US EPA ARCHIVE DOCUMENT



Test No. 09019906  
 Arrestor  
 Solid-Phase

Particle Counts per Indicated OPC Channel (1-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)	0.45	0.59	0.73	0.80	1.02	1.44	1.86	2.28	2.85	3.13	4.25	5.66	7.07	7.77	9.88	
Max. Diam. (um)	0.59	0.73	0.80	1.02	1.44	1.86	2.28	2.85	3.13	4.25	5.66	7.07	7.77	9.88	14.10	
Geo. Mean Diam (um)	0.52	0.66	0.77	0.90	1.21	1.64	2.06	2.55	2.98	3.65	4.91	6.33	7.41	8.76	11.81	
ENTER DATA BELOW																
U. Bckgrnd	1 01 09-01-1999 14:19:00 01:00	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
Upstream	1 01 09-01-1999 14:24:18 01:00	10710	15960	5062	9167	13880	8321	10710	11050	2624	5820	3502	1240	195	351	230
Upstream	1 01 09-01-1999 14:26:48 01:00	10340	15310	4816	8930	13430	7968	10330	10960	2574	5835	3482	1271	211	360	261
Upstream	1 01 09-01-1999 14:29:18 01:00	10490	15500	4933	8885	13680	7909	10450	10840	2698	5702	3525	1280	202	324	232
Upstream	1 01 09-01-1999 14:31:48 01:00	10340	15580	4970	8903	13570	8080	10600	10670	2538	5791	3537	1252	199	305	217
Upstream	1 01 09-01-1999 14:34:18 01:00	10070	15340	4851	8744	13280	7972	10280	10750	2613	5636	3566	1238	225	354	234
Upstream	1 01 09-01-1999 14:36:48 01:00	10360	15650	4920	9018	13480	8021	10370	10920	2643	5692	3528	1234	226	329	243
Upstream	1 01 09-01-1999 14:39:18 01:00	10520	15410	4930	9015	13670	8092	10640	10830	2567	5569	3676	1202	225	343	232
Upstream	1 01 09-01-1999 14:41:48 01:00	10440	15640	4952	8926	13780	8062	10490	10790	2693	5682	3535	1222	218	311	235
Upstream	1 01 09-01-1999 14:44:18 01:00	10100	15390	4911	8712	13210	7758	10470	10780	2575	5695	3412	1234	183	342	223
Upstream	1 01 09-01-1999 14:46:48 01:00	10480	15320	4964	8748	13360	7994	10410	10750	2666	5564	3414	1184	199	325	224
U. Bckgrnd	1 01 09-01-1999 14:57:24 01:00	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
ENTER DATA BELOW																
D. Bckgrnd	2 01 09-01-1999 14:20:15 01:00	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
Downstream	2 01 09-01-1999 14:25:33 01:00	6401	9146	2668	4538	6260	2990	3566	3011	607	963	361	55	4	7	3
Downstream	2 01 09-01-1999 14:28:03 01:00	6431	9063	2689	4546	6228	3167	3542	3094	594	1030	346	65	5	8	3
Downstream	2 01 09-01-1999 14:30:33 01:00	6566	8945	2672	4474	6098	3138	3533	3039	546	979	345	58	9	9	9
Downstream	2 01 09-01-1999 14:33:03 01:00	6351	8886	2691	4511	6041	3102	3524	2778	561	951	332	75	8	11	2
Downstream	2 01 09-01-1999 14:35:33 01:00	6401	8950	2637	4414	6034	3108	3455	2879	530	903	355	48	6	9	2
Downstream	2 01 09-01-1999 14:38:03 01:00	6176	8738	2606	4366	5951	2990	3351	2712	539	967	299	54	3	6	3
Downstream	2 01 09-01-1999 14:40:33 01:00	6468	8937	2593	4344	6166	3095	3438	2877	547	888	301	45	4	5	0
Downstream	2 01 09-01-1999 14:43:03 01:00	6246	8811	2704	4535	5996	3066	3443	3009	565	926	356	59	3	7	2
Downstream	2 01 09-01-1999 14:45:33 01:00	6510	9002	2688	4521	6093	3282	3688	2977	545	977	339	58	3	7	7
Downstream	2 01 09-01-1999 14:48:03 01:00	6409	9213	2635	4594	6250	3091	3629	3017	567	977	309	55	3	7	9
D. Bckgrnd	2 01 09-01-1999 14:58:39 01:00	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
Meas. Penetration		0.62	0.58	0.54	0.50	0.45	0.39	0.34	0.27	0.21	0.17	0.10	0.05	0.02	0.02	0.02
P100 correction values		1.01	1.02	1.01	1.01	1.02	1.00	1.01	1.00	1.01	1.01	1.00	0.99	1.02	0.95	0.93
Corrected Penetration		0.61	0.57	0.53	0.50	0.44	0.39	0.33	0.27	0.21	0.17	0.10	0.05	0.02	0.02	0.02
Corrected Efficiency (%)		39	43	47	50	56	61	67	73	79	83	90	95	98	98	98
Data Acceptance Criteria:																
Total Challenge Counts for Each Channel:		103850	155100	49309	89048	135340	80177	104750	108340	26191	56986	35177	12357	2083	3344	2331
Data Quality Objective:		> 500	> 500	> 500	> 500	> 500	> 500	> 500	> 500	> 500	> 500	> 500	> 500	> 500	> 500	> 500
Does this meet DQO:		Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Standard Deviation of Penetration for Each Channel :		0.02	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01
Data Quality Objective:		<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.30	<0.30	<0.30	<0.30	<0.30	<0.30
Does this meet DQO:		Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Maximum observed particle concentration (#/cc):		17.9														
Data Quality Objective: max. allowable conc. (#/cc):		< 23														
Does this meet the DQO:		Yes, (applies to all channels)														

Test No. 08319904  
 HEPA  
 Solid-Phase

Particle Counts per Indicated OPC Channel (1-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)	0.45	0.59	0.73	0.80	1.02	1.44	1.86	2.28	2.85	3.13	4.25	5.66	7.07	7.77	9.88
Max. Diam. (um)	0.59	0.73	0.80	1.02	1.44	1.86	2.28	2.85	3.13	4.25	5.66	7.07	7.77	9.88	14.10
Geo. Mean Diam (um)	0.52	0.66	0.77	0.90	1.21	1.64	2.06	2.55	2.98	3.65	4.91	6.33	7.41	8.76	11.81

ENTER DATA BELOW

U. Bckgrnd	1 01 08-31-1999 13:21:20 01:00	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Upstream	1 01 08-31-1999 13:30:30 01:00	9906	15210	4721	8631	13060	7586	10050	11040	2743	5920	3442	1149	191	297
Upstream	1 01 08-31-1999 13:33:00 01:00	10140	15260	4804	8950	13360	7959	10180	11250	2837	6030	3564	1170	200	303
Upstream	1 01 08-31-1999 13:35:30 01:00	10410	15560	4867	9101	13840	8060	10440	11550	2828	6156	3569	1175	204	309
Upstream	1 01 08-31-1999 13:38:00 01:00	10020	14890	4814	8556	13350	7905	10220	11320	2790	6017	3444	1167	201	320
Upstream	1 01 08-31-1999 13:40:30 01:00	10100	14850	4829	8570	13280	7877	10120	11290	2726	5961	3453	1288	211	336
Upstream	1 01 08-31-1999 13:43:00 01:00	9782	14920	4769	8396	12730	7719	10000	11070	2828	5833	3446	1167	174	328
Upstream	1 01 08-31-1999 13:45:30 01:00	8866	13340	4235	7393	11380	6768	8732	9584	2284	5022	2752	939	160	254
Upstream	1 01 08-31-1999 13:48:00 01:00	9952	14880	4725	8314	12550	7560	9809	10470	2506	5235	3100	1034	182	302
Upstream	1 01 08-31-1999 13:50:30 01:00	10040	14910	4738	8308	12870	7608	9800	10540	2540	5386	3184	1015	158	261
Upstream	1 01 08-31-1999 13:53:00 01:00	9933	14870	4601	8359	12770	7614	9846	10330	2503	5398	3046	1069	168	289
U. Bckgrnd	1 01 08-31-1999 14:03:28 01:00	0	0	0	0	0	0	0	0	0	0	0	0	0	0

ENTER DATA BELOW

D. Bckgrnd	2 01 08-31-1999 13:22:35 01:00	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Downstream	2 01 08-31-1999 13:31:45 01:00	12	21	2	11	12	6	10	9	6	2	1	1	0	0
Downstream	2 01 08-31-1999 13:34:15 01:00	10	14	3	9	17	8	13	13	2	1	5	0	0	0
Downstream	2 01 08-31-1999 13:36:45 01:00	8	19	4	5	14	8	17	10	1	7	0	2	0	1
Downstream	2 01 08-31-1999 13:39:15 01:00	7	14	6	10	14	10	8	7	1	5	0	2	0	0
Downstream	2 01 08-31-1999 13:41:45 01:00	9	18	4	8	15	8	5	4	1	5	1	0	0	0
Downstream	2 01 08-31-1999 13:44:15 01:00	12	17	2	7	19	11	11	9	0	8	1	1	0	0
Downstream	2 01 08-31-1999 13:46:45 01:00	5	20	4	5	13	7	9	7	3	3	2	0	0	0
Downstream	2 01 08-31-1999 13:49:15 01:00	12	16	5	6	11	4	9	6	2	2	4	0	0	0
Downstream	2 01 08-31-1999 13:51:45 01:00	9	17	5	10	5	10	7	6	3	8	0	0	0	0
Downstream	2 01 08-31-1999 13:54:15 01:00	7	20	1	6	16	9	8	11	1	3	2	0	0	0
D. Bckgrnd	2 01 08-31-1999 14:04:43 01:00	0	2	0	2	1	0	2	2	1	1	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
P100 correction values	1.01	1.00	1.01	1.00	1.01	1.01	1.02	1.03	0.99	1.01	1.01	1.01	1.01	0.95	0.88
Corrected 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
Corrected Efficiency (%)	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100

Data Acceptance Criteria:

Total Challenge Counts for Each Channel:	99149	148690	47103	84578	129190	76656	99197	108444	26585	56958	33000	11173	1849	2999	1924
Data Quality Objective:	> 500	> 500	> 500	> 500	> 500	> 500	> 500	> 500	> 500	> 500	> 500	> 500	> 500	> 500	> 500
Does this meet DQO:	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes

Standard Deviation of Penetration for Each Channel :	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
Data Quality Objective:	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.30	<0.30	<0.30	<0.30	<0.30	<0.30
Does this meet DQO:	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes

Maximum observed particle concentration (#/cc):	17.7
Data Quality Objective: max. allowable conc. (#/cc):	< 23
Does this meet the DQO:	Yes, (applies to all channels)

Test No. 09019907  
 No Filter  
 Liquid-Phase

Particle Counts per Indicated OPC Channel (1-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)	0.28	0.37	0.47	0.52	0.66	0.94	1.22	1.51	1.88	2.07	2.83	3.77	4.71	5.18	6.60
Max. Diam. (um)	0.37	0.47	0.52	0.66	0.94	1.22	1.51	1.88	2.07	2.83	3.77	4.71	5.18	6.60	9.43
Geo. Mean Diam (um)	0.32	0.42	0.49	0.58	0.78	1.07	1.36	1.68	1.97	2.42	3.26	4.21	4.94	5.85	7.89

ENTER DATA BELOW

U. Bckgrnd	1 01 09-01-1999 15:17:44 01:00	0	0	0	0	1	1	0	1	0	0	0	0	0	0
Upstream	1 01 09-01-1999 15:30:34 01:00	9945	15570	5556	10250	15420	10900	17910	12720	2961	6976	4087	1115	163	270
Upstream	1 01 09-01-1999 15:33:04 01:00	9982	15680	5531	10190	15050	11060	17730	12720	2921	6991	4061	1102	166	260
Upstream	1 01 09-01-1999 15:35:34 01:00	9368	15140	5286	9648	14630	10740	17120	12380	2759	6707	3945	1056	145	252
Upstream	1 01 09-01-1999 15:38:04 01:00	9694	15650	5604	10050	15020	10780	17600	12960	2897	6923	4101	1102	189	272
Upstream	1 01 09-01-1999 15:40:34 01:00	10000	15750	5547	10030	15550	11040	17880	12810	2974	7005	4170	1107	153	268
Upstream	1 01 09-01-1999 15:43:04 01:00	10080	15810	5606	10160	15650	10840	17890	13210	2956	7113	4131	1163	164	275
Upstream	1 01 09-01-1999 15:45:34 01:00	9919	14980	5340	9936	14920	10220	16930	12420	2924	6724	4024	1096	151	266
Upstream	1 01 09-01-1999 15:48:04 01:00	10170	16450	5711	10210	15830	11350	18350	13270	3027	7327	4194	1146	194	293
Upstream	1 01 09-01-1999 15:50:34 01:00	10250	16180	5756	10230	15660	11190	17970	13060	3057	7105	4157	1109	165	275
Upstream	1 01 09-01-1999 15:53:04 01:00	10860	16880	5975	10950	16060	11820	19150	13720	3050	7358	4374	1186	172	277
U. Bckgrnd	1 01 09-01-1999 16:01:18 01:00	0	0	0	0	0	0	0	0	0	0	0	0	0	0

ENTER DATA BELOW

D. Bckgrnd	2 01 09-01-1999 15:18:59 01:00	0	0	0	0	0	0	0	1	0	0	0	1	0	0
Downstream	2 01 09-01-1999 15:31:49 01:00	9910	15470	5562	10010	15390	11080	17640	12890	2940	6981	4116	1108	171	232
Downstream	2 01 09-01-1999 15:34:19 01:00	9838	15510	5431	9775	15230	10870	17670	12760	2845	7006	4208	1079	172	257
Downstream	2 01 09-01-1999 15:36:49 01:00	10470	16400	5729	10300	15970	11320	18020	13310	3109	7172	4314	1204	177	252
Downstream	2 01 09-01-1999 15:39:19 01:00	9742	15400	5393	9800	14930	10750	17580	12630	2790	6745	4193	1069	153	260
Downstream	2 01 09-01-1999 15:41:49 01:00	9727	15340	5494	9855	15390	10740	17120	12760	2838	6830	4096	1138	166	238
Downstream	2 01 09-01-1999 15:44:19 01:00	9677	15130	5392	9748	14870	10530	17090	12760	2967	7076	4030	1146	168	250
Downstream	2 01 09-01-1999 15:46:49 01:00	10060	15700	5728	9889	15410	11090	17780	12850	3023	7055	4078	1086	174	271
Downstream	2 01 09-01-1999 15:49:19 01:00	9801	16200	5640	10220	15640	11030	17740	13130	2876	7239	4167	1165	172	236
Downstream	2 01 09-01-1999 15:51:49 01:00	10370	16780	5958	10610	16080	11610	18790	13520	3084	7350	4307	1203	177	261
Downstream	2 01 09-01-1999 15:54:19 01:00	10280	16180	5675	10090	15730	11110	18000	13050	3001	7117	4096	1160	194	269
D. Bckgrnd	2 01 09-01-1999 16:02:33 01:00	0	0	0	0	0	0	0	1	0	0	0	0	0	0

Meas. Penetration	1.00	1.00	1.00	0.99	1.01	1.00	0.99	1.00	1.00	1.00	1.01	1.02	1.04	0.93	0.97
P100 correction values	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Corrected Penetration	1.00	1.00	1.00	0.99	1.01	1.00	0.99	1.00	1.00	1.00	1.01	1.02	1.04	0.93	0.97
Corrected Efficiency (%)	0	0	0	1	-1	0	1	0	0	0	-1	-2	-4	7	3

Data Acceptance Criteria:

Total Challenge Counts for Each Channel:	100268	158090	55912	101654	153790	109940	178530	129270	29526	70229	41244	11182	1662	2708	1490
Data Quality Objective:	> 500	> 500	> 500	> 500	> 500	> 500	> 500	> 500	> 500	> 500	> 500	> 500	> 500	> 500	> 500
Does this meet DQO:	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes

Standard Deviation of Penetration for Each Channel :	0.05	0.05	0.05	0.04	0.04	0.05	0.04	0.04	0.05	0.04	0.04	0.06	0.12	0.06	0.12
Data Quality Objective:	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.30	<0.30	<0.30	<0.30	<0.30
Does this meet DQO:	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes

Maximum observed particle concentration (#/cc): 17.2  
 Data Quality Objective: max. allowable conc. (#/cc): < 23  
 Does this meet the DQO: Yes, (applies to all channels)

Test No. 09019908  
 Arrestor  
 Liquid-Phase

Particle Counts per Indicated OPC Channel (1-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)	0.28	0.37	0.47	0.52	0.66	0.94	1.22	1.51	1.88	2.07	2.83	3.77	4.71	5.18	6.60
Max. Diam. (um)	0.37	0.47	0.52	0.66	0.94	1.22	1.51	1.88	2.07	2.83	3.77	4.71	5.18	6.60	9.43
Geo. Mean Diam (um)	0.32	0.42	0.49	0.58	0.78	1.07	1.36	1.68	1.97	2.42	3.26	4.21	4.94	5.85	7.89

ENTER DATA BELOW

U. Bckgrnd	1	01	09-01-1999	16:09:32	01:00	0	0	0	0	0	0	0	0	0	0	0				
Upstream	1	01	09-01-1999	16:16:07	01:00	9434	14920	5183	9539	14170	10310	16890	12350	2801	6618	3963	1073	181	276	146
Upstream	1	01	09-01-1999	16:18:37	01:00	10010	15710	5614	9986	15330	10890	17960	13290	3060	6980	4248	1104	192	262	154
Upstream	1	01	09-01-1999	16:21:07	01:00	9905	15760	5608	10030	15240	11030	17820	13020	3002	7012	4243	1118	160	255	151
Upstream	1	01	09-01-1999	16:23:37	01:00	10330	16240	5805	10350	15850	11300	18520	13430	3026	7169	4372	1138	179	280	155
Upstream	1	01	09-01-1999	16:26:07	01:00	10020	15680	5539	10260	15130	10890	17710	12920	2914	6989	4155	1126	183	251	154
Upstream	1	01	09-01-1999	16:28:37	01:00	9650	15440	5448	10170	15290	10810	17470	12810	3076	7080	4138	1071	177	255	148
Upstream	1	01	09-01-1999	16:31:07	01:00	8633	14110	4942	8903	13660	9454	15510	12340	2716	6529	3988	1110	172	280	147
Upstream	1	01	09-01-1999	16:33:37	01:00	9366	14600	5269	9667	14440	10150	16740	13190	2944	7029	4385	1129	176	285	150
Upstream	1	01	09-01-1999	16:36:07	01:00	9297	14440	4907	9379	14140	9730	16140	13060	2915	6769	4320	1163	160	284	135
Upstream	1	01	09-01-1999	16:38:37	01:00	9478	14690	5153	9633	14890	10140	16980	13380	2895	7155	4447	1249	191	285	166
U. Bckgrnd	1	01	09-01-1999	16:46:24	01:00	1	0	1	0	0	0	0	0	0	0	0	0	0	0	0

ENTER DATA BELOW

D. Bckgrnd	2	01	09-01-1999	16:10:47	01:00	6	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Downstream	2	01	09-01-1999	16:17:22	01:00	6404	9921	3446	5932	8473	5530	7992	4912	928	1839	810	85	12	15	4
Downstream	2	01	09-01-1999	16:19:52	01:00	6752	10340	3565	6333	8914	5739	8160	5055	958	1934	790	92	13	11	2
Downstream	2	01	09-01-1999	16:22:22	01:00	6766	10480	3566	6271	8964	5616	8270	5027	1017	1996	822	99	4	10	2
Downstream	2	01	09-01-1999	16:24:52	01:00	6818	10490	3553	6452	9101	5744	8394	5010	949	2039	807	118	13	6	2
Downstream	2	01	09-01-1999	16:27:22	01:00	6735	10240	3579	6450	8807	5784	8297	5040	948	1950	793	121	8	13	6
Downstream	2	01	09-01-1999	16:29:52	01:00	6689	10230	3566	6275	8633	5662	8031	4927	936	1909	813	124	9	12	4
Downstream	2	01	09-01-1999	16:32:22	01:00	6446	9547	3469	6134	8537	5475	8063	5195	969	1997	899	123	13	13	2
Downstream	2	01	09-01-1999	16:34:52	01:00	6208	9591	3332	5948	8506	5327	7943	5234	986	1941	890	115	12	12	1
Downstream	2	01	09-01-1999	16:37:22	01:00	6539	9733	3414	6147	8981	5594	8149	5626	978	2118	900	134	19	11	3
Downstream	2	01	09-01-1999	16:39:52	01:00	6233	9462	3285	6067	8535	5296	7826	5219	987	1999	837	129	7	16	3
D. Bckgrnd	2	01	09-01-1999	16:47:39	01:00	0	3	0	0	0	0	0	0	0	0	0	0	0	0	0

Meas. Penetration	0.68	0.66	0.65	0.63	0.59	0.53	0.47	0.39	0.33	0.28	0.20	0.10	0.06	0.04	0.02
P100 correction values	1.00	1.00	1.00	0.99	1.01	1.00	0.99	1.00	1.00	1.00	1.01	1.02	1.04	0.93	0.97
Corrected Penetration	0.68	0.66	0.65	0.64	0.59	0.53	0.48	0.39	0.33	0.28	0.20	0.10	0.06	0.05	0.02
Corrected Efficiency (%)	32	34	35	36	41	47	52	61	67	72	80	90	94	95	98

Data Acceptance Criteria:

Total Challenge Counts for Each Channel:	96123	151590	53468	97917	148140	104704	171740	129790	29349	69330	42259	11281	1771	2713	1506
Data Quality Objective:	> 500	> 500	> 500	> 500	> 500	> 500	> 500	> 500	> 500	> 500	> 500	> 500	> 500	> 500	> 500
Does this meet DQO:	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes

Standard Deviation of Penetration for Each Channel :

Data Quality Objective:	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.30	<0.30	<0.30	<0.30	<0.30
Does this meet DQO:	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes

Maximum observed particle concentration (#/cc):

Data Quality Objective: max. allowable conc. (#/cc):	16.7
Does this meet the DQO:	< 23
	Yes, (applies to all channels)

Test No. 09029902  
 No Filter  
 Liquid-Phase

Particle Counts per Indicated OPC Channel (1-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)		0.28	0.37	0.47	0.52	0.66	0.94	1.22	1.51	1.88	2.07	2.83	3.77	4.71	5.18	6.60
Max. Diam. (um)		0.37	0.47	0.52	0.66	0.94	1.22	1.51	1.88	2.07	2.83	3.77	4.71	5.18	6.60	9.43
Geo. Mean Diam (um)		0.32	0.42	0.49	0.58	0.78	1.07	1.36	1.68	1.97	2.42	3.26	4.21	4.94	5.85	7.89
ENTER DATA BELOW																
U. Bckgrnd	1 01 09-02-1999 07:38:55 01:00	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Upstream	1 01 09-02-1999 07:45:31 01:00	9441	15160	5418	9811	14740	10420	17510	13830	3141	7360	4457	1252	174	298	168
Upstream	1 01 09-02-1999 07:48:01 01:00	9432	14630	5208	9565	14570	10320	16980	13550	2981	7169	4422	1212	193	303	170
Upstream	1 01 09-02-1999 07:50:31 01:00	9986	15560	5369	9985	15670	10750	17920	14350	3250	7461	4583	1227	201	306	166
Upstream	1 01 09-02-1999 07:53:01 01:00	10040	15440	5394	10010	15380	10720	17970	14110	3126	7507	4593	1295	209	322	187
Upstream	1 01 09-02-1999 07:55:31 01:00	10160	15560	5524	10240	15860	10870	18330	14410	3177	7557	4798	1334	198	332	198
Upstream	1 01 09-02-1999 07:58:01 01:00	9923	15590	5472	10270	15490	10890	18290	14270	3254	7500	4771	1286	202	336	179
Upstream	1 01 09-02-1999 08:00:31 01:00	9191	14170	4967	9306	14100	10070	16370	12200	2782	6544	3876	1088	188	281	154
Upstream	1 01 09-02-1999 08:03:01 01:00	9694	15390	5414	9845	14970	10760	17420	12890	3043	6876	4065	1089	173	284	151
Upstream	1 01 09-02-1999 08:05:31 01:00	9921	15350	5454	9885	15060	10580	17640	13010	2852	7082	4304	1125	193	263	161
Upstream	1 01 09-02-1999 08:08:01 01:00	9470	14840	5263	9457	14310	10300	17150	12920	2949	6935	4085	1115	168	293	134
U. Bckgrnd	1 01 09-02-1999 08:15:51 01:00	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
ENTER DATA BELOW																
D. Bckgrnd	2 01 09-02-1999 07:40:10 01:00	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Downstream	2 01 09-02-1999 07:46:46 01:00	9676	14960	5341	9729	14990	10470	17490	13760	3114	7282	4623	1297	203	311	191
Downstream	2 01 09-02-1999 07:49:16 01:00	9338	14650	5185	9654	14670	10060	17030	13590	2951	7144	4555	1218	210	332	164
Downstream	2 01 09-02-1999 07:51:46 01:00	9723	15020	5237	9743	14900	10310	17310	13730	3029	7546	4654	1277	186	315	157
Downstream	2 01 09-02-1999 07:54:16 01:00	9650	15090	5369	9895	15020	10420	17390	13860	3090	7319	4673	1263	214	315	195
Downstream	2 01 09-02-1999 07:56:46 01:00	9659	15590	5439	9993	15250	10590	17970	14170	3246	7527	4650	1344	204	284	178
Downstream	2 01 09-02-1999 07:59:16 01:00	9925	15510	5336	10140	15370	10730	17660	14250	3176	7629	4723	1328	226	345	184
Downstream	2 01 09-02-1999 08:01:46 01:00	10030	15450	5665	10090	15270	10800	18040	13130	2978	7403	4357	1186	173	304	167
Downstream	2 01 09-02-1999 08:04:16 01:00	9888	15660	5527	9836	15170	10880	17840	13130	3089	7210	4273	1226	200	269	174
Downstream	2 01 09-02-1999 08:06:46 01:00	9667	15140	5284	9591	14700	10420	17210	12880	2961	6922	4338	1251	200	273	157
Downstream	2 01 09-02-1999 08:09:16 01:00	9680	15360	5320	9564	15040	10560	17390	12820	2853	6962	4224	1150	189	307	150
D. Bckgrnd	2 01 09-02-1999 08:17:06 01:00	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Meas. Penetration		1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.01	1.03	1.04	1.06	1.01	1.03
P100 correction values		1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Corrected Penetration		1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.01	1.03	1.04	1.06	1.01	1.03
Corrected Efficiency (%)		0	0	0	0	0	0	0	0	0	-1	-3	-4	-6	-1	-3
Data Acceptance Criteria:																
Total Challenge Counts for Each Channel:		97258	151690	53483	98374	150150	105680	175580	135540	30555	71991	43954	12023	1899	3018	1668
Data Quality Objective:		> 500	> 500	> 500	> 500	> 500	> 500	> 500	> 500	> 500	> 500	> 500	> 500	> 500	> 500	> 500
Does this meet DQO:		Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Standard Deviation of Penetration for Each Channel :		0.04	0.04	0.04	0.04	0.04	0.03	0.04	0.07	0.07	0.06	0.08	0.09	0.11	0.11	0.15
Data Quality Objective:		<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.30	<0.30	<0.30	<0.30	<0.30
Does this meet DQO:		Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Maximum observed particle concentration (#/cc):		16.8														
Data Quality Objective: max. allowable conc. (#/cc):		< 23														
Does this meet the DQO:		Yes, (applies to all channels)														

Test No. 09029903

Arrestor  
Liquid-Phase

Particle Counts per Indicated OPC Channel (1-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)	0.28	0.37	0.47	0.52	0.66	0.94	1.22	1.51	1.88	2.07	2.83	3.77	4.71	5.18	6.60
Max. Diam. (um)	0.37	0.47	0.52	0.66	0.94	1.22	1.51	1.88	2.07	2.83	3.77	4.71	5.18	6.60	9.43
Geo. Mean Diam (um)	0.32	0.42	0.49	0.58	0.78	1.07	1.36	1.68	1.97	2.42	3.26	4.21	4.94	5.85	7.89
ENTER DATA BELOW															
U. Bckgrnd	1 01 09-02-1999 08:34:21 01:00	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Upstream	1 01 09-02-1999 08:43:26 01:00	9180	14020	5076	8959	13800	9927	16470	12180	2678	6789	3976	1092	134	289
Upstream	1 01 09-02-1999 08:45:56 01:00	10370	16470	5672	10720	16010	11580	19040	14010	3201	7504	4539	1218	213	306
Upstream	1 01 09-02-1999 08:48:26 01:00	10680	17100	6010	10900	16660	11920	19460	14400	3394	7891	4668	1258	210	335
Upstream	1 01 09-02-1999 08:50:56 01:00	10570	16890	5876	10770	16550	11810	19150	14130	3197	7634	4526	1298	211	297
Upstream	1 01 09-02-1999 08:53:26 01:00	10570	16780	5935	10800	16550	12010	19390	14470	3224	7743	4547	1268	211	286
Upstream	1 01 09-02-1999 08:55:56 01:00	10320	16180	5855	10310	15720	11170	18540	13610	3056	7311	4322	1201	161	270
Upstream	1 01 09-02-1999 08:58:26 01:00	9828	15390	5617	10210	15430	10800	18140	14770	3205	7555	4755	1323	213	304
Upstream	1 01 09-02-1999 09:00:56 01:00	9860	15030	5394	10120	15170	10550	17800	14900	3248	7569	4755	1304	220	334
Upstream	1 01 09-02-1999 09:03:26 01:00	9582	14930	5269	9749	14950	10470	17500	14440	3147	7425	4621	1366	198	353
Upstream	1 01 09-02-1999 09:05:56 01:00	9633	14860	5370	9981	15220	10320	17530	14480	3234	7460	4615	1366	187	314
U. Bckgrnd	1 01 09-02-1999 09:18:43 01:00	0	0	1	0	2	2	2	0	1	1	1	0	0	0
ENTER DATA BELOW															
D. Bckgrnd	2 01 09-02-1999 08:35:36 01:00	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Downstream	2 01 09-02-1999 08:44:41 01:00	6599	10010	3367	6287	8598	5523	8088	5119	951	1999	840	147	10	8
Downstream	2 01 09-02-1999 08:47:11 01:00	7456	11510	4012	7043	9967	6651	9582	5971	1125	2191	955	128	22	15
Downstream	2 01 09-02-1999 08:49:41 01:00	7470	11700	4048	7026	10040	6389	9466	5753	1099	2289	960	155	11	15
Downstream	2 01 09-02-1999 08:52:11 01:00	7669	11260	4054	6966	9946	6546	9510	5886	1159	2325	957	151	11	12
Downstream	2 01 09-02-1999 08:54:41 01:00	7372	11300	3990	6886	9706	6416	9217	5750	1067	2257	898	133	9	11
Downstream	2 01 09-02-1999 08:57:11 01:00	7176	11060	3780	6695	9550	6266	9126	5379	1128	2139	938	139	7	9
Downstream	2 01 09-02-1999 08:59:41 01:00	6644	10040	3586	6429	9240	5754	8795	6105	1068	2280	1058	150	18	13
Downstream	2 01 09-02-1999 09:02:11 01:00	6472	9948	3485	6161	9021	5783	8597	5796	1043	2183	1028	173	17	15
Downstream	2 01 09-02-1999 09:04:41 01:00	6855	10170	3444	6546	9467	5747	8977	5939	1092	2225	1033	167	18	13
Downstream	2 01 09-02-1999 09:07:11 01:00	6637	10230	3554	6422	9310	5646	8795	5975	1132	2231	998	148	14	19
D. Bckgrnd	2 01 09-02-1999 09:19:58 01:00	1	1	1	0	1	1	0	0	0	0	0	0	0	0
Meas. Penetration		0.70	0.68	0.67	0.65	0.61	0.55	0.49	0.41	0.34	0.30	0.21	0.12	0.07	0.04
P100 correction values		1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.01	1.03	1.04	1.06	1.01
Corrected Penetration		0.70	0.68	0.66	0.65	0.61	0.55	0.49	0.41	0.34	0.29	0.21	0.11	0.07	0.04
Corrected Efficiency (%)		30	32	34	35	39	45	51	59	66	71	79	89	93	96
Data Acceptance Criteria:															
Total Challenge Counts for Each Channel:		100593	157650	56074	102519	156060	110557	183020	141390	31584	74881	45324	12694	1958	3088
Data Quality Objective:		> 500	> 500	> 500	> 500	> 500	> 500	> 500	> 500	> 500	> 500	> 500	> 500	> 500	> 500
Does this meet DQO:		Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Standard Deviation of Penetration for Each Channel :		0.06	0.06	0.06	0.05	0.05	0.05	0.04	0.03	0.03	0.02	0.02	0.01	0.03	0.01
Data Quality Objective:		<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.30	<0.30	<0.30	<0.30
Does this meet DQO:		Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Maximum observed particle concentration (#/cc):		17.7													
Data Quality Objective: max. allowable conc. (#/cc):		< 23													
Does this meet the DQO:		Yes, (applies to all channels)													

US EPA ARCHIVE DOCUMENT

Test No. 09029904

No Filter

Liquid-Phase

Particle Counts per Indicated OPC Channel (1-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)	0.28	0.37	0.47	0.52	0.66	0.94	1.22	1.51	1.88	2.07	2.83	3.77	4.71	5.18	6.60
Max. Diam. (um)	0.37	0.47	0.52	0.66	0.94	1.22	1.51	1.88	2.07	2.83	3.77	4.71	5.18	6.60	9.43
Geo. Mean Diam (um)	0.32	0.42	0.49	0.58	0.78	1.07	1.36	1.68	1.97	2.42	3.26	4.21	4.94	5.85	7.89

ENTER DATA BELOW

U. Bckgrnd	1	01	09-02-1999	09:36:31	01:00	0	0	0	0	0	0	0	0	0	0	0				
Upstream	1	01	09-02-1999	09:43:09	01:00	10020	15730	5487	10040	15180	11050	18130	13490	3079	7308	4309	1146	199	281	148
Upstream	1	01	09-02-1999	09:45:39	01:00	9787	15740	5537	9707	14830	10730	17830	12730	3021	7022	4106	1143	142	297	148
Upstream	1	01	09-02-1999	09:48:09	01:00	9729	16040	5713	10090	15470	11080	18230	13310	2947	7425	4206	1095	172	281	158
Upstream	1	01	09-02-1999	09:50:39	01:00	10040	15840	5515	9783	15490	10910	17890	13040	2884	7137	4206	1166	190	267	166
Upstream	1	01	09-02-1999	09:53:09	01:00	9813	15370	5572	9866	15280	10760	17880	13270	2963	7165	4131	1180	154	251	166
Upstream	1	01	09-02-1999	09:55:39	01:00	9623	14740	5271	9399	14330	10380	16870	12240	2848	6623	3865	1081	145	252	156
Upstream	1	01	09-02-1999	09:58:09	01:00	9340	14740	5207	9424	14250	10490	16840	12460	2811	6830	3846	1130	162	275	147
Upstream	1	01	09-02-1999	10:00:39	01:00	9524	15030	5134	9079	14200	10650	16690	11680	2646	6565	3595	963	151	230	132
Upstream	1	01	09-02-1999	10:03:09	01:00	9405	14780	5190	9014	14240	10280	16890	11830	2660	6334	3675	1011	171	241	118
Upstream	1	01	09-02-1999	10:05:39	01:00	9498	15120	5260	9114	14180	10910	17050	11580	2717	6521	3655	954	140	237	143
U. Bckgrnd	1	01	09-02-1999	10:13:29	01:00	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0

ENTER DATA BELOW

D. Bckgrnd	2	01	09-02-1999	09:37:46	01:00	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Downstream	2	01	09-02-1999	09:44:24	01:00	9786	15150	5490	9735	14980	10730	17320	12810	2866	7040	4280	1162	177	280	161
Downstream	2	01	09-02-1999	09:46:54	01:00	9726	15290	5284	9763	14930	10790	17550	13010	2938	7049	4240	1118	183	303	173
Downstream	2	01	09-02-1999	09:49:24	01:00	10130	16050	5515	10080	15700	11010	18190	13470	3006	7382	4354	1198	201	270	164
Downstream	2	01	09-02-1999	09:51:54	01:00	9989	15820	5576	9879	15270	11290	18100	12840	2880	7060	4157	1146	171	261	153
Downstream	2	01	09-02-1999	09:54:24	01:00	10040	15720	5580	9446	15030	11140	17370	11950	2709	6645	3814	1056	149	260	123
Downstream	2	01	09-02-1999	09:56:54	01:00	9420	15050	5245	9186	14110	10560	16880	11600	2652	6472	3769	982	161	225	151
Downstream	2	01	09-02-1999	09:59:24	01:00	9779	15490	5364	9531	14750	10840	17190	12060	2808	6523	3802	1040	209	243	148
Downstream	2	01	09-02-1999	10:01:54	01:00	9101	14860	5119	9288	14260	10250	16810	12190	2782	6617	3999	1091	163	252	119
Downstream	2	01	09-02-1999	10:04:24	01:00	9409	15220	5404	9262	14280	10870	17100	11420	2663	6500	3765	978	160	244	131
Downstream	2	01	09-02-1999	10:06:54	01:00	9452	14910	5161	9028	14260	10540	16780	11870	2701	6551	3812	985	145	210	124
D. Bckgrnd	2	01	09-02-1999	10:14:44	01:00	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

Meas. Penetration	1.00	1.00	1.00	1.00	1.00	1.01	0.99	0.98	0.98	0.98	1.01	0.99	1.06	0.98	0.98
P100 correction values	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Corrected Penetration	1.00	1.00	1.00	1.00	1.00	1.01	0.99	0.98	0.98	0.98	1.01	0.99	1.06	0.98	0.98
Corrected Efficiency (%)	0	0	0	0	0	-1	1	2	2	2	-1	1	-6	2	2

Data Acceptance Criteria:

Total Challenge Counts for Each Channel:	96779	153130	53886	95516	147450	107240	174300	125630	28576	68930	39594	10869	1626	2612	1482
Data Quality Objective:	> 500	> 500	> 500	> 500	> 500	> 500	> 500	> 500	> 500	> 500	> 500	> 500	> 500	> 500	> 500
Does this meet DQO:	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes

Standard Deviation of Penetration for Each Channel :	0.04	0.04	0.05	0.05	0.05	0.04	0.05	0.08	0.07	0.07	0.09	0.11	0.18	0.13	0.16
Data Quality Objective:	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.30	<0.30	<0.30	<0.30	<0.30
Does this meet DQO:	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes

Maximum observed particle concentration (#/cc):	16.5
Data Quality Objective: max. allowable conc. (#/cc):	< 23
Does this meet the DQO:	Yes, (applies to all channels)

Test No. 09029905

Arrestor

Liquid-Phase

Particle Counts per Indicated OPC Channel (1-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)	0.28	0.37	0.47	0.52	0.66	0.94	1.22	1.51	1.88	2.07	2.83	3.77	4.71	5.18	6.60
Max. Diam. (um)	0.37	0.47	0.52	0.66	0.94	1.22	1.51	1.88	2.07	2.83	3.77	4.71	5.18	6.60	9.43
Geo. Mean Diam (um)	0.32	0.42	0.49	0.58	0.78	1.07	1.36	1.68	1.97	2.42	3.26	4.21	4.94	5.85	7.89

ENTER DATA BELOW

U. Bckgrnd	1	01	09-02-1999	10:27:07	01:00	0	0	0	0	0	0	0	0	0	0	0
Upstream	1	01	09-02-1999	10:33:41	01:00	9105	13860	4947	9378	14270	9736	16390	13670	2887	6855	4407
Upstream	1	01	09-02-1999	10:36:11	01:00	10010	15610	5375	10310	15950	10940	18560	14880	3200	7844	4839
Upstream	1	01	09-02-1999	10:38:41	01:00	10320	16250	5847	10580	16430	11540	19050	15210	3313	7901	4938
Upstream	1	01	09-02-1999	10:41:11	01:00	10340	16460	5781	10720	16650	11720	19180	15430	3427	8116	4978
Upstream	1	01	09-02-1999	10:43:41	01:00	10450	16410	5858	10570	16330	11410	19280	15220	3405	7841	4930
Upstream	1	01	09-02-1999	10:46:11	01:00	10540	16540	5893	10750	16900	11800	19730	15400	3446	8189	4801
Upstream	1	01	09-02-1999	10:48:41	01:00	9803	15690	5530	9962	15650	10880	18360	13730	3112	7328	4354
Upstream	1	01	09-02-1999	10:51:11	01:00	10400	16360	5774	10430	15900	11470	19310	14400	3226	7545	4416
Upstream	1	01	09-02-1999	10:53:41	01:00	10390	16080	5841	10350	16080	11520	19090	14240	3140	7539	4708
Upstream	1	01	09-02-1999	10:56:11	01:00	10600	16600	5837	10640	16420	11680	19730	14520	3343	7787	4649
U. Bckgrnd	1	01	09-02-1999	11:04:14	01:00	0	0	0	0	0	0	0	0	0	0	0

ENTER DATA BELOW

D. Bckgrnd	2	01	09-02-1999	10:28:22	01:00	0	0	0	0	0	0	0	0	0	0	0
Downstream	2	01	09-02-1999	10:34:56	01:00	6411	9541	3236	6074	8651	5408	8089	5539	987	2030	915
Downstream	2	01	09-02-1999	10:37:26	01:00	7147	11070	3749	6863	9914	6401	9465	6157	1140	2399	1019
Downstream	2	01	09-02-1999	10:39:56	01:00	7043	10660	3540	6715	9528	5931	9090	5918	1089	2275	958
Downstream	2	01	09-02-1999	10:42:26	01:00	7432	11370	3962	7016	10100	6590	9718	6282	1185	2443	1093
Downstream	2	01	09-02-1999	10:44:56	01:00	7593	11290	3915	7144	10270	6516	9627	6473	1170	2403	995
Downstream	2	01	09-02-1999	10:47:26	01:00	7257	11140	3821	7135	9871	6344	9464	6148	1142	2312	968
Downstream	2	01	09-02-1999	10:49:56	01:00	7620	11530	4023	7174	10000	6586	9592	6011	1154	2231	1018
Downstream	2	01	09-02-1999	10:52:26	01:00	7337	11230	3786	6981	9960	6431	9428	5700	1098	2244	967
Downstream	2	01	09-02-1999	10:54:56	01:00	7423	11370	3978	7041	10020	6431	9493	5832	1155	2169	949
Downstream	2	01	09-02-1999	10:57:26	01:00	7344	11000	3761	6723	9763	6232	9370	5798	1083	2244	939
D. Bckgrnd	2	01	09-02-1999	11:05:29	01:00	0	0	0	0	0	0	0	0	0	0	0

Meas. Penetration	0.71	0.69	0.67	0.66	0.61	0.56	0.49	0.41	0.34	0.30	0.21	0.12	0.07	0.05	0.03
P100 correction values	1.00	1.00	1.00	1.00	1.00	1.01	0.99	0.98	0.98	0.98	1.01	0.99	1.06	0.98	0.98
Corrected Penetration	0.71	0.69	0.67	0.67	0.61	0.55	0.50	0.42	0.35	0.30	0.21	0.12	0.06	0.05	0.03
Corrected Efficiency (%)	29	31	33	33	39	45	50	58	65	70	79	88	94	95	97

Data Acceptance Criteria:

Total Challenge Counts for Each Channel:	101958	159860	56683	103690	160580	112696	188680	146700	32499	76945	47020	12921	2090	3212	1794
Data Quality Objective:	> 500	> 500	> 500	> 500	> 500	> 500	> 500	> 500	> 500	> 500	> 500	> 500	> 500	> 500	> 500
Does this meet DQO:	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes

Standard Deviation of Penetration for Each Channel :	0.05	0.05	0.05	0.04	0.04	0.04	0.04	0.03	0.03	0.02	0.02	0.01	0.02	0.01	0.01
Data Quality Objective:	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.30	<0.30	<0.30	<0.30	<0.30
Does this meet DQO:	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes

Maximum observed particle concentration (#/cc):	17.8
Data Quality Objective: max. allowable conc. (#/cc):	< 23
Does this meet the DQO:	Yes, (applies to all channels)