

US EPA ARCHIVE DOCUMENT

Environmental Technology Verification Report

Paint Overspray Arrestor
AAF International
DriPak 90-95%

Prepared by



Research Triangle Institute

Under a Cooperative Agreement with



U.S. Environmental Protection Agency

US EPA ARCHIVE DOCUMENT

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Environmental Technology Verification Report

Paint Overspray Arrestor

AAF International DriPak 90-95%

Prepared by

Kathleen Owen
James Hanley
Jack Farmer

Air Pollution Control Technology Program
Research Triangle Institute
Research Triangle Park, NC 27709-2194

EPA Cooperative Agreement CR 826152-01-1

EPA Project Officer: Theodore G. Brna
Air Pollution Prevention and Control Division
National Risk Management Research Laboratory
Research Triangle Park, NC 27711

Notice

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UNITED STATES ENVIRONMENTAL PROTECTION AGENCY

Office of Research and Development

Washington, D.C. 20460



ENVIRONMENTAL TECHNOLOGY VERIFICATION PROGRAM
VERIFICATION STATEMENT

TECHNOLOGY TYPE:	PAINT OVERSPRAY ARRESTOR		
APPLICATION:	CONTROL OF PARTICLE EMISSIONS FROM AEROSPACE PAINT SPRAYING FACILITIES		
TECHNOLOGY NAME:	AAF DriPak 90-95%		
COMPANY:	AAF International		
ADDRESS:	215 Central Ave. Louisville, KY 40208	PHONE:	(502) 637-0195
		FAX:	(502) 637-0341
WEB SITE:	http://www.aafintl.com		
E-MAIL:	rlong@aafintl.com		

PROGRAM DESCRIPTION

The U.S. Environmental Protection Agency (EPA) has created the Environmental Technology Verification (ETV) Program to facilitate the deployment of innovative or improved environmental technologies through performance verification and dissemination of information. The goal of the ETV Program is to further environmental protection by substantially accelerating the acceptance and use of improved and cost-effective technologies. ETV seeks to achieve this goal by providing high quality, peer reviewed data on technology performance to those involved in the design, distribution, financing, permitting, purchase, and use of environmental technologies.

ETV works in partnership with recognized standards and testing organizations, stakeholder groups which consist of buyers, vendor organizations and permittees, and with the full participation of individual technology developers. The program evaluates the performance of innovative technologies by developing test plans that are responsive to the needs of stakeholders, conducting field or laboratory tests (as appropriate), collecting and analyzing data, and preparing peer reviewed reports. All evaluations are conducted in accordance with rigorous quality assurance protocols to ensure that data of known and adequate quality are generated and that the results are defensible.

The Air Pollution Control Technology (APCT) program, one of 12 technology areas under ETV, is operated by the Research Triangle Institute (RTI), in cooperation with EPA's National Risk Management Research Laboratory. APCT has recently evaluated the performance of paint overspray arrestors used primarily in the aerospace industry. This verification statement provides a summary of the test results for the AAF International AAF DriPak 90-95%.

VERIFICATION TEST DESCRIPTION

All tests were performed in accordance with the APCT “Generic Verification Protocol for Paint Overspray Arrestors.” The protocol incorporates all requirements of EPA Method 319: Determination of Filtration Efficiency for Paint Overspray Arrestors. [Method 319 is part of the National Emission Standards for Hazardous Air Pollutants (NESHAP) for Aerospace Manufacturing and Rework Facilities and was published in the *Federal Register* on March 27, 1998 (40 CFR Part 63).] The protocol also includes requirements for quality management, quality assurance, procedures for product selection, auditing of the test laboratories, and test reporting format.

Filtration efficiency is 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 arrestor are measured with an aerosol analyzer that simultaneously counts and sizes the particles in the aerosol stream. The aerosol analyzer covers the particle diameter size range from 0.3 to 10 μm in a series of contiguous sizing channels. Each sizing channel covers a narrow range of particle diameters. By taking the ratio of the downstream to upstream counts on a channel by channel basis, the filtration efficiency is computed for each of the sizing channels.

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 Six “no-filter” control tests (one performed prior to each arrestor test),
- C One high efficiency particulate air (HEPA) filter control test, and
- C One reference filter control test.

TECHNOLOGY DESCRIPTION

The AAF DriPak 90-95% arrestor is an eight-pocket bag filter with nominal dimensions of 24 x 24 x 15 in. (0.61 x 0.61 x 0.36 m). The arrestor has a metal frame, and the filter media color is yellow. The label is yellow, $\frac{1}{2}$ x 7 in. (1.3 x 17.8 cm) in size, and is affixed to the metal frame. The label includes the following information: DriPak Extended Surface Filter, 90-95% ASHRAE Efficiency, manufactured under the following US Patent: 4,356,011. 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.

VERIFICATION OF PERFORMANCE

Verification testing of the arrestor was performed from March 26 through 29, 1999, at the test facilities of RTI. For ready comparison, the filtration efficiency requirements of the NESHAP are tabulated with the test results in Tables 1 through 4. The test results indicate that the tested arrestor exceeded the requirements listed in Tables 1 and 2 for existing sources and those listed in Tables 3 and 4 for new sources. The pressure drop across the tested arrestors at 120 fpm (0.61 m/s) ranged from 0.18 to 0.23 in. H_2O (45 to 57 Pa) for the six arrestors tested.

The APCT quality assurance officer has reviewed the test results and the quality control data and has concluded that the data quality objectives given in the generic verification protocol have been attained.

This verification statement 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 report is valid for 12 months after the publication date 8-11-99.

**TABLE 1. EXISTING SOURCES*:
LIQUID-PHASE CHALLENGE AEROSOL PARTICLES**

Aerodynamic particle diameter range, μm	Filtration efficiency requirement, %	Filtration efficiency achieved, %
> 5.7	> 90	>99
> 4.1	> 50	>99
> 2.2	> 10	>99

**TABLE 2. EXISTING SOURCES*:
SOLID-PHASE CHALLENGE AEROSOL PARTICLES**

Aerodynamic particle diameter range, μm	Filtration efficiency requirement, %	Filtration efficiency achieved, %
> 8.1	> 90	>99
> 5.0	> 50	>99
> 2.6	> 10	99

**TABLE 3. NEW SOURCES*:
LIQUID-PHASE CHALLENGE AEROSOL PARTICLES**

Aerodynamic particle diameter range, μm	Filtration efficiency requirement, %	Filtration efficiency achieved, %
> 2.0	> 95	>99
> 1.0	> 80	93
> 0.42	> 65	76

**TABLE 4. NEW SOURCES*:
SOLID-PHASE CHALLENGE AEROSOL PARTICLES**

Aerodynamic particle diameter range, μm	Filtration efficiency requirement, %	Filtration efficiency achieved, %
> 2.5	> 95	99
> 1.1	> 85	91
> 0.70	> 75	82

*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.

Original Signed By
E. Timothy Oppelt
7/27/99

Original Signed By
Jack R. Farmer
7/29/99

E. Timothy Oppelt Date
Director
National Risk Management Research
Laboratory
Office of Research and Development
United States Environmental
Protection Agency

Jack R. Farmer Date
Program Manager,
Air Pollution Control Technology Program
Research Triangle Institute

NOTICE: EPA verifications are based on an evaluation of technology performance under specific, predetermined criteria and the appropriate quality assurance procedures. EPA and RTI make no expressed or implied warranties as to the performance of the technology and do not certify that a technology will always operate as verified. The end user is solely responsible for complying with any and all applicable federal, state, and local requirements. Mention of commercial product names does not imply endorsement.

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*)
<http://www.epa.gov/ncepihom/>

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 μm . 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 AAF International's DriPak 90-95% during the period March 26-29, 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 DriPak 90-95% exceeded the NESHAP requirements for new and existing sources.

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List of Abbreviations and Acronyms

APCT	Air Pollution Control Technology
APPCD	Air Pollution Prevention and Control Division
cfm	cubic feet per minute
cm	centimeter
DQO	data quality objective
EPA	U.S. Environmental Protection Agency
ETV	Environmental Technology Verification
ETVR	Environmental Technology Verification Report
fpm	feet per minute
HEPA	high efficiency particulate air
in.	inch
mm	millimeter
m/s	meters per second
NESHAP	National Emission Standards for Hazardous Air Pollutants
Pa	pascal
POA	paint overspray arrestor
QA	quality assurance
RTI	Research Triangle Institute
µm	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 Project 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 Ron Long of AAF International.

For more information on the Paint Overspray Arrestor Verification Testing, contact

James Hanley
Research Triangle Institute
P.O. Box 12194
Research Triangle Park, NC 27709-2194
919-541-5811

For more information on the AAF DriPak 90-95%, contact

Ron Long
AAF International
215 Central Ave.
Louisville, KY 40208
502-637-0195

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"¹ and the "Test/QA Plan for Paint Overspray Arrestors."² This protocol incorporates all requirements of EPA Method 319: Determination of Filtration Efficiency for Paint Overspray Arrestors. Method 319³ is part of the National Emission Standards for Hazardous Air Pollutants (NESHAP) for Aerospace Manufacturing and Rework Facilities.⁴ 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 μm in a series of contiguous sizing channels. Each sizing channel covered a narrow range of particle diameters. For example, channel 1 may cover from 0.3 to 0.4 μm , channel 2 from 0.4 to 0.5 μm , and channel 15 from 7 to 10 μm . By taking the ratio of the downstream to upstream counts on a channel by channel basis, 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 removed 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 μm and provided a sufficient upstream concentration in each of the sizing channels to allow accurate 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 1. Additional details on the test procedure are provided in Appendix A.

TABLE 1. TEST SERIES

RTI Test No.	TYPE OF TEST				Challenge Aerosol
	No-Filter	Test Arrestor	HEPA Filter	Reference Filter	
03269901	X				Solid-Phase
03269902				X	
03269903	X				
03269904		X			
03269905	X				
03269906		X			
03269907	X				
03269908		X			
03199907			X		
03269909	X				Liquid-Phase
03269910		X			
03269911	X				
03299901		X			
03299902	X				
03299903		X			

2.1 SELECTION OF TESTED PAINT OVERSPRAY ARRESTORS

The test arrestors (DriPak 90-95%) were supplied to the test laboratory directly from the manufacturer (AAF International) with a letter signed by James F. Douglas, V.P. Sales Air Filter Products, attesting that the arrestors were selected in an unbiased manner from a minimum of 100 similar arrestors and have not been treated in any manner different from the arrestors they offer to the public. The manufacturer supplied the test laboratory with 18 arrestors; from these 18, the test laboratory randomly selected six for testing.

SECTION 3 DESCRIPTION OF ARRESTOR

The AAF DriPak 90-95% arrestor is an eight-pocket bag filter with nominal dimensions of 24 x 24 x 15 in. (0.61 x 0.61 x 0.36 m). The arrestor has a metal frame, and the filter media color is yellow. The label is yellow, ½ x 7 in. (1.3 x 17.8 cm) dimension, and is affixed to the metal frame. The label includes the following information: DriPak Extended Surface Filter, 90-95% ASHRAE Efficiency, manufactured under the following US Patent: 4,356,011. In addition there were some illegible numbers that appeared to have been stamped on the label. 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.² As part of the Test/QA Plan, periodic audits are performed of the testing laboratory to ensure compliance with Method 319 facilities, equipment, and procedures. Additionally, the test results were reviewed by APCT personnel to ensure they met data quality objectives of Method 319, the Test Protocol, and the Test/QA Plan. Certificates of Calibration for the optical particle counter and the airflow reference device are provided in Appendix B.

4.2 RESULTS

Tables 2 and 3, and Figures 1 through 4, summarize the fractional filtration efficiency measurements for the solid- and liquid-phase tests, respectively. 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 m³/s)] is shown in Table 4. This pressure drop ranged from 0.18 to 0.23 in. H₂O (45 to 57 Pa) for the six arrestors tested.

Tables 5-8 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 exceeded the requirements listed in Tables 5 and 6 for existing sources and those listed in Tables 7 and 8 for new sources.

4.3 LIMITATIONS

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 report and the associated verification statement are valid for 12 months after the publication date.

SECTION 5 REFERENCES

1. Generic Verification Protocol for Paint Overspray Arrestors, Research Triangle Institute, Research Triangle Park, NC, October 1998.
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 2. 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
AAF Dri Pak 90-95%																
Run #1	03269904	75	81	85	88	93	96	98	99	100	100	100	100	100	100	100
Run #2	03269906	75	81	85	88	93	96	98	99	100	100	100	100	100	100	100
Run #3	03269908	75	80	85	88	92	96	98	99	100	100	100	100	100	100	100
Average		75	80	85	88	92	96	98	99	100	100	100	100	100	100	100
Interpolated Efficiency Values (%) for Two-Stage Criteria:																
Interpolated Efficiency Values (%) for Three-Stage Criteria:																
HEPA Filter Control Test (applicable to both solid and liquid phase conditions)																
Run #1	03199907	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100
Reference Filter QA Test																
Current	03269902	0	2	4	5	9	16	27	46	62	76	89	93	93	91	91
Baseline	03189903	1	3	4	5	8	15	26	44	61	75	90	94	94	95	95
Difference		0	-1	0	0	1	1	1	2	1	0	-1	-1	-1	-4	-3
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	03269903	1.00	1.01	1.02	1.01	1.02	1.02	1.01	1.02	1.03	1.03	1.04	1.04	0.98	0.94	1.01
Run #2	03269905	1.01	1.01	1.01	1.01	1.02	1.02	1.02	1.01	1.02	1.02	1.06	1.01	1.01	0.99	0.95
Run #3	03269907	0.99	0.99	0.99	1.00	1.00	1.00	1.00	1.00	1.03	1.02	1.03	1.01	0.99	1.04	0.94

TABLE 3. SUMMARY OF LIQUID- 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)	0.28	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	
AAF Dri Pak 90-95%																
Run #1	03269910	71	76	80	83	89	94	97	99	100	100	100	100	100	100	
Run #2	03299901	72	76	80	84	89	94	98	99	100	100	100	100	100	100	
Run #3	03299903	71	76	80	83	89	94	97	99	100	100	100	100	100	100	
Average		71	76	80	83	89	94	97	99	100	100	100	100	100	100	
Interpolated Efficiency Values (%) for Two-Stage Criteria:																
2.20 um (> 10% required):	100															
4.10 um (> 50% required):	100															
5.70 um (> 90% required):	100															
Interpolated Efficiency Values (%) for Three-Stage Criteria:																
0.42 um (> 65% required):	76															
1.00 um (> 80% required):	93															
2.00 um (> 95% required):	100															
"No Filter" Control Tests																
		Penetration For Each Size Range														
Run #1	03269909	0.99	1.00	0.99	1.00	1.00	0.99	1.01	1.00	1.02	1.03	1.02	1.04	1.13	1.03	0.97
Run #2	03269911	0.99	0.99	0.99	0.99	0.99	1.00	1.00	0.98	0.99	1.02	1.03	1.02	1.02	1.04	1.01
Run #3	03299902	0.98	0.99	0.99	0.99	1.00	0.99	1.00	0.99	1.00	1.01	1.04	1.05	0.99	1.03	0.97

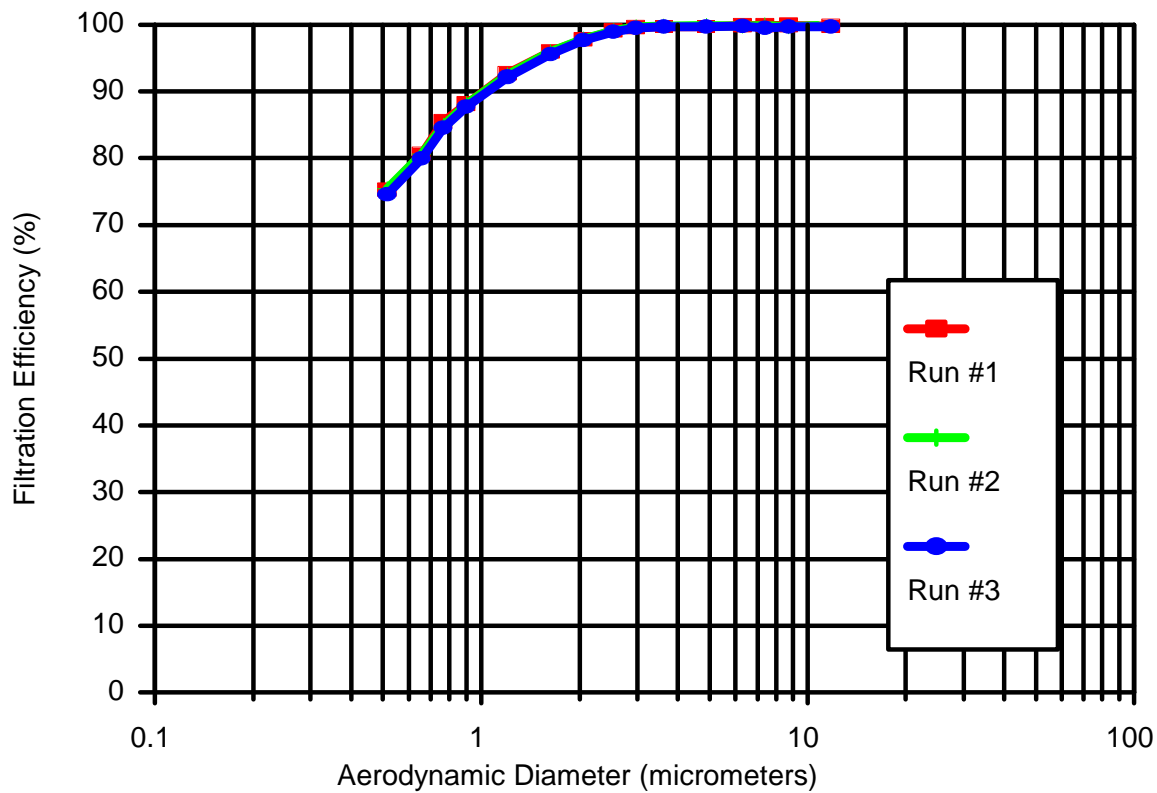


Figure 1. Triplicate solid-phase particle removal efficiency curves for AAF DriPak 90-95% paint overspray arrestor.

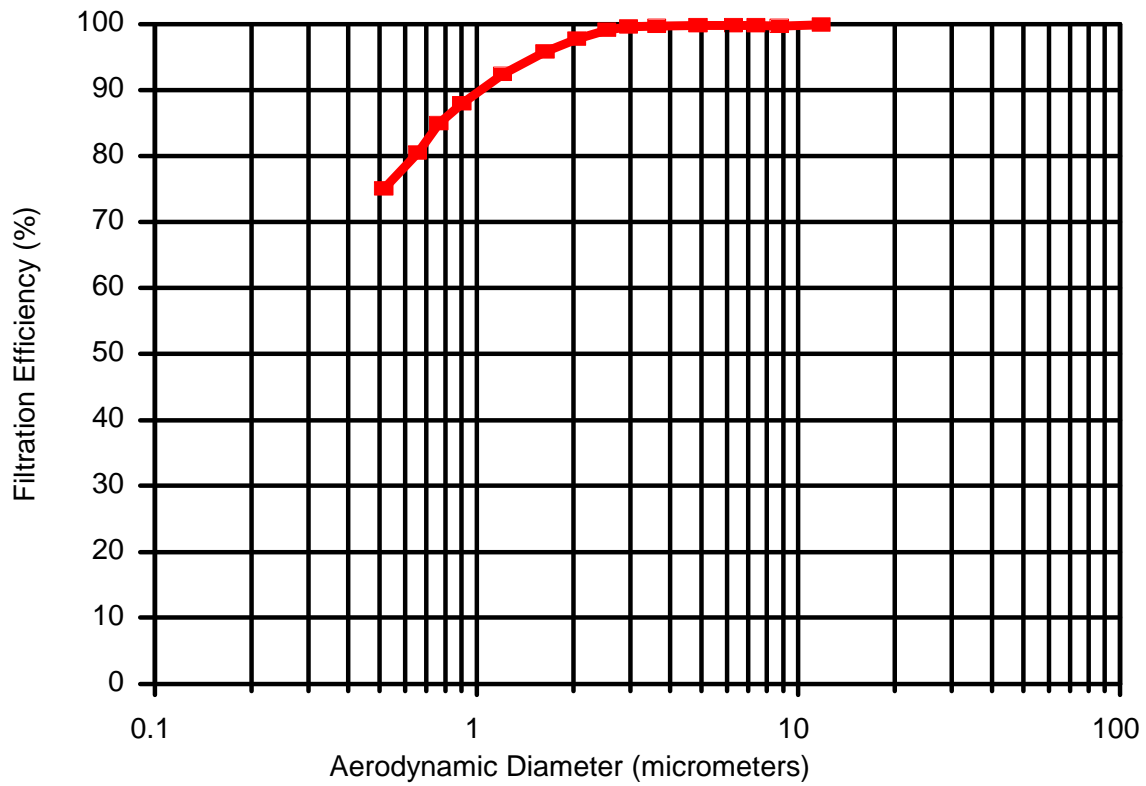


Figure 2. Average of the solid-phase particle removal efficiency curves for AAF DriPak 90-95% paint overspray arrester.

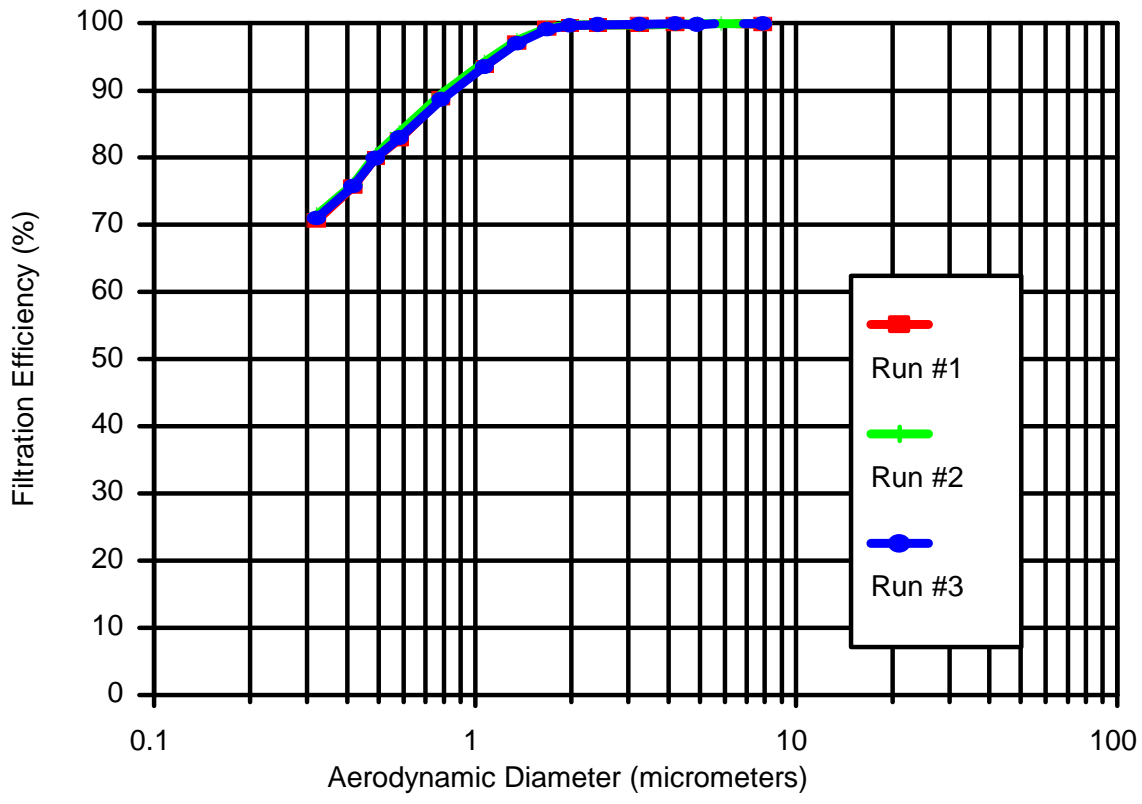


Figure 3. Triplicate liquid-phase particle removal efficiency curves for AAF DriPak 90-95% paint overspray arrester.

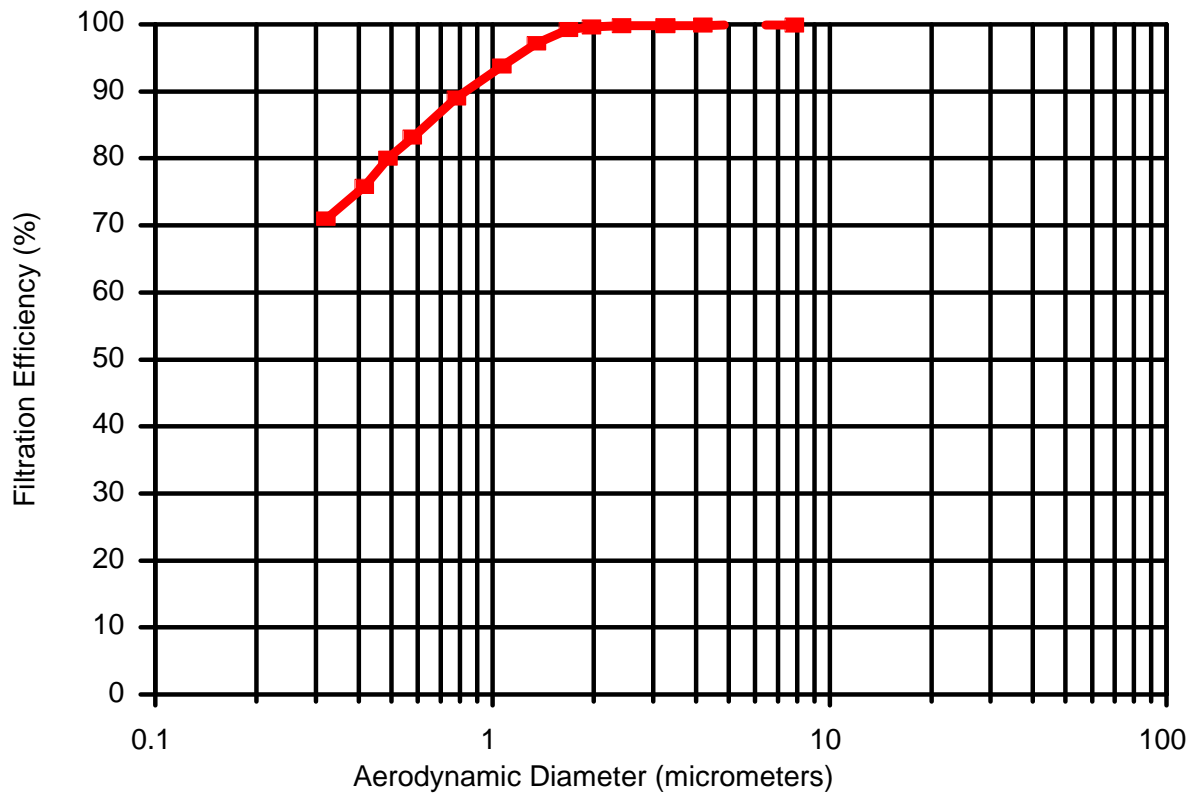


Figure 4. Average of the liquid-phase particle removal efficiency curves for AAF DriPak 90-95% paint overspray arrestor.

TABLE 4
SUMMARY OF PRESSURE DROP MEASUREMENTS

Test No.	Initial Pressure Drop (inch H ₂ O)
03269904	0.18
03269906	0.19
03269908	0.19
03269910	0.23
03299901	0.23
03299903	0.22

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

Aerodynamic particle diameter range, μm	Filtration efficiency requirement, %	Filtration efficiency achieved, %
> 5.7	> 90	>99
> 4.1	> 50	>99
> 2.2	> 10	>99

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

Aerodynamic particle diameter range, μm	Filtration efficiency requirement, %	Filtration efficiency achieved, %
> 8.1	> 90	>99
> 5.0	> 50	>99
> 2.6	> 10	99

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

Aerodynamic particle diameter range, μm	Filtration efficiency requirement, %	Filtration efficiency achieved, %
> 2.0	> 95	>99
> 1.0	> 80	93
> 0.42	> 65	76

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

Aerodynamic particle diameter range, μm	Filtration efficiency requirement, %	Filtration efficiency achieved, %
> 2.5	> 95	99
> 1.1	> 85	91
> 0.70	> 75	82

* 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 m³/s) at 13 in. H₂O (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 m³/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.

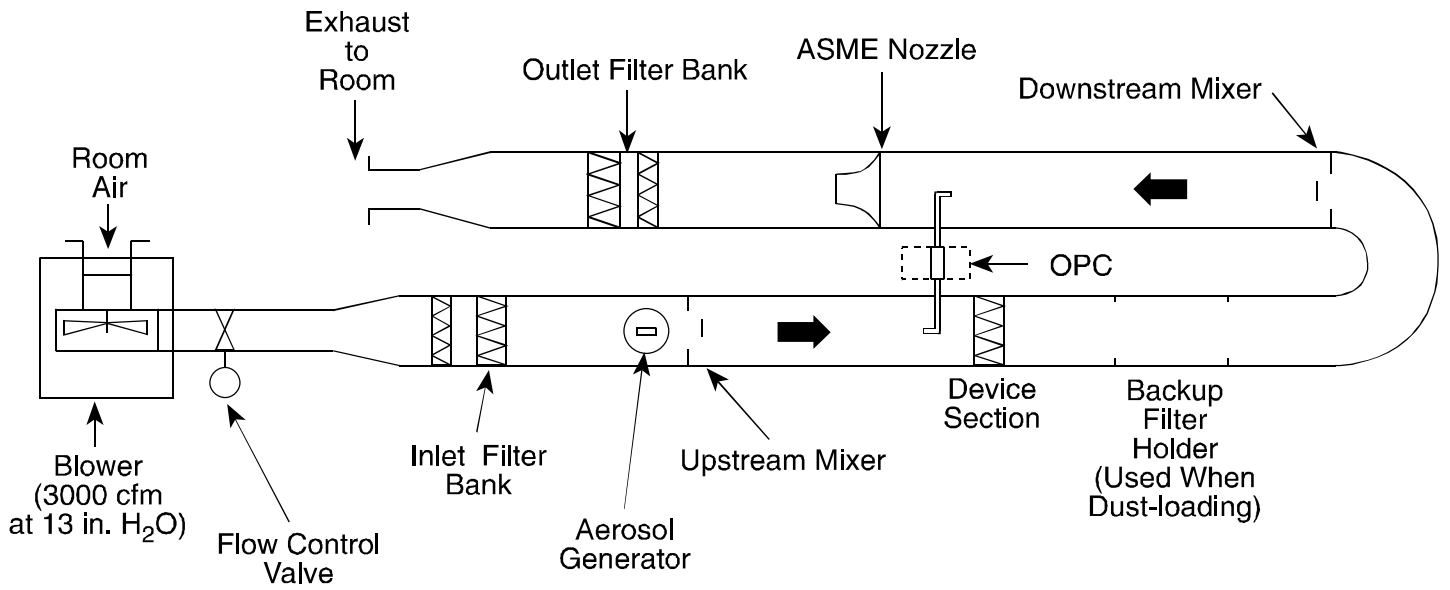
AIRFLOW

Airflow was measured with a 4 in. (0.1 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.

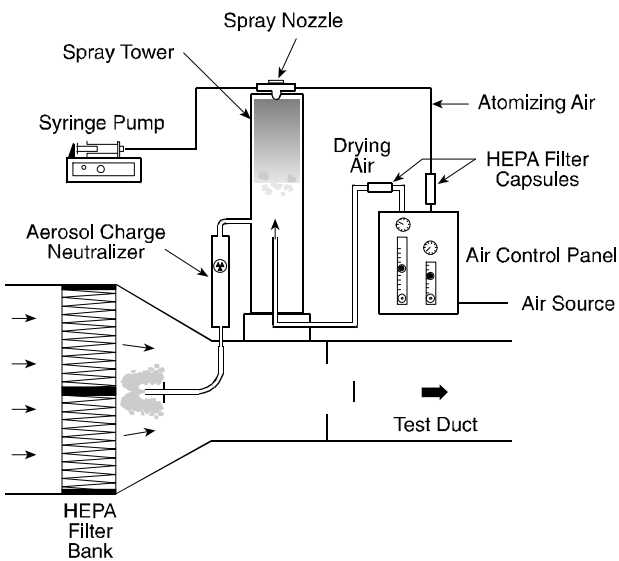
OPTICAL PARTICLE COUNTER (OPC)

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 m³/s).

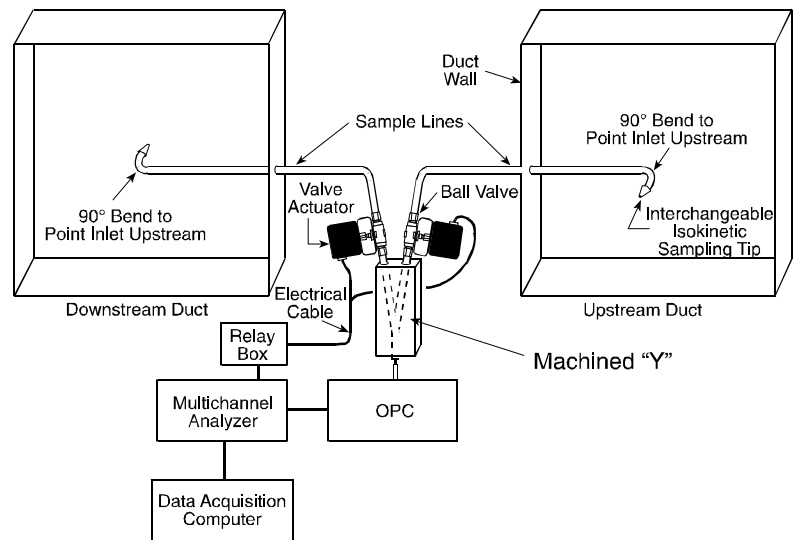
The output of the OPC was input to a Climet Instruments Model 8040 multichannel analyzer equipped with Model 05872005 and 05872006 input boards. These boards provide 16 sizing channels covering the range from 0.3 to 10 μm. The 8040 was also equipped with a Model CI-298 sequential interface board. This 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 ft³ (1 L) of distilled water. Both oleic acid and KCl are compatible with accurate measurement by the optical particle counter.

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 (4.2×10^{-5} ft³/min) by means of a pump. Varying the operating air pressure of the generator allows control of the mean diameter of the challenge aerosol.

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 five measurements 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 five additional upstream and downstream background measurements.

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

- U = Upstream particle count
- D = Downstream particle count
- U_b = Upstream background count
- D_b = Downstream background count
- P_o = observed penetration = D/U

P_{100} = 100% penetration value determined from the control tests

P = Penetration corrected for P_{100} value

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 μm 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_{Aero}) is related to the physical diameter (D_{Physical}) by:

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

where

ρ_{Particle} is the density of the particle in g/cm^3 .

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

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

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

χ is the dynamic shape factor.

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

KCl has a density of $1.98 \text{ g}/\text{cm}^3$. 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

OPC Channel Number	Particle Diameter Size Range (μm)*		
	PSL Physical Diameter	OLEIC ACID Aerodynamic Diameter	KCl 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.

APPENDIX B

Certificates of Calibration

Certificate of Traceability

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

Certificate Number: 1046 **Date: 28-Oct-98** **P.O. 00328** **Order/RMA: 104638**
Customer Number:

Calibration Standards Information
 The following standards and equipment were used as references for this calibration.

Tested By	Date Tested	Inst. No.	Cal. Due	NIST Test Numbers
LOZADA	10/23/98	747	4/9/00	259340; 257602; 258909; 258598; 260222; 811/256622;
		746	4/9/00	811/258522; 811/260178;
		922	6/8/00	836/259947-98 ;
		881	11/16/98	811/257078 ; 247770 ; 263906 ; 811/255474 ; 253699 ; USN22783C ; Chem. Const. ; 254227 ; 811/254736 ; 811/251992 ; 251971 ; 811/251741 ; 811/253662 ; 811/256216 ; 811802 ;
		857	6/8/00	836/259947-98 ; ;
		794	3/18/99	
		666	2/21/00	811/255785 ; 251971 ; 811/259304-98 ; 811/257773 ; 256216 ; ;
		399	11/12/98	P-8531A ; P-8531B ; 38126 ; 254160 ; 255302 ;
		326	2/4/99	P-8531A ; P-8531B ; 38126 ; 254160 ; 259009 ;
		319	11/12/98	P-8531A ; P-8531B ; 38126 ; 254160 ; 255302 ;
		301	12/11/98	836/257126-96 ;

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 natural physical constants. The policies and procedures used comply with MIL-STD-45662A. This certificate shall not be reproduced except in full, without the written consent of Alnor.

Reviewed by  28-Oct-98
 Date

ALNOR
A T S P Company
 Alnor Instrument Company
 7555 N. Linder Avenue, Skokie, IL 60077
 Tel. 847-677-3500 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.

QUALITY ASSURANCE INSPECTOR
MERIAM INSTRUMENT

QUALITY ASSURANCE MANAGER
MERIAM INSTRUMENT

US EPA ARCHIVE DOCUMENT

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 61882

CONTROL NUMBER: LC503501

DATE CALIBRATED: 2/14/1999 NEXT CALIBRATION: 8/14/1999

RECOMMENDED CALIBRATION INTERVAL: 6 months

L. Sparks
CALIBRATED BY

Jim R. Guter
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)
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:

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

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:

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

Corrected Efficiency (%): 100 x (1 - Corrected Penetration)

DQO Data Quality Objective

Test No. 03269901
 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 03-26-1999 06:40:54 01:00	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Upstream	1 01 03-26-1999 06:52:50 01:00	9376	14070	4393	8086	11980	7441	9578	8765	2087	4475	2637	872	156	238
Upstream	1 01 03-26-1999 06:55:20 01:00	9339	14090	4443	7734	11960	7471	9469	8586	2069	4453	2647	862	155	232
Upstream	1 01 03-26-1999 06:57:50 01:00	9063	13830	4256	7988	11670	7228	9108	8368	1867	4563	2629	787	116	235
Upstream	1 01 03-26-1999 07:00:20 01:00	9165	13760	4255	7667	11450	7230	9370	8303	2024	4331	2633	890	165	240
Upstream	1 01 03-26-1999 07:02:50 01:00	9266	13930	4405	7866	11700	7308	9314	8431	2044	4458	2634	896	156	272
Upstream	1 01 03-26-1999 07:05:20 01:00	8998	13460	4272	7525	11240	7197	9107	8250	1929	4292	2536	870	121	227
Upstream	1 01 03-26-1999 07:07:50 01:00	8866	13060	4136	7711	11320	6973	9279	8698	2119	4719	2951	917	171	297
Upstream	1 01 03-26-1999 07:10:20 01:00	9309	13670	4391	7999	11850	7345	9462	9149	2159	4855	2819	990	173	274
Upstream	1 01 03-26-1999 07:12:50 01:00	9154	13600	4269	7964	11880	7404	9268	9081	2289	4819	2977	1005	169	271
Upstream	1 01 03-26-1999 07:15:20 01:00	9058	13350	4344	7834	11610	7354	9423	9146	2283	4866	2958	1016	171	276
U. Bckgrnd	1 01 03-26-1999 07:24:17 01:00	1	1	0	3	0	0	0	1	0	0	0	0	0	0

ENTER DATA BELOW

D. Bckgrnd	2 01 03-26-1999 06:42:09 01:00	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Downstream	2 01 03-26-1999 06:54:05 01:00	9444	13920	4485	8268	12230	7793	9800	8958	2059	4655	2672	946	159	234
Downstream	2 01 03-26-1999 06:56:35 01:00	9347	14140	4292	8049	11810	7440	9468	8815	2012	4518	2723	876	139	212
Downstream	2 01 03-26-1999 06:59:05 01:00	9217	14100	4368	8037	11990	7406	9282	8750	2051	4419	2764	854	122	243
Downstream	2 01 03-26-1999 07:01:35 01:00	9362	13960	4429	7917	11920	7399	9462	8658	2079	4460	2630	938	130	235
Downstream	2 01 03-26-1999 07:04:05 01:00	9022	13950	4382	7793	11740	7439	9271	8458	1979	4464	2729	908	144	216
Downstream	2 01 03-26-1999 07:06:35 01:00	9170	13520	4471	7505	11460	7131	9011	7981	1979	4282	2568	849	120	217
Downstream	2 01 03-26-1999 07:09:05 01:00	9040	13300	4271	7930	11880	7309	9274	8846	2166	4873	2969	1007	194	270
Downstream	2 01 03-26-1999 07:11:35 01:00	9459	13680	4382	8088	12270	7386	9603	9064	2274	4872	3094	1043	171	280
Downstream	2 01 03-26-1999 07:14:05 01:00	9343	13460	4382	7920	12320	7378	9488	9378	2266	4878	3062	1019	181	266
Downstream	2 01 03-26-1999 07:16:35 01:00	8860	13440	4226	7916	11930	7350	9301	9126	2186	4824	3100	1080	166	250
D. Bckgrnd	2 01 03-26-1999 07:25:32 01:00	0	0	0	0	0	0	0	1	0	0	1	0	0	0

Meas. Penetration	1.01	1.00	1.01	1.01	1.02	1.01	1.01	1.01	1.01	1.01	1.01	1.03	1.05	0.98	0.95
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	1.00	1.01	1.01	1.02	1.01	1.01	1.01	1.01	1.01	1.01	1.03	1.05	0.98	0.95
Corrected Efficiency (%)	-1	0	-1	-1	-2	-1	-1	-1	-1	-1	-1	-3	-5	2	5

Data Acceptance Criteria:

Total Challenge Counts for Each Channel:	91594	136820	43164	78374	116660	72951	93378	86777	20870	45831	27421	9105	1553	2562	1658
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	<0.30	<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):

Data Quality Objective: max. allowable conc. (#/cc):	12.1
Does this meet the DQO:	< 23
	Yes, (applies to all channels)

Test No. 03269902
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	03-26-1999	07:39:22	01:00	0	1	6	0	1	0	1	0	0	1	1	0	0	0	0
Upstream	1 01	03-26-1999	07:48:26	01:00	10840	16090	5254	9332	13710	8482	11240	10520	2505	5578	3467	1167	182	293	227
Upstream	1 01	03-26-1999	07:50:56	01:00	10530	15340	5046	9206	13640	8300	10780	10410	2441	5434	3234	1090	206	287	196
Upstream	1 01	03-26-1999	07:53:26	01:00	10440	15790	4931	9310	13640	8374	10910	10500	2569	5361	3418	1091	160	308	222
Upstream	1 01	03-26-1999	07:55:56	01:00	10340	15810	5019	9166	13520	8317	10820	10290	2536	5503	3338	1054	212	331	225
Upstream	1 01	03-26-1999	07:58:26	01:00	10170	15390	5057	9064	13550	8162	10490	10220	2536	5244	3298	1105	172	290	195
Upstream	1 01	03-26-1999	08:00:56	01:00	10420	15520	5065	9151	13690	8320	10840	10290	2655	5551	3275	1211	191	315	221
Upstream	1 01	03-26-1999	08:03:26	01:00	9577	14440	4601	8286	12440	7552	9893	9011	2212	4765	2799	929	179	237	176
Upstream	1 01	03-26-1999	08:05:56	01:00	10580	15560	5027	8911	13120	8194	10730	9905	2373	4841	3127	1017	137	296	185
Upstream	1 01	03-26-1999	08:08:26	01:00	10840	15800	5019	9302	13440	8294	10740	9864	2431	5129	3083	1044	167	295	210
Upstream	1 01	03-26-1999	08:10:56	01:00	10350	15550	4914	8838	13230	7953	10520	9791	2362	5023	3049	1001	189	279	187
U. Bckgrnd	1 01	03-26-1999	08:22:25	01:00	0	1	0	0	0	0	0	0	0	0	0	0	0	1	0

ENTER DATA BELOW

D. Bckgrnd	2 01	03-26-1999	07:40:37	01:00	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Downstream	2 01	03-26-1999	07:49:41	01:00	10580	15940	4963	8993	12700	7282	8259	5990	1060	1448	433	104	22	27	20
Downstream	2 01	03-26-1999	07:52:11	01:00	10540	15550	4907	8850	12800	7203	8156	5886	1037	1360	404	79	13	30	21
Downstream	2 01	03-26-1999	07:54:41	01:00	10150	15320	4817	8746	12680	6925	8001	5866	1017	1402	420	101	19	28	21
Downstream	2 01	03-26-1999	07:57:11	01:00	10470	15320	4906	8875	12600	7136	8069	5927	1023	1443	411	75	17	32	13
Downstream	2 01	03-26-1999	07:59:41	01:00	10420	15030	5006	8708	12440	7097	7877	5811	1042	1381	406	100	13	28	24
Downstream	2 01	03-26-1999	08:02:11	01:00	10280	15030	4825	8655	12350	6844	7891	5659	940	1439	374	92	11	22	16
Downstream	2 01	03-26-1999	08:04:41	01:00	10420	15030	4791	8644	12090	6781	7546	5051	844	1066	283	62	8	14	11
Downstream	2 01	03-26-1999	08:07:11	01:00	10470	15180	4793	8666	12590	6885	7591	5047	821	1058	271	48	8	20	14
Downstream	2 01	03-26-1999	08:09:41	01:00	10670	15550	4922	8627	12440	7022	7647	5122	760	1118	231	60	5	16	11
Downstream	2 01	03-26-1999	08:12:11	01:00	10490	15310	4708	8584	12020	6829	7483	5253	801	1145	344	76	15	26	19
D. Bckgrnd	2 01	03-26-1999	08:23:40	01:00	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0

Meas. Penetration	1.00	0.99	0.97	0.96	0.93	0.85	0.73	0.55	0.38	0.25	0.11	0.07	0.07	0.08	0.08
P100 correction values	1.01	1.00	1.01	1.01	1.02	1.01	1.01	1.01	1.01	1.01	1.03	1.05	0.98	0.95	0.95
Corrected Penetration	1.00	0.98	0.96	0.95	0.91	0.84	0.73	0.54	0.38	0.24	0.11	0.07	0.07	0.09	0.09
Corrected Efficiency (%)	0	2	4	5	9	16	27	46	62	76	89	93	93	91	91

Data Acceptance Criteria:

Total Challenge Counts for Each Channel:	104087	155290	49933	90566	133980	81948	106963	100801	24620	52429	32088	10709	1795	2931	2044
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	0.03	0.03	0.04	0.05	0.05	0.03	0.02	0.02	0.03	0.02	0.02
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):	14.0
Data Quality Objective: max. allowable conc. (#/cc):	< 23
Does this meet the DQO:	Yes, (applies to all channels)

Test No. 03269903
 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	03-26-1999	08:37:31	01:00	0	1	0	1	2	0	1	0	0	0	0	0			
Upstream	1 01	03-26-1999	08:46:38	01:00	10280	15520	5020	8878	13380	8183	10590	9829	2264	5152	3149	1055	171	305	208
Upstream	1 01	03-26-1999	08:49:08	01:00	10220	15200	4790	8696	13210	7963	10490	9674	2280	5054	3024	1009	167	301	187
Upstream	1 01	03-26-1999	08:51:38	01:00	10210	15220	4696	8712	12800	8014	10210	9533	2381	5067	2996	1022	182	290	201
Upstream	1 01	03-26-1999	08:54:08	01:00	10160	15120	4691	8705	12930	7812	10160	9477	2175	5072	2976	943	176	304	169
Upstream	1 01	03-26-1999	08:56:38	01:00	10110	14940	4695	8871	12760	7979	10190	9546	2244	4927	2949	986	179	273	190
Upstream	1 01	03-26-1999	08:59:08	01:00	9940	14860	4646	8381	12740	7771	10070	9119	2186	4819	2849	992	170	298	223
Upstream	1 01	03-26-1999	09:01:38	01:00	8998	13350	4180	7866	11760	7208	9548	9015	2338	4878	2889	1050	169	263	209
Upstream	1 01	03-26-1999	09:04:08	01:00	10010	14650	4948	8852	13000	7923	10330	10040	2443	5344	3191	1107	193	350	197
Upstream	1 01	03-26-1999	09:06:38	01:00	10190	15230	4815	8807	13300	8167	10620	10280	2499	5258	3222	1112	174	305	210
Upstream	1 01	03-26-1999	09:09:08	01:00	10140	15210	4618	8877	13320	8124	10430	9989	2550	5307	3271	1169	170	282	184
U. Bckgrnd	1 01	03-26-1999	09:16:15	01:00	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

ENTER DATA BELOW

D. Bckgrnd	2 01	03-26-1999	08:38:46	01:00	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0
Downstream	2 01	03-26-1999	08:47:53	01:00	10310	15580	4945	8854	13220	8060	10640	9871	2396	5076	3177	1059	190	272	207
Downstream	2 01	03-26-1999	08:50:23	01:00	9866	14990	4573	8500	12850	7858	10160	9557	2303	5090	3104	981	167	252	203
Downstream	2 01	03-26-1999	08:52:53	01:00	10120	15610	4830	8883	13170	8306	10380	9687	2338	5090	3139	1079	170	271	201
Downstream	2 01	03-26-1999	08:55:23	01:00	9954	14900	4814	8621	12900	7877	10310	9566	2229	5107	3129	1005	158	282	208
Downstream	2 01	03-26-1999	08:57:53	01:00	10040	15070	4824	8812	12990	8163	10240	9665	2352	5133	2952	992	182	284	186
Downstream	2 01	03-26-1999	09:00:23	01:00	9909	14940	4700	8384	13000	7926	10220	9780	2388	5005	2907	1055	147	248	173
Downstream	2 01	03-26-1999	09:02:53	01:00	10060	15030	4870	8817	13270	8216	10860	10340	2634	5454	3387	1177	178	293	191
Downstream	2 01	03-26-1999	09:05:23	01:00	10080	14580	4899	8907	13430	8265	10420	10210	2525	5506	3295	1112	153	286	218
Downstream	2 01	03-26-1999	09:07:53	01:00	9922	14740	4670	8695	13250	7913	10370	9731	2446	5445	3289	1185	162	279	207
Downstream	2 01	03-26-1999	09:10:23	01:00	9943	14830	4716	8995	13250	8035	10200	10010	2492	5309	3349	1166	203	320	212
D. Bckgrnd	2 01	03-26-1999	09:17:30	01:00	0	1	0	0	0	0	1	0	0	0	0	0	0	0	0

Meas. Penetration	1.00	1.01	1.02	1.01	1.02	1.02	1.01	1.02	1.03	1.03	1.04	1.04	0.98	0.94	1.01
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	1.01	1.02	1.01	1.02	1.02	1.01	1.02	1.03	1.03	1.04	1.04	0.98	0.94	1.01
Corrected Efficiency (%)	0	-1	-2	-1	-2	-2	-1	-2	-3	-3	-4	-4	2	6	-1

Data Acceptance Criteria:

Total Challenge Counts for Each Channel:	100258	149300	47099	86645	129200	79144	102638	96502	23360	50878	30516	10445	1751	2971	1978
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	0.05	0.05	0.04	0.04	0.04	0.04	0.05	0.08	0.05	0.07	0.10	0.11	0.10	0.11
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):	13.4
Data Quality Objective: max. allowable conc. (#/cc):	< 23
Does this meet the DQO:	Yes, (applies to all channels)

Test No. 03269904
 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	03-26-1999	09:36:42	01:00	0	0	0	0	0	0	0	0	0	0	0				
Upstream	1	01	03-26-1999	09:44:33	01:00	10270	15420	4866	8783	13160	8196	10300	9584	2265	5080	2966	1043	177	253	191
Upstream	1	01	03-26-1999	09:47:03	01:00	10130	15310	4739	8673	13210	8110	10550	9753	2334	5086	2988	1018	202	301	184
Upstream	1	01	03-26-1999	09:49:33	01:00	9980	14840	4718	8434	12630	7879	9909	9254	2253	4773	2830	982	151	264	201
Upstream	1	01	03-26-1999	09:52:03	01:00	10280	15160	4763	8631	12780	8071	10300	9508	2297	5074	3002	1000	196	308	190
Upstream	1	01	03-26-1999	09:54:33	01:00	10000	14840	4751	8617	12560	7958	10130	9394	2253	4872	2978	1046	160	247	170
Upstream	1	01	03-26-1999	09:57:03	01:00	9884	14510	4690	8297	12540	7671	9880	9219	2304	4884	2880	1032	160	278	187
Upstream	1	01	03-26-1999	09:59:33	01:00	9471	14120	4532	8431	12440	7806	9840	9335	2348	5051	3098	1028	164	304	193
Upstream	1	01	03-26-1999	10:02:03	01:00	9816	14500	4732	8657	12870	7757	10120	9787	2492	5316	3090	1150	178	278	222
Upstream	1	01	03-26-1999	10:04:33	01:00	9743	15060	4871	8858	13320	7960	10400	10030	2508	5349	3267	1103	179	322	225
Upstream	1	01	03-26-1999	10:07:03	01:00	10080	15140	4794	8843	13060	7974	10560	10120	2512	5398	3225	1074	173	343	214
U. Bckgrnd	1	01	03-26-1999	10:16:07	01:00	1	1	0	1	0	0	0	0	0	0	0	0	0	0	0

ENTER DATA BELOW

D. Bckgrnd	2	01	03-26-1999	09:37:57	01:00	2	8	1	2	2	2	0	1	1	0	0	0	0	1	0
Downstream	2	01	03-26-1999	09:45:48	01:00	2556	2828	671	982	961	293	231	73	13	14	5	1	0	0	0
Downstream	2	01	03-26-1999	09:48:18	01:00	2478	2865	668	981	952	333	203	74	6	14	8	1	0	1	0
Downstream	2	01	03-26-1999	09:50:48	01:00	2520	2989	697	967	946	339	218	64	11	15	6	0	0	0	0
Downstream	2	01	03-26-1999	09:53:18	01:00	2454	2782	684	1041	885	320	230	78	7	11	9	0	1	0	1
Downstream	2	01	03-26-1999	09:55:48	01:00	2428	2770	678	911	859	298	203	78	15	9	7	1	0	1	1
Downstream	2	01	03-26-1999	09:58:18	01:00	2460	2868	677	1000	940	277	192	66	10	8	5	0	2	0	0
Downstream	2	01	03-26-1999	10:00:48	01:00	2438	2987	722	1085	1009	334	233	89	8	13	4	1	0	1	0
Downstream	2	01	03-26-1999	10:03:18	01:00	2483	2960	738	1033	958	340	227	95	8	18	8	2	1	0	0
Downstream	2	01	03-26-1999	10:05:48	01:00	2402	2887	765	1137	1032	348	268	88	15	23	8	3	0	0	0
Downstream	2	01	03-26-1999	10:08:18	01:00	2461	2982	710	1142	1057	327	221	86	14	14	11	3	0	1	1
D. Bckgrnd	2	01	03-26-1999	10:17:22	01:00	2	0	0	0	1	0	0	1	1	1	0	0	0	0	0

Meas. Penetration	0.25	0.19	0.15	0.12	0.07	0.04	0.02	0.01	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	1.00	1.01	1.02	1.01	1.02	1.02	1.01	1.02	1.03	1.03	1.04	1.04	1.04	0.98	0.94	1.01				
Corrected Penetration	0.25	0.19	0.15	0.12	0.07	0.04	0.02	0.01	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 (%)	75	81	85	88	93	96	98	99	100	100	100	100	100	100	100	100	100	100	100	100

Data Acceptance Criteria:

Total Challenge Counts for Each Channel:	99654	148900	47456	86224	128570	79382	101989	95984	23566	50883	30324	10476	1740	2898	1977
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 :	0.01	0.01	0.01	0.01	0.01	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	<0.10	<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): 13.2
 Data Quality Objective: max. allowable conc. (#/cc): < 23
 Does this meet the DQO: Yes, (applies to all channels)

Test No. 03269905
 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 03-26-1999 10:27:17 01:00	0	0	0	0	2	0	0	0	0	0	0	0	0	0	0
Upstream	1 01 03-26-1999 10:35:14 01:00	10010	14730	4791	8819	13160	8006	10320	9985	2412	5376	3148	1124	201	279	201
Upstream	1 01 03-26-1999 10:37:44 01:00	9887	14860	4749	8289	13000	7867	10120	9868	2418	5212	3121	1174	169	308	208
Upstream	1 01 03-26-1999 10:40:14 01:00	9692	14420	4659	8427	12670	7768	10260	9961	2429	5326	3132	1124	187	323	208
Upstream	1 01 03-26-1999 10:42:44 01:00	9775	14340	4680	8600	12680	7657	9750	9818	2431	5157	3088	1056	171	316	218
Upstream	1 01 03-26-1999 10:45:14 01:00	9512	14330	4587	8585	12920	7719	10020	9712	2495	5320	3136	1108	192	302	211
Upstream	1 01 03-26-1999 10:47:44 01:00	9454	14060	4619	8584	12520	7617	9970	9631	2364	5117	3053	1142	186	297	207
Upstream	1 01 03-26-1999 10:50:14 01:00	9021	13590	4328	7787	11480	7145	9212	8776	1982	4510	2688	909	151	261	148
Upstream	1 01 03-26-1999 10:52:44 01:00	10110	14990	4877	8587	12950	7846	10220	9625	2359	4967	2916	1009	176	265	191
Upstream	1 01 03-26-1999 10:55:14 01:00	9962	14950	4614	8516	12770	8016	9948	9401	2264	5026	2949	1005	182	286	231
Upstream	1 01 03-26-1999 10:57:44 01:00	9922	14740	4732	8588	12660	7997	10350	9441	2245	4896	2882	1038	159	274	206
U. Bckgrnd	1 01 03-26-1999 11:10:56 01:00	8	0	0	3	1	1	0	0	0	0	0	0	0	0	0

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D. Bckgrnd	2 01 03-26-1999 10:28:32 01:00	1	0	0	0	0	0	1	0	0	0	0	0	1	0	0
Downstream	2 01 03-26-1999 10:36:29 01:00	9993	15080	4978	8942	13410	8178	10530	10290	2603	5665	3326	1124	178	297	213
Downstream	2 01 03-26-1999 10:38:59 01:00	9878	14860	4764	8784	13340	8114	10390	10110	2534	5486	3325	1121	195	291	188
Downstream	2 01 03-26-1999 10:41:29 01:00	9875	14510	4696	8748	12820	7839	10230	9847	2496	5264	3321	1117	188	275	194
Downstream	2 01 03-26-1999 10:43:59 01:00	9791	14640	4800	8602	12970	7770	10340	10000	2401	5316	3250	1151	167	303	195
Downstream	2 01 03-26-1999 10:46:29 01:00	9583	14440	4695	8451	12830	7889	10070	9840	2387	5314	3310	1098	189	299	218
Downstream	2 01 03-26-1999 10:48:59 01:00	9484	14160	4573	8470	12760	7881	9848	9720	2398	5278	3317	1137	197	330	205
Downstream	2 01 03-26-1999 10:51:29 01:00	9783	14590	4735	8469	12680	7871	9895	9558	2305	4980	3012	985	176	269	182
Downstream	2 01 03-26-1999 10:53:59 01:00	9878	14610	4690	8489	12710	7798	10150	9360	2313	4958	2950	994	157	260	171
Downstream	2 01 03-26-1999 10:56:29 01:00	10200	14760	4654	8712	13060	7933	10280	9523	2200	4890	3076	1023	175	283	164
Downstream	2 01 03-26-1999 10:58:59 01:00	9629	14320	4666	8362	12460	7676	9959	9193	2282	4877	2993	999	169	269	196
D. Bckgrnd	2 01 03-26-1999 11:12:11 01:00	3	2	1	0	0	0	0	0	0	0	0	0	0	0	0

Meas. Penetration	1.01	1.01	1.01	1.01	1.02	1.02	1.02	1.01	1.02	1.02	1.06	1.01	1.01	0.99	0.95
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	1.01	1.01	1.01	1.02	1.02	1.02	1.01	1.02	1.02	1.06	1.01	1.01	0.99	0.95
Corrected Efficiency (%)	-1	-1	-1	-1	-2	-2	-2	-1	-2	-2	-6	-1	-1	1	5

Data Acceptance Criteria:

Total Challenge Counts for Each Channel:	97345	145010	46636	84782	126810	77638	100170	96218	23399	50907	30113	10689	1774	2911	2029
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	0.05	0.08	0.07	0.07	0.10	0.11	0.10	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):	13.4
Data Quality Objective: max. allowable conc. (#/cc):	< 23
Does this meet the DQO:	Yes, (applies to all channels)

Test No. 03269906
 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 03-26-1999 11:32:39 01:00	0	0	0	0	0	0	1	0	0	0	0	0	0	0
Upstream	1 01 03-26-1999 11:44:03 01:00	9707	14510	4687	8464	12730	7886	9946	9727	2325	5114	3058	1033	183	294
Upstream	1 01 03-26-1999 11:46:33 01:00	9773	14280	4607	8508	12440	7675	10000	9638	2310	5071	3094	1069	172	258
Upstream	1 01 03-26-1999 11:49:03 01:00	9429	14350	4626	8261	12350	7609	9917	9354	2339	5030	3055	1073	183	312
Upstream	1 01 03-26-1999 11:51:33 01:00	9765	14300	4490	8300	12630	7631	9990	9561	2308	5039	3143	1057	169	335
Upstream	1 01 03-26-1999 11:54:03 01:00	9563	14320	4620	8413	12540	7517	9904	9224	2351	4985	3051	1079	184	289
Upstream	1 01 03-26-1999 11:56:33 01:00	9496	14030	4507	8310	12220	7651	9815	9585	2316	4910	3075	1045	173	309
Upstream	1 01 03-26-1999 11:59:03 01:00	9476	14330	4663	8412	12530	7642	9868	9238	2177	4706	2917	1021	145	269
Upstream	1 01 03-26-1999 12:01:33 01:00	9833	14250	4622	8178	12290	7792	9964	9194	2314	4816	2827	1031	159	251
Upstream	1 01 03-26-1999 12:04:03 01:00	9722	14360	4546	8291	12310	7514	9808	9209	2204	4748	2902	1020	173	276
Upstream	1 01 03-26-1999 12:06:33 01:00	9436	14250	4546	8232	12290	7587	9735	9222	2196	4775	2902	977	154	269
U. Bckgrnd	1 01 03-26-1999 12:13:33 01:00	0	0	0	1	0	0	1	0	0	0	1	0	0	0
ENTER DATA BELOW															
D. Bckgrnd	2 01 03-26-1999 11:33:54 01:00	12	6	4	4	6	4	9	4	1	1	4	0	0	0
Downstream	2 01 03-26-1999 11:45:18 01:00	2441	2938	738	1081	1024	330	232	105	7	13	10	3	0	2
Downstream	2 01 03-26-1999 11:47:48 01:00	2489	2766	691	987	1009	353	207	83	9	11	9	1	0	1
Downstream	2 01 03-26-1999 11:50:18 01:00	2369	2807	749	1011	989	341	225	70	8	12	2	1	0	0
Downstream	2 01 03-26-1999 11:52:48 01:00	2400	2762	697	973	945	300	235	71	7	7	6	2	0	3
Downstream	2 01 03-26-1999 11:55:18 01:00	2376	2807	715	1011	894	294	222	93	10	12	5	3	0	1
Downstream	2 01 03-26-1999 11:57:48 01:00	2377	2851	695	964	961	301	212	72	13	23	9	6	0	1
Downstream	2 01 03-26-1999 12:00:18 01:00	2340	2786	673	975	914	324	203	71	5	9	8	0	0	1
Downstream	2 01 03-26-1999 12:02:48 01:00	2412	2871	690	1017	908	339	189	83	7	7	6	2	0	1
Downstream	2 01 03-26-1999 12:05:18 01:00	2381	2675	655	1043	908	294	204	61	7	6	7	2	0	0
Downstream	2 01 03-26-1999 12:07:48 01:00	2261	2681	684	982	932	319	189	71	5	15	1	1	0	0
D. Bckgrnd	2 01 03-26-1999 12:14:48 01:00	4	1	0	0	1	1	0	0	0	2	0	0	0	1
Meas. Penetration		0.25	0.20	0.15	0.12	0.08	0.04	0.02	0.01	0.00	0.00	0.00	0.00	0.00	0.00
P100 correction values		1.01	1.01	1.01	1.01	1.02	1.02	1.02	1.01	1.02	1.02	1.06	1.01	1.01	0.99
Corrected Penetration		0.25	0.19	0.15	0.12	0.07	0.04	0.02	0.01	0.00	0.00	0.00	0.00	0.00	0.00
Corrected Efficiency (%)		75	81	85	88	93	96	98	99	100	100	100	100	100	100
Data Acceptance Criteria:															
Total Challenge Counts for Each Channel:		96200	142980	45914	83369	124330	76504	98947	93952	22840	49194	30024	10405	1695	2862
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 :		0.01	0.01	0.01	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	<0.30	<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
Maximum observed particle concentration (#/cc):		12.7													
Data Quality Objective: max. allowable conc. (#/cc):		< 23													
Does this meet the DQO:		Yes, (applies to all channels)													

Test No. 03269907
 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 03-26-1999 12:30:26 01:00	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0
Upstream	1 01 03-26-1999 12:40:41 01:00	10000	14910	4902	8582	12710	7840	10080	9393	2204	5055	2962	981	155	286	186
Upstream	1 01 03-26-1999 12:43:11 01:00	9894	14970	4908	8659	12890	8137	10110	9433	2237	4865	2889	1078	153	272	173
Upstream	1 01 03-26-1999 12:45:41 01:00	10130	14670	4665	8299	12620	7690	10120	9217	2261	4819	2845	944	196	294	219
Upstream	1 01 03-26-1999 12:48:11 01:00	10060	14800	4651	8586	12580	7832	10060	9381	2153	4870	3027	1013	139	248	184
Upstream	1 01 03-26-1999 12:50:41 01:00	9659	14450	4572	8435	12340	7725	9702	9186	2234	4693	2930	962	166	271	167
Upstream	1 01 03-26-1999 12:53:11 01:00	9477	14110	4555	8193	12280	7504	9885	9479	2254	5099	3131	1067	194	301	225
Upstream	1 01 03-26-1999 12:55:41 01:00	9336	14050	4480	8153	12480	7549	9792	9411	2244	4857	2897	1128	198	279	233
Upstream	1 01 03-26-1999 12:58:11 01:00	9543	14320	4682	8688	12900	7753	10230	9667	2405	5203	3170	1091	184	297	232
Upstream	1 01 03-26-1999 13:00:41 01:00	9610	14250	4654	8448	12570	7897	9992	9578	2318	4970	3030	1075	162	296	229
Upstream	1 01 03-26-1999 13:03:11 01:00	9436	14240	4679	8428	12650	7768	10000	9665	2374	5006	3202	1077	201	283	254
U. Bckgrnd	1 01 03-26-1999 13:11:12 01:00	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0

ENTER DATA BELOW

D. Bckgrnd	2 01 03-26-1999 12:31:41 01:00	0	5	0	0	1	0	0	0	0	0	0	0	0	0	0
Downstream	2 01 03-26-1999 12:41:56 01:00	9812	14750	4672	8290	12750	7881	10130	9334	2220	4961	2975	1022	185	290	196
Downstream	2 01 03-26-1999 12:44:26 01:00	9762	14700	4634	8586	12860	8021	9981	9406	2277	4870	2970	1017	162	289	191
Downstream	2 01 03-26-1999 12:46:56 01:00	9747	14170	4511	8143	12530	7608	9728	8927	2217	4831	2925	958	167	278	189
Downstream	2 01 03-26-1999 12:49:26 01:00	9742	14760	4693	8485	12590	7676	9986	9455	2252	4975	3024	1012	145	258	159
Downstream	2 01 03-26-1999 12:51:56 01:00	9639	14450	4761	8563	12580	7529	10050	9722	2378	5290	3176	1097	184	310	227
Downstream	2 01 03-26-1999 12:54:26 01:00	9618	14040	4598	8370	12610	7718	10050	9522	2493	5139	3109	1062	165	285	218
Downstream	2 01 03-26-1999 12:56:56 01:00	9656	14400	4656	8681	12910	7939	10200	9767	2460	5187	3207	1085	178	306	211
Downstream	2 01 03-26-1999 12:59:26 01:00	9644	14310	4572	8628	12920	7877	9846	9674	2358	5124	3189	1032	183	331	195
Downstream	2 01 03-26-1999 13:01:56 01:00	9624	14180	4591	8492	12560	7773	10090	9697	2425	5214	3137	1118	196	314	198
Downstream	2 01 03-26-1999 13:04:26 01:00	9394	14050	4583	8176	12310	7607	9723	9377	2379	5002	3137	1117	171	273	187
D. Bckgrnd	2 01 03-26-1999 13:12:27 01:00	4	4	3	4	1	6	1	1	0	0	0	0	0	0	0

Meas. Penetration	0.99	0.99	0.99	1.00	1.00	1.00	1.00	1.00	1.00	1.03	1.02	1.03	1.01	0.99	1.04	0.94
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
Corrected Penetration	0.99	0.99	0.99	1.00	1.00	1.00	1.00	1.00	1.00	1.03	1.02	1.03	1.01	0.99	1.04	0.94
Corrected Efficiency (%)	1	1	1	0	0	0	0	0	-3	-2	-3	-1	1	-4	6	

Data Acceptance Criteria:

Total Challenge Counts for Each Channel:	97145	144770	46748	84471	126020	77695	99971	94410	22684	49437	30083	10416	1748	2827	2102
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 :	0.03	0.03	0.03	0.03	0.02	0.03	0.02	0.03	0.06	0.04	0.05	0.08	0.15	0.10	0.16
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):	12.9
Data Quality Objective: max. allowable conc. (#/cc):	< 23
Does this meet the DQO:	Yes, (applies to all channels)

Test No. 03269908
 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	03-26-1999	13:30:51	01:00	1	2	0	0	2	0	0	0	0	0	0	0	0	0	
Upstream	1	01	03-26-1999	13:43:35	01:00	9770	14620	4854	8723	12860	7799	9847	9498	2363	4982	2923	952	195	291	196
Upstream	1	01	03-26-1999	13:46:05	01:00	9788	14800	4741	8572	12620	7686	9981	9409	2299	4911	2907	899	155	271	170
Upstream	1	01	03-26-1999	13:48:35	01:00	9275	14040	4425	8034	11940	7306	9222	8975	2201	4655	2818	935	141	284	184
Upstream	1	01	03-26-1999	13:51:05	01:00	9034	13630	4213	7946	11870	7048	9261	8417	2216	4640	2662	855	146	258	177
Upstream	1	01	03-26-1999	13:53:35	01:00	9085	13690	4396	7961	11880	7230	9254	8677	2073	4764	2696	929	142	275	193
Upstream	1	01	03-26-1999	13:56:05	01:00	9130	13450	4343	8023	11900	7479	9300	9037	2293	4859	2924	1004	147	255	184
Upstream	1	01	03-26-1999	13:58:35	01:00	9230	13880	4531	8250	12330	7474	9525	9230	2282	5125	3055	1071	188	308	200
Upstream	1	01	03-26-1999	14:01:05	01:00	9235	13950	4481	8188	12220	7482	9488	9328	2329	5045	3014	1062	185	269	185
Upstream	1	01	03-26-1999	14:03:35	01:00	9423	14010	4552	8492	12510	7496	9851	9326	2363	5034	2995	1083	163	280	202
Upstream	1	01	03-26-1999	14:06:05	01:00	8747	13370	4273	7987	12080	7305	9424	9084	2177	4918	2899	1038	163	286	221
U. Bckgrnd	1	01	03-26-1999	14:16:38	01:00	4	1	0	0	0	1	0	0	0	1	0	0	0	0	0

ENTER DATA BELOW

D. Bckgrnd	2	01	03-26-1999	13:32:06	01:00	3	10	3	5	10	3	10	2	2	1	2	0	0	0	0
Downstream	2	01	03-26-1999	13:44:50	01:00	2486	2806	666	980	948	301	200	81	6	15	8	2	0	2	0
Downstream	2	01	03-26-1999	13:47:20	01:00	2281	2761	627	962	923	315	204	91	11	15	10	2	1	1	0
Downstream	2	01	03-26-1999	13:49:50	01:00	2367	2804	677	993	886	306	237	83	8	19	7	1	0	0	2
Downstream	2	01	03-26-1999	13:52:20	01:00	2343	2726	641	937	918	314	198	95	11	24	8	2	0	0	1
Downstream	2	01	03-26-1999	13:54:50	01:00	2220	2715	708	1026	1000	334	225	104	18	17	11	4	0	2	0
Downstream	2	01	03-26-1999	13:57:20	01:00	2317	2758	752	1026	913	356	232	114	12	18	11	3	1	1	0
Downstream	2	01	03-26-1999	13:59:50	01:00	2385	2837	720	982	1024	353	220	94	11	29	13	5	1	0	0
Downstream	2	01	03-26-1999	14:02:20	01:00	2344	2847	709	1088	1002	375	246	110	14	10	5	4	1	1	0
Downstream	2	01	03-26-1999	14:04:50	01:00	2388	2756	701	1079	994	334	239	101	11	15	10	1	0	1	2
Downstream	2	01	03-26-1999	14:07:20	01:00	2287	2725	665	1020	977	326	221	86	13	14	9	2	3	1	1
D. Bckgrnd	2	01	03-26-1999	14:17:53	01:00	1	2	0	0	0	1	1	0	0	1	0	1	0	0	0

Meas. Penetration	0.25	0.20	0.15	0.12	0.08	0.04	0.02	0.01	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	0.99	0.99	0.99	1.00	1.00	1.00	1.00	1.00	1.03	1.02	1.03	1.01	0.99	1.04	0.94				
Corrected Penetration	0.25	0.20	0.15	0.12	0.08	0.04	0.02	0.01	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	
Corrected Efficiency (%)	75	80	85	88	92	96	98	99	100	100	100	100	100	100	100	100	100	100	

Data Acceptance Criteria:

Total Challenge Counts for Each Channel:	92717	139440	44809	82176	122210	74305	95153	90981	22596	48933	28893	9828	1625	2777	1912
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 :	0.01	0.01	0.01	0.01	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.01	0.00
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):	12.7
Data Quality Objective: max. allowable conc. (#/cc):	< 23
Does this meet the DQO:	Yes, (applies to all channels)

Test No. 03199907
 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 03-19-1999 15:11:42 01:00	0	1	1	0	0	0	0	0	0	0	0	0	0	0	
Upstream	1 01 03-19-1999 15:34:44 01:00	9558	14460	4529	8619	12920	7855	10470	9988	2389	5321	3340	1174	206	321	220
Upstream	1 01 03-19-1999 15:37:14 01:00	9784	14750	4659	8822	12880	8039	10430	10150	2448	5317	3422	1194	229	361	232
Upstream	1 01 03-19-1999 15:39:44 01:00	10100	14900	4827	8789	13110	8021	10580	9856	2371	5123	3179	1093	172	296	197
Upstream	1 01 03-19-1999 15:42:14 01:00	9926	14660	4826	8672	13010	7868	10500	9587	2309	5132	3218	1092	188	290	218
Upstream	1 01 03-19-1999 15:44:44 01:00	9948	14910	4765	8825	12960	8107	10550	9900	2368	5199	3165	1131	187	316	237
Upstream	1 01 03-19-1999 15:47:14 01:00	9782	14550	4628	8573	12630	7937	10340	9606	2306	5071	3154	1040	185	273	231
Upstream	1 01 03-19-1999 15:49:44 01:00	9777	14490	4571	8414	12700	7857	10320	9575	2303	4991	3260	1107	205	306	235
Upstream	1 01 03-19-1999 15:52:14 01:00	9655	14440	4469	8363	12640	7587	10110	9601	2210	5105	3077	1103	171	304	211
Upstream	1 01 03-19-1999 15:54:44 01:00	9846	14680	4671	8496	12920	7871	10060	9577	2335	4940	3279	1100	176	300	202
Upstream	1 01 03-19-1999 15:57:14 01:00	9861	14680	4627	8797	13030	7914	10530	9722	2318	5114	3173	1093	184	318	186
U. Bckgrnd	1 01 03-19-1999 16:06:17 01:00	2	1	0	0	0	0	0	0	0	0	0	0	0	0	0

ENTER DATA BELOW

D. Bckgrnd	2 01 03-19-1999 15:12:57 01:00	0	0	0	0	0	0	0	1	0	0	0	0	0	0
Downstream	2 01 03-19-1999 15:35:59 01:00	4	7	4	3	4	7	9	6	2	4	1	1	0	2
Downstream	2 01 03-19-1999 15:38:29 01:00	9	9	2	2	6	3	7	1	3	4	1	0	0	0
Downstream	2 01 03-19-1999 15:40:59 01:00	8	6	1	6	4	9	3	9	1	0	2	0	0	0
Downstream	2 01 03-19-1999 15:43:29 01:00	3	3	0	5	11	2	2	5	1	0	2	0	1	0
Downstream	2 01 03-19-1999 15:45:59 01:00	9	11	3	10	8	1	7	6	2	1	0	1	0	0
Downstream	2 01 03-19-1999 15:48:29 01:00	16	19	9	13	8	5	3	2	0	3	2	0	0	0
Downstream	2 01 03-19-1999 15:50:59 01:00	7	5	0	2	7	4	0	1	2	3	2	0	0	0
Downstream	2 01 03-19-1999 15:53:29 01:00	3	5	3	5	8	3	4	4	0	1	3	0	0	0
Downstream	2 01 03-19-1999 15:55:59 01:00	2	7	2	6	6	9	5	4	1	0	0	0	0	1
Downstream	2 01 03-19-1999 15:58:29 01:00	6	6	2	3	2	4	4	2	0	2	3	0	0	1
D. Bckgrnd	2 01 03-19-1999 16:07:32 01:00	3	5	0	0	1	3	0	0	0	0	0	1	0	1

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	0.98	0.99	1.00	1.00	0.99	1.01	1.03	1.03	1.03	1.04	0.94	1.00	0.97
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:	98237	146520	46572	86370	128800	79056	103890	97562	23357	51313	32267	11127	1903	3085	2169
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	-0.01
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):	13.1
Data Quality Objective: max. allowable conc. (#/cc):	< 23
Does this meet the DQO:	Yes, (applies to all channels)

Test No. 03269909
 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	03-26-1999	14:39:07	01:00	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
Upstream	1	01	03-26-1999	14:49:23	01:00	10780	16930	6158	11080	16550	12090	20180	14080	2860	6567	4028	1117	160	287	203
Upstream	1	01	03-26-1999	14:51:53	01:00	10420	16320	5834	10930	16360	11730	19370	13750	2846	6645	3978	1144	180	301	169
Upstream	1	01	03-26-1999	14:54:23	01:00	10270	16360	5915	10750	16090	11780	19620	13720	2766	6596	3856	1074	161	248	193
Upstream	1	01	03-26-1999	14:56:53	01:00	10630	16510	6029	11130	16370	12090	20080	14280	2895	6708	3958	1123	192	311	189
Upstream	1	01	03-26-1999	14:59:23	01:00	10180	16080	5870	10720	16190	11600	19220	13950	2758	6333	3911	1099	201	293	153
Upstream	1	01	03-26-1999	15:01:53	01:00	10710	16670	5992	11080	16270	11980	19980	14160	2804	6781	4011	1176	163	267	171
Upstream	1	01	03-26-1999	15:04:23	01:00	10640	16850	6110	10980	16330	12140	20070	13760	2815	6630	3859	1106	157	283	180
Upstream	1	01	03-26-1999	15:06:53	01:00	10930	16980	6195	11260	16750	12410	20190	14040	2887	6663	3919	1121	171	294	174
Upstream	1	01	03-26-1999	15:09:23	01:00	10630	17150	6068	11130	16580	12180	19700	13660	2745	6714	3968	1101	161	310	180
Upstream	1	01	03-26-1999	15:11:53	01:00	10590	16790	5985	10890	16330	12100	20010	13740	2772	6660	3942	1124	170	315	195
U. Bckgrnd	1	01	03-26-1999	15:20:30	01:00	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0

ENTER DATA BELOW

D. Bckgrnd	2	01	03-26-1999	14:40:22	01:00	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Downstream	2	01	03-26-1999	14:50:38	01:00	10290	16320	5760	10940	16160	11460	19330	13530	2883	6716	3932	1125	177	278	187
Downstream	2	01	03-26-1999	14:53:08	01:00	10260	16370	5850	10850	16260	11880	19540	13830	2814	6586	3951	1100	208	302	178
Downstream	2	01	03-26-1999	14:55:38	01:00	10490	16330	5810	10840	16340	11810	19710	13730	2872	6831	3989	1181	187	336	186
Downstream	2	01	03-26-1999	14:58:08	01:00	10150	16270	5965	10770	16150	11760	19950	14000	2879	6702	4081	1180	189	264	170
Downstream	2	01	03-26-1999	15:00:38	01:00	10290	16320	5944	10660	16130	11530	20010	13930	2798	6712	4150	1125	203	295	176
Downstream	2	01	03-26-1999	15:03:08	01:00	10380	16560	5858	10680	16090	11750	19560	13420	2818	6627	3988	1121	176	291	158
Downstream	2	01	03-26-1999	15:05:38	01:00	10920	17260	6248	11540	16590	12180	20230	13870	2974	6925	4094	1179	180	295	187
Downstream	2	01	03-26-1999	15:08:08	01:00	10650	16990	6026	11360	16590	12320	20370	14140	3026	7024	4048	1210	211	334	168
Downstream	2	01	03-26-1999	15:10:38	01:00	10660	17140	6199	11040	16830	12470	20760	14240	2825	7228	4095	1208	195	317	153
Downstream	2	01	03-26-1999	15:13:08	01:00	10690	16520	6121	10960	16310	12250	20260	13850	2811	6725	3974	1200	208	277	185
D. Bckgrnd	2	01	03-26-1999	15:21:45	01:00	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

Meas. Penetration	0.99	1.00	0.99	1.00	1.00	0.99	1.01	1.00	1.02	1.03	1.02	1.04	1.13	1.03	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	0.99	1.00	0.99	1.00	1.00	0.99	1.01	1.00	1.02	1.03	1.02	1.04	1.13	1.03	0.97
Corrected Efficiency (%)	1	0	1	0	0	1	-1	0	-2	-3	-2	-4	-13	-3	3

Data Acceptance Criteria:

Total Challenge Counts for Each Channel:	105780	166640	60156	109950	163820	120100	198420	139140	28148	66297	39430	11185	1716	2909	1807
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 :	0.03	0.03	0.03	0.03	0.02	0.03	0.03	0.02	0.03	0.04	0.02	0.04	0.13	0.11	0.10
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): 17.7
 Data Quality Objective: max. allowable conc. (#/cc): < 23
 Does this meet the DQO: Yes, (applies to all channels)

Test No. 03269910
 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 03-26-1999 15:41:40 01:00	15	6	12	4	3	1	1	2	0	0	0	0	0	0	0
Upstream	1 01 03-26-1999 15:50:41 01:00	10650	16830	6193	11390	16680	12210	20420	14230	2902	6705	4077	1167	206	336	188
Upstream	1 01 03-26-1999 15:53:11 01:00	11250	17200	6230	11370	17200	12670	20810	14580	2878	7041	4101	1159	178	340	202
Upstream	1 01 03-26-1999 15:55:41 01:00	10740	17340	6273	11260	16670	12260	20510	14320	2921	6859	3948	1123	186	317	185
Upstream	1 01 03-26-1999 15:58:11 01:00	10470	16670	5897	10780	16290	11740	19930	14000	2779	6760	3923	1117	194	323	159
Upstream	1 01 03-26-1999 16:00:41 01:00	10770	17070	6155	11170	16650	12470	20330	14440	2852	6870	4035	1141	191	334	200
Upstream	1 01 03-26-1999 16:03:11 01:00	10830	16620	6051	11470	16840	11820	20260	15700	3103	7101	4417	1273	200	344	217
Upstream	1 01 03-26-1999 16:05:41 01:00	10760	16660	6035	11210	16820	11710	20200	15630	3148	7327	4432	1275	214	351	202
Upstream	1 01 03-26-1999 16:08:11 01:00	10640	16290	5971	11370	16800	11420	19770	15700	3073	6958	4418	1291	182	353	221
Upstream	1 01 03-26-1999 16:10:41 01:00	10390	16230	5853	11330	16440	11240	19990	15430	3058	6990	4383	1281	209	349	211
Upstream	1 01 03-26-1999 16:13:11 01:00	10860	16690	6058	11490	17180	12110	20460	16000	3134	7161	4480	1270	204	353	217
U. Bckgrnd	1 01 03-26-1999 16:20:54 01:00	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
ENTER DATA BELOW																
D. Bckgrnd	2 01 03-26-1999 15:42:55 01:00	3	10	1	6	3	2	5	6	1	2	0	0	1	1	0
Downstream	2 01 03-26-1999 15:51:56 01:00	3085	4078	1205	1979	1888	723	556	102	5	12	8	1	0	0	0
Downstream	2 01 03-26-1999 15:54:26 01:00	3155	4130	1213	1905	1807	757	561	89	11	16	10	1	0	0	0
Downstream	2 01 03-26-1999 15:56:56 01:00	3234	4223	1281	1920	1873	759	552	97	3	19	11	2	0	0	0
Downstream	2 01 03-26-1999 15:59:26 01:00	3124	4065	1220	1897	1741	719	539	95	10	12	4	0	0	0	0
Downstream	2 01 03-26-1999 16:01:56 01:00	2702	3461	1043	1639	1594	640	498	108	11	15	7	0	0	1	0
Downstream	2 01 03-26-1999 16:04:26 01:00	3175	4147	1199	2040	1905	759	600	131	20	20	8	2	0	0	0
Downstream	2 01 03-26-1999 16:06:56 01:00	3231	4197	1275	2024	2022	794	644	145	9	16	10	0	0	0	1
Downstream	2 01 03-26-1999 16:09:26 01:00	3189	4143	1245	2048	1965	848	652	152	13	27	17	1	1	1	0
Downstream	2 01 03-26-1999 16:11:56 01:00	3181	4083	1216	2007	1919	768	663	130	12	21	6	3	0	1	1
Downstream	2 01 03-26-1999 16:14:26 01:00	3149	4143	1231	1985	1948	833	630	135	9	17	9	3	0	0	0
D. Bckgrnd	2 01 03-26-1999 16:22:09 01:00	0	0	1	0	1	0	1	0	0	4	3	0	0	0	0
Meas. Penetration		0.29	0.24	0.20	0.17	0.11	0.06	0.03	0.01	0.00	0.00	0.00	0.00	0.00	0.00	0.00
P100 correction values		0.99	1.00	0.99	1.00	1.00	0.99	1.01	1.00	1.02	1.03	1.02	1.04	1.13	1.03	0.97
Corrected Penetration		0.29	0.24	0.20	0.17	0.11	0.06	0.03	0.01	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Corrected Efficiency (%)		71	76	80	83	89	94	97	99	100	100	100	100	100	100	100
Data Acceptance Criteria:																
Total Challenge Counts for Each Channel:		107360	167600	60716	112840	167570	119650	202680	150030	29848	69772	42214	12097	1964	3400	2002
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	0.00	0.00	0.00	0.00	0.00	0.00	-0.01	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	<0.10	<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):		18.0														
Data Quality Objective: max. allowable conc. (#/cc):		< 23														
Does this meet the DQO:		Yes, (applies to all channels)														

Test No. 03269911

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	03-26-1999	16:38:05	01:00	0	0	0	0	0	0	0	0	0	0	0				
Upstream	1	01	03-26-1999	16:47:06	01:00	10470	16480	5946	11250	16660	11840	19960	15250	3041	7102	4295	1246	207	322	217
Upstream	1	01	03-26-1999	16:49:36	01:00	10830	16830	6134	11560	16960	11910	20510	15840	3084	7375	4436	1288	222	341	198
Upstream	1	01	03-26-1999	16:52:06	01:00	10650	16750	5964	11440	16910	11690	20200	15810	3205	7151	4294	1213	206	329	218
Upstream	1	01	03-26-1999	16:54:36	01:00	10900	16470	6073	11200	16570	11780	20130	15190	3048	7085	4245	1297	208	355	220
Upstream	1	01	03-26-1999	16:57:06	01:00	10800	16760	5945	11260	16680	11740	20020	15420	3031	7108	4384	1281	205	338	227
Upstream	1	01	03-26-1999	16:59:36	01:00	10760	16270	5990	11140	16650	11760	19630	15180	3088	6868	4352	1284	230	334	199
Upstream	1	01	03-26-1999	17:02:06	01:00	10830	17120	6297	11140	16680	12310	20200	14580	3040	6997	4144	1221	190	334	194
Upstream	1	01	03-26-1999	17:04:36	01:00	11130	17460	6368	11500	16840	12580	20940	15130	2975	7005	4132	1234	199	322	180
Upstream	1	01	03-26-1999	17:07:06	01:00	10790	17110	6153	11420	16620	12320	20490	14580	2953	7009	4151	1132	211	283	195
Upstream	1	01	03-26-1999	17:09:36	01:00	10630	16740	6107	11020	16460	12210	20060	14030	2835	6781	3992	1190	197	309	201
U. Bckgrnd	1	01	03-26-1999	17:19:06	01:00	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0

ENTER DATA BELOW

D. Bckgrnd	2	01	03-26-1999	16:39:20	01:00	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Downstream	2	01	03-26-1999	16:48:21	01:00	10560	16810	6120	11320	16860	11960	20670	15350	3089	7275	4580	1374	206	373	215
Downstream	2	01	03-26-1999	16:50:51	01:00	10610	16370	6094	11240	16630	11890	20510	15560	2946	7453	4650	1267	236	390	202
Downstream	2	01	03-26-1999	16:53:21	01:00	10810	16420	5911	11310	16900	11920	20280	15230	3048	7169	4427	1358	218	338	188
Downstream	2	01	03-26-1999	16:55:51	01:00	10450	16180	5906	11170	16570	11820	19860	15100	2998	7096	4371	1209	210	351	232
Downstream	2	01	03-26-1999	16:58:21	01:00	10570	16290	5846	11220	16530	11780	20310	15010	3107	7347	4460	1332	229	357	213
Downstream	2	01	03-26-1999	17:00:51	01:00	10550	16660	6120	11240	16340	11880	20010	14290	2934	7123	4250	1256	237	314	216
Downstream	2	01	03-26-1999	17:03:21	01:00	10510	16970	6011	11050	16440	12010	20180	14270	2994	7110	4258	1179	188	320	212
Downstream	2	01	03-26-1999	17:05:51	01:00	10750	16940	6089	11060	16460	12170	20370	14310	2990	7195	4338	1256	190	348	221
Downstream	2	01	03-26-1999	17:08:21	01:00	10890	16800	6068	11090	16610	12410	20480	14350	2903	6984	4267	1211	217	300	187
Downstream	2	01	03-26-1999	17:10:51	01:00	10750	16890	6165	11060	16590	12290	20470	14080	2938	6874	4169	1216	193	309	187
D. Bckgrnd	2	01	03-26-1999	17:20:21	01:00	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

Meas. Penetration	0.99	0.99	0.99	0.99	0.99	1.00	1.00	0.98	0.99	1.02	1.03	1.02	1.02	1.04	1.01
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	0.99	0.99	0.99	0.99	0.99	1.00	1.00	0.98	0.99	1.02	1.03	1.02	1.02	1.04	1.01
Corrected Efficiency (%)	1	1	1	1	1	0	0	2	1	-2	-3	-2	-2	-4	-1

Data Acceptance Criteria:

Total Challenge Counts for Each Channel:	107790	167990	60977	112930	167030	120140	202140	151010	30300	70481	42425	12386	2075	3267	2049
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	0.03	0.03	0.02	0.01	0.03	0.02	0.05	0.04	0.03	0.05	0.07	0.11	0.11	0.11
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):	18.1
Data Quality Objective: max. allowable conc. (#/cc):	< 23
Does this meet the DQO:	Yes, (applies to all channels)

Test No. 03299901
 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 03-29-1999 06:22:18 01:00	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Upstream	1 01 03-29-1999 06:32:31 01:00	10590	16360	5975	10960	15900	11510	19940	14860	2988	6986	4032	1183	190	341	182
Upstream	1 01 03-29-1999 06:35:01 01:00	10270	15690	5694	10520	15690	11370	19080	14180	2848	6692	3960	1156	181	302	179
Upstream	1 01 03-29-1999 06:37:31 01:00	10640	16360	5787	10970	16400	11910	20060	15080	2949	6977	4108	1170	193	340	196
Upstream	1 01 03-29-1999 06:40:01 01:00	10680	16610	5881	10890	16390	11640	19990	14660	2927	6736	4078	1100	211	302	184
Upstream	1 01 03-29-1999 06:42:31 01:00	10460	16260	5731	10750	15890	11670	19710	14090	2899	6676	3882	1097	197	284	178
Upstream	1 01 03-29-1999 06:45:01 01:00	10580	16390	5801	10600	15850	11610	19540	13990	2895	6609	3901	1067	186	274	187
Upstream	1 01 03-29-1999 06:47:31 01:00	10430	16190	5813	10670	15800	11540	19250	13450	2678	6337	3798	1091	151	283	206
Upstream	1 01 03-29-1999 06:50:01 01:00	10300	15760	5610	9983	15120	11490	18520	12420	2714	6148	3534	1020	179	307	179
Upstream	1 01 03-29-1999 06:52:31 01:00	10440	16240	5901	10310	15290	12180	18530	12010	2548	6110	3426	951	160	212	137
Upstream	1 01 03-29-1999 06:55:01 01:00	10460	16350	5622	10280	15620	11920	18670	12210	2582	6009	3415	931	175	273	146
U. Bckgrnd	1 01 03-29-1999 07:04:56 01:00	2	0	1	1	1	0	0	0	0	0	0	0	0	0	0

ENTER DATA BELOW

D. Bckgrnd	2 01 03-29-1999 06:23:33 01:00	0	0	0	0	0	0	1	0	1	0	0	0	0	0	0
Downstream	2 01 03-29-1999 06:33:46 01:00	2867	3864	1165	1826	1729	702	543	92	5	11	12	0	0	0	0
Downstream	2 01 03-29-1999 06:36:16 01:00	2992	3894	1151	1844	1819	645	556	123	11	21	8	3	0	0	1
Downstream	2 01 03-29-1999 06:38:46 01:00	3057	4076	1164	1787	1768	726	516	87	6	18	3	3	0	0	0
Downstream	2 01 03-29-1999 06:41:16 01:00	3035	3891	1198	1796	1766	678	549	111	11	25	7	4	0	0	0
Downstream	2 01 03-29-1999 06:43:46 01:00	2905	3692	1100	1730	1671	675	512	107	3	16	6	1	0	0	0
Downstream	2 01 03-29-1999 06:46:16 01:00	2993	3780	1090	1736	1630	661	454	103	5	13	6	0	0	0	0
Downstream	2 01 03-29-1999 06:48:46 01:00	2968	3807	1096	1677	1615	698	455	83	5	5	4	1	0	0	0
Downstream	2 01 03-29-1999 06:51:16 01:00	2938	3854	1092	1574	1445	660	438	74	5	5	6	0	0	0	0
Downstream	2 01 03-29-1999 06:53:46 01:00	2823	3742	1087	1542	1483	665	393	70	9	13	3	1	0	0	0
Downstream	2 01 03-29-1999 06:56:16 01:00	2906	3845	1039	1554	1573	620	442	80	7	17	4	1	0	0	0
D. Bckgrnd	2 01 03-29-1999 07:06:11 01:00	0	1	0	0	0	0	0	1	0	0	0	0	0	0	0

Meas. Penetration	0.28	0.24	0.19	0.16	0.10	0.06	0.03	0.01	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
P100 correction values	0.99	0.99	0.99	0.99	0.99	1.00	1.00	0.98	0.99	1.02	1.03	1.02	1.02	1.04	1.01	1.01
Corrected Penetration	0.28	0.24	0.20	0.16	0.11	0.06	0.02	0.01	0.00	0.00	0.00	0.00	0.00	0.00	0.00	
Corrected Efficiency (%)	72	76	80	84	89	94	98	99	100	100	100	100	100	100	100	

Data Acceptance Criteria:

Total Challenge Counts for Each Channel:	104850	162210	57815	105933	157950	116840	193290	136950	28028	65280	38134	10766	1823	2918	1774
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):	17.4
Data Quality Objective: max. allowable conc. (#/cc):	< 23
Does this meet the DQO:	Yes, (applies to all channels)

Test No. 03299902

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	03-29-1999	07:22:09	01:00	0	0	0	0	0	0	0	0	0	0	0				
Upstream	1	01	03-29-1999	07:29:43	01:00	10660	15830	5702	10990	15940	10940	19320	15330	2996	7018	4308	1229	216	307	209
Upstream	1	01	03-29-1999	07:32:13	01:00	10120	15470	5558	10540	15510	10830	18890	15140	2947	6814	4107	1220	209	337	221
Upstream	1	01	03-29-1999	07:34:43	01:00	9978	15530	5569	10610	15530	10840	18940	14970	2950	6753	4269	1242	209	317	204
Upstream	1	01	03-29-1999	07:37:13	01:00	10220	15560	5461	10630	15840	10970	19010	15200	3056	6926	4218	1226	186	341	209
Upstream	1	01	03-29-1999	07:39:43	01:00	10040	15540	5500	10510	15760	10960	18770	15150	2934	6794	4151	1155	186	320	195
Upstream	1	01	03-29-1999	07:42:13	01:00	10030	15860	5640	10490	15110	11140	18900	14250	2724	6591	3971	1079	181	314	190
Upstream	1	01	03-29-1999	07:44:43	01:00	9964	15440	5421	10150	15160	10830	18530	13720	2747	6555	3906	1075	197	266	182
Upstream	1	01	03-29-1999	07:47:13	01:00	10070	15600	5594	10300	15130	11070	18660	14130	2793	6611	3909	1107	181	291	194
Upstream	1	01	03-29-1999	07:49:43	01:00	10310	15530	5507	10340	15370	11070	18990	14030	2750	6610	3856	1163	210	313	180
Upstream	1	01	03-29-1999	07:52:13	01:00	10170	15520	5734	10320	15300	10990	18950	14320	2858	6557	4006	1119	205	308	200
U. Bckgrnd	1	01	03-29-1999	08:01:27	01:00	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0

ENTER DATA BELOW

D. Bckgrnd	2	01	03-29-1999	07:23:24	01:00	4	3	0	3	0	0	0	1	0	0	0	0	0	0	0
Downstream	2	01	03-29-1999	07:30:58	01:00	10090	15090	5452	10380	15570	10870	18940	15020	2935	7022	4346	1299	209	324	218
Downstream	2	01	03-29-1999	07:33:28	01:00	10020	15490	5560	10690	15520	11100	19370	15350	3054	6838	4455	1266	209	366	206
Downstream	2	01	03-29-1999	07:35:58	01:00	9878	15410	5615	10400	15510	10690	19080	14840	2877	6946	4427	1191	207	323	197
Downstream	2	01	03-29-1999	07:38:28	01:00	9833	15200	5458	10400	15510	10770	18790	14680	2977	7014	4193	1213	187	335	202
Downstream	2	01	03-29-1999	07:40:58	01:00	9947	15380	5429	10350	15300	10810	18870	14580	2943	6780	4367	1237	194	316	190
Downstream	2	01	03-29-1999	07:43:28	01:00	9809	15640	5406	10220	15290	10850	18550	13910	2711	6501	4025	1179	201	298	174
Downstream	2	01	03-29-1999	07:45:58	01:00	9812	15230	5462	10280	15180	10830	18650	13900	2852	6516	4012	1155	164	309	169
Downstream	2	01	03-29-1999	07:48:28	01:00	10150	15590	5464	10290	15420	11090	18890	14100	2830	6740	4094	1181	201	300	197
Downstream	2	01	03-29-1999	07:50:58	01:00	10050	15460	5524	10340	15240	11070	18980	13980	2798	6745	4039	1181	204	334	191
Downstream	2	01	03-29-1999	07:53:28	01:00	10110	15710	5663	10420	15680	10960	19200	14190	2883	6810	4219	1275	190	296	180
D. Bckgrnd	2	01	03-29-1999	08:02:42	01:00	1	0	0	0	0	0	0	0	0	1	0	0	0	0	0

Meas. Penetration	0.98	0.99	0.99	0.99	1.00	0.99	1.00	0.99	1.00	1.01	1.04	1.05	0.99	1.03	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	0.98	0.99	0.99	0.99	1.00	0.99	1.00	0.99	1.00	1.01	1.04	1.05	0.99	1.03	0.97
Corrected Efficiency (%)	2	1	1	1	0	1	0	1	0	-1	-4	-5	1	-3	3

Data Acceptance Criteria:

Total Challenge Counts for Each Channel:	101562	155880	55686	104880	154650	109640	188960	146240	28755	67229	40701	11615	1980	3114	1984
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	0.02	0.03	0.02	0.02	0.02	0.05	0.05	0.04	0.06	0.07	0.10	0.10	0.10
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): 17.1
 Data Quality Objective: max. allowable conc. (#/cc): < 23
 Does this meet the DQO: Yes, (applies to all channels)

Test No. 03299903
 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 03-29-1999 08:20:22 01:00	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
Upstream	1 01 03-29-1999 08:28:09 01:00	10450	15950	5660	10550	16060	11200	19610	14620	2851	6843	4064	1102	199	314	181
Upstream	1 01 03-29-1999 08:30:39 01:00	10310	15670	5539	10360	15190	11000	19130	14020	2823	6659	3986	1165	195	327	200
Upstream	1 01 03-29-1999 08:33:09 01:00	10380	16020	5648	10770	15780	11390	19320	14620	2837	6825	4061	1257	183	318	209
Upstream	1 01 03-29-1999 08:35:39 01:00	10220	15770	5599	10730	15530	11120	18970	14460	2828	6601	4082	1121	214	309	197
Upstream	1 01 03-29-1999 08:38:09 01:00	10170	15500	5575	10440	15330	10990	18780	14200	2791	6679	4060	1168	179	328	205
Upstream	1 01 03-29-1999 08:40:39 01:00	9861	15430	5392	10360	15100	10580	18320	14660	2861	6584	4073	1174	193	328	199
Upstream	1 01 03-29-1999 08:43:09 01:00	9883	15130	5274	10270	15060	10580	17880	14420	2895	6580	4097	1212	206	338	179
Upstream	1 01 03-29-1999 08:45:39 01:00	10070	15430	5491	10540	15420	10790	18950	15040	2907	6890	4193	1236	189	356	230
Upstream	1 01 03-29-1999 08:48:09 01:00	9916	15090	5345	10250	15350	10370	18060	14780	2828	6585	4125	1222	202	355	220
Upstream	1 01 03-29-1999 08:50:39 01:00	10250	15510	5412	10370	15700	10880	18810	15180	2981	6826	4355	1261	216	345	192
U. Bckgrnd	1 01 03-29-1999 09:00:53 01:00	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
ENTER DATA BELOW																
D. Bckgrnd	2 01 03-29-1999 08:21:37 01:00	8	3	3	3	9	1	8	5	1	3	1	1	0	1	0
Downstream	2 01 03-29-1999 08:29:24 01:00	2855	3729	1065	1746	1766	710	539	128	12	10	5	1	2	1	0
Downstream	2 01 03-29-1999 08:31:54 01:00	2904	3701	1097	1789	1713	675	544	106	11	10	4	0	0	1	0
Downstream	2 01 03-29-1999 08:34:24 01:00	2869	3866	1135	1711	1654	694	560	105	10	7	9	1	0	0	0
Downstream	2 01 03-29-1999 08:36:54 01:00	2951	3759	1115	1759	1713	693	530	102	5	12	6	2	0	0	0
Downstream	2 01 03-29-1999 08:39:24 01:00	2879	3719	1087	1675	1716	700	479	112	4	19	5	1	0	0	0
Downstream	2 01 03-29-1999 08:41:54 01:00	2880	3548	1119	1752	1736	737	592	130	11	20	2	0	0	0	0
Downstream	2 01 03-29-1999 08:44:24 01:00	2801	3766	1064	1726	1751	641	589	104	13	11	9	1	0	0	0
Downstream	2 01 03-29-1999 08:46:54 01:00	2893	3689	1086	1813	1802	701	605	142	9	16	9	4	0	0	1
Downstream	2 01 03-29-1999 08:49:24 01:00	2965	3865	1085	1859	1822	722	635	145	15	21	5	0	1	1	0
Downstream	2 01 03-29-1999 08:51:54 01:00	2919	3716	1076	1794	1820	748	570	174	12	14	4	2	0	0	0
D. Bckgrnd	2 01 03-29-1999 09:02:08 01:00	0	2	0	0	0	1	0	0	0	0	0	0	0	0	0
Meas. Penetration		0.28	0.24	0.20	0.17	0.11	0.06	0.03	0.01	0.00	0.00	0.00	0.00	0.00	0.00	0.00
P100 correction values		0.98	0.99	0.99	0.99	1.00	0.99	1.00	0.99	1.00	1.01	1.04	1.05	0.99	1.03	0.97
Corrected Penetration		0.29	0.24	0.20	0.17	0.11	0.06	0.03	0.01	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Corrected Efficiency (%)		71	76	80	83	89	94	97	99	100	100	100	100	100	100	100
Data Acceptance Criteria:																
Total Challenge Counts for Each Channel:		101510	155500	54935	104640	154520	108900	187830	146000	28602	67072	41096	11918	1976	3318	2012
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:		0.01	0.01	0.01	0.01	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Does this meet DQO:		<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):		16.9														
Data Quality Objective: max. allowable conc. (#/cc):		< 23														
Does this meet the DQO:		Yes, (applies to all channels)														