September 2001

Environmental Technology Verification Report

Baghouse Filtration Products

Polymer Group, Inc.
DURAPEX™ PET Filter Sample

Prepared by

ETS, Incorporated

RTI INTERNATIONAL

Under a Cooperative Agreement with

EPA United States Environmental Protection Agency

ETV ETV ETV

Environmental Technology Verification Report

Baghouse Filtration Products

Polymer Group, Inc. DURAPEX™ PET Filter Sample

Prepared by

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Notice

This document was prepared by ETS, Inc. (ETS) under a contract with RTI with funding from Cooperative Agreement No. CR826152-01-3 with the U.S. Environmental Protection Agency (EPA). The document has been subjected to RTI/EPA's peer and administrative reviews and has been approved for publication. Mention of corporation names, trade names, or commercial products does not constitute endorsement or recommendation for use of specific products.

Availability of Verification Statement and Report

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

1. **RTI**
   P.O. Box 12194
   Research Triangle Park, NC 27709-2194

   http://etv.rti.org/apct/documents.cfm
   http://www.epa.gov/etv *(click on partners)*

2. **USEPA / APPCD**
   MD-4
   Research Triangle Park, NC 27711

   http://www.epa.gov/etv/library.htm *(electronic copy)*
   http://www.epa.gov/ncepihom/

Abstract

Baghouse filtration products (BFPs) were evaluated by the Air Pollution Control Technology (APCT) Verification Center. The performance factor verified was the mean outlet particle concentration for the filter fabric as a function of the size of those particles equal to and smaller than 2.5 µm in aerodynamic diameter ($PM_{2.5}$). The APCT Verification Center developed a generic verification protocol for testing baghouse filtration products that is based on a modified Verein Deutscher Ingenieure (VDI) Method 3926. The protocol was developed by RTI and ETS, Inc. (ETS), reviewed by a technical panel of experts, and approved by the U.S. Environmental Protection Agency (EPA). The protocol addresses several issues that VDI Method 3926 does not cover, including periodic testing, acquisition of BFP samples for testing, and product definition. A test/quality assurance plan and a standard operating procedure were prepared to address the test procedure, quality assurance, quality control requirements for obtaining verification data of sufficient quantity and quality to satisfy the data quality objectives.

ETS performed tests on Polymer Group Inc.'s filter sample DURAPEX™ PET during February 19 - 23, 2001 for the standard condition tests and February 26 - March 2, 2001 for the non-standard condition tests. Mean outlet particle concentrations for total mass and $PM_{2.5}$ were determined. In addition, the following verification parameters were measured and reported: initial residual pressure drop, residual pressure drop increase, average residual pressure drop, average filtration cycle time, and mass gain of the filter sample.

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List of Abbreviations and Acronyms

APCT	Air Pollution Control Technology
APPCD	Air Pollution Prevention and Control Division
BFP	baghouse filtration product
cfm	cubic feet per minute
cm	centimeters
cm w.g.	centimeters of water gauge
dia.	diameter
DP	pressure drop
dscmh	dry standard cubic meters per hour
EPA	U.S. Environmental Protection Agency
ETS	ETS, Inc.
ETV	Environmental Technology Verification
FEMA	Filtration Efficiency Media Analyzer
fpm	feet per minute
ft^3	cubic feet
g	grams
G/C	gas-to-cloth ratio (filtration velocity)
gr	grains
gr/dscf	grains per dry standard cubic foot
g/dscm	grams per dry standard cubic meter
g/h	grams per hour
g/m^2	grams per square meter
h	hours
in.	inches
in. w.g.	inches of water gauge
kPa	kilopascals
m	meters
mbar	millibars
min	minutes
m/h	meters per hour
m^3/h	cubic meters per hour

mm	millimeters
MPa	megapascals
ms	milliseconds
NA	not applicable
oz/yd^2	ounces per square yard
Pa	pascals
PM	particulate matter
$PM_{2.5}$	particulate matter 2.5 micrometers in aerodynamic diameter or smaller
psi	pounds per square inch
psia	pounds per square inch absolute
PTFE	polytetrafluoroethylene
QA	quality assurance
QC	quality control
RTI	Research Triangle Institute
s	seconds
scf	standard cubic feet
scfm	standard cubic feet per minute
VDI	Verein Deutscher Ingenieure
µg	micrograms
µm	micrometers
°C	degrees Celsius
°F	degrees Fahrenheit
°R	degrees Rankine

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SECTION 1
INTRODUCTION

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

EPA's partner in the Air Pollution Control Technology (APCT) Verification Center is RTI. With the full participation of the technology developer, the APCT Verification Center develops plans, conducts tests, collects and analyzes data, and reports findings. The evaluations are conducted according to a rigorous protocol and quality assurance (QA) and quality control (QC) oversight. The APCT Verification Center 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 baghouse filtration products were tested in accordance with the APCT "Generic Verification Protocol for Baghouse Filtration Products"[1] and the "Test/QA Plan for the Verification Testing of Baghouse Filtration Products."[2] This protocol incorporated all requirements for quality management, quality assurance, procedures for product selection, auditing of the test laboratories, and reporting format. The Generic Verification Protocol describes the overall procedures to be used for verification testing and defines the data quality objectives. The values for inlet dust concentration, raw gas flow rate, and filtration velocity used for current verification testing have been revised since posting of the Generic Verification Protocol. The protocol is being revised to include these and other changes under recommendation or concurrence of the Baghouse Filtration Products Technical Panel. The test/QA plan details how the test laboratory at ETS, Inc. (ETS) will implement and meet the requirements of the Generic Verification Protocol.

Mean outlet particle concentration was determined from the Filtration Efficiency Media Analyzer (FEMA) test apparatus. The test apparatus consists of a brush-type dust feeder that disperses test dust into a vertical rectangular duct (raw-gas channel). A radioactive polonium-210 alpha source is used to neutralize the dust electrically before its entry into the raw-gas channel. A portion of the gas flow is extracted from the raw-gas channel through the test filter, which is mounted vertically at the entrance to a horizontal duct (clean-gas channel). The clean-gas flow is separated using an aerodynamic "Y" so that a representative sample of the clean gas flows through an Andersen impactor that determines the outlet particle concentration.

The particle size was measured while a fine dust was injected into the air stream upstream of the filter fabric sample.

The following series of tests was performed on three separate, randomly selected filter fabric samples:

- Dust characterization (first sample fabric verification test only),
- Conditioning period,
- Recovery period, and
- Performance test period.

To simulate long-term operation, the test filter was first subjected to a conditioning period, which consists of 10,000 rapid-pulse cleaning cycles under continuous dust loading. During this period, the time between cleaning pulses is maintained at 3 seconds. No filter performance parameters are measured in this period.

The conditioning period is immediately followed by a recovery period, which allows the test filter fabric to recover from rapid pulsing. The recovery period consists of 30 normal filtration cycles under continuous and constant dust loading. During a normal filtration cycle, the dust cake is allowed to form on the test filter until a differential pressure of 1,000 Pa (4.0 in. w.g.) is reached. At this point, the test filter is cleaned by a pulse of compressed air from the clean-gas side of the fabric. The next filtration cycle begins immediately after the cleaning is complete.

Performance testing occurs for a 6-hour period immediately following the recovery period (a cumulative total of 10,030 filtration cycles after the test filter has been installed in the test apparatus). During the performance test period, normal filtration cycles are maintained and, as in the case of the conditioning and recovery periods, the test filter is subjected to continuous and constant dust loading.

The filtration velocity (gas-to-cloth ratio [G/C]) and inlet dust concentrations are maintained at 180 ± 9 m/h (9.8 ± 0.5 fpm) and 18.4 ± 3.6 g/dscm (8.0 ± 1.6 gr/dscf), respectively, throughout all phases of the test.

Additional details on the test procedure are provided in Appendix A.

2.1 SELECTION OF FILTRATION SAMPLE FOR TESTING

Filter fabric samples of DURAPEX™ PET were supplied to ETS directly from the manufacturer (Polymer Group Inc.) with a letter signed by Per Lindblom, Director, Sales, Marketing, and New Product Development, and Ping Hao, Manager, New Product Development, Polymer Group Inc., attesting that the filter media were selected at random in an unbiased manner from commercial-grade media and were not treated in any manner different from the media provided to customers. The manufacturer supplied the test laboratory with nine 46 x 91 cm (18 x 36 in.) filter samples. The test laboratory randomly selected three samples and prepared them for testing by cutting one test specimen of 150 mm (5.9 in.) diameter from each selected sample for insertion in the test rig sample holder. The sample holder has an opening of 140 mm (5.5 in.) in diameter, which is the dimension used to calculate the face area of the tested specimen.

SECTION 3
DESCRIPTION OF FILTER FABRIC

The Polymer Group Inc. DURAPEX™ PET filter fabric is a non-scrim-supported, 10 oz/yd^2, 100 percent polyester, non-woven fabric. This product is traditionally used to capture fine particulate in ambient and hot gas filtration applications.

SECTION 4
VERIFICATION OF PERFORMANCE

4.1 QUALITY ASSURANCE

The verification tests were conducted in accordance with an approved test/QA plan.[2] The EPA Quality Assurance Manager conducted an independent assessment of the test laboratory in February 2000 and found that the test laboratory was equipped and being operated as specified in the test/QA plan.

The ETS QA Officer and APCT QA staff have reviewed the results of this test and have found, with the exception of the results from the dust characterization control test, that the results meet data quality objectives as stated in the test/QA plan. It was determined that the dust characteristics continued to achieve the intent of the program and were found not to change the results of the tests significantly. Therefore, the verification test runs proceeded and the results were retained. In addition, it should be noted that, due to the highly efficient nature of the filter medium being tested, one or more of the impactor substrate weighings for these results were near the reproducibility of the balance. The result of this occurrence is that the tests do not meet the data quality objectives stated in the test/QA plan for mass gain associated with outlet concentrations. The true values of the outlet concentrations may be more than plus or minus 15 percent of the reported values. Data on calibration certificates for the flow meters, flow transducers, weights, low- and high-resolution balances, thermometer, and humidity logger are provided in Appendix B.

4.2 RESULTS

Table 3 summarizes the mean outlet particle concentration measurements for the verification test periods. Measurements were conducted during the 6-hour performance test period. The performance test period followed a 10,000-cycle conditioning period and a 30-cycle recovery period. Upstream and downstream particle concentration information for each verification test period is provided in Appendix C.

Table 3 summarizes three verification tests that were performed under standard verification test conditions. Table 4 summarizes three additional verification test runs that were conducted at a filtration velocity of 4.9 fpm at the manufacturer's request.

For the standard verification condition tests, the average residual pressure drop (DP) across each filter sample at the nominal 180 m/h (9.8 fpm) filtration velocity (for a flowrate of 5.8 m^3/h [3.4 cfm]) is also shown in Table 3. This pressure drop ranged from 12.82 to 13.85 cm w.g. (5.05 to 5.45 in. w.g.) for the three filter samples tested. The residual pressure drop increase ranged from 4.87 to 5.62 cm w.g. (1.92 to 2.21 in. w.g.) for the samples tested. All three standard condition verification runs were used to compute the averages given in Table 3. The $PM_{2.5}$ concentration average for the three runs is 0.0000423 g/dscm. The total PM concentration average for the three runs is 0.0000676 g/dscm.

For the non-standard verification condition tests, the average residual pressure drop across each filter sample at the nominal 90 m/h (4.9 fpm) filtration velocity is also shown in Table 4. This pressure drop ranged from 3.12 to 3.60 cm w.g. (1.23 to 1.42 in. w.g.) for the three filter samples tested. The residual pressure drop increase ranged from 0.25 to 0.35 cm w.g. (0.10 to 0.14 in. w.g.) for the samples tested. All three standard condition verification runs were used to compute the averages given in Table 4. The $PM_{2.5}$ concentration average for the three runs is 0.0000188 g/dscm. The total PM concentration average for the three runs is 0.0000720 g/dscm.

Table 3. Summary of Verification Results for Polymer Group Inc. DURAPEX™ PET at 9.8/1 FPM.

Test Run Number	2V03-R1	2V03-R2	2V03-R3	Average*
$PM_{2.5}$ (g/dscm)**	0.0000231	0.0000509	0.0000529	0.0000423
Total PM (g/dscm)	0.0000509	0.0000678	0.0000841	0.0000676
Average Residual DP (cm w.g.)	13.85	13.07	12.82	13.25
Initial Residual DP (cm w.g.)	10.37	9.89	9.91	10.06
Residual DP Increase (cm w.g.)	5.62	5.25	4.87	5.25
Mass Gain of Sample Filter (g)	1.51	1.56	1.61	1.56
Average Filtration Cycle Time (s)	6	6	6	6

*All three verification runs were used to compute averages.
** Standard conditions: 101.3 kPa (14.7 psia) and 20°C (68°F). One or more of the impactor substrate weight changes for these results were near the reproducibility of the balance.

Table 4. Summary of Verification Results for Polymer Group Inc. DURAPEX™ PET at 4.9/1 FPM.

Test Run Number	2V03-R4	2V03-R5	2V03-R6	Average*
$PM_{2.5}$ (g/dscm)**	0.0000296	0.0000047	0.0000220	0.0000188
Total PM (g/dscm)	0.0000810	0.0000282	0.0001069	0.0000720
Average Residual DP (cm w.g.)	3.60	3.60	3.12	3.44
Initial Residual DP (cm w.g.)	3.45	3.41	2.95	3.27
Residual DP Increase (cm w.g.)	0.25	0.35	0.32	0.31
Mass Gain of Sample Filter (g)	1.51	1.31	1.71	1.51
Average Filtration Cycle Time (s)	295	284	303	294

*All three verification runs were used to compute averages.
** Standard conditions: 101.3 kPa (14.7 psia) and 20°C (68°F). One or more of the impactor substrate weight changes for these results were near the reproducibility of the balance.

4.3 LIMITATIONS AND APPLICATIONS

This verification report addresses two aspects of baghouse filtration product performance: outlet particle concentration and pressure drop. Users may wish to consider other performance parameters such as service life and cost when selecting a baghouse filtration fabric for their application.

In accordance with the generic verification protocol, this verification statement is applicable to the baghouse filtration product manufactured between September 28, 2001 and 3 years thereafter.

SECTION 5
REFERENCES

1. Generic Verification Protocol for Baghouse Filtration Products, RTI, Research Triangle Park, NC, February 2000. Available at http://etv.rti.org/apct/pdf/baghouseprotocol.pdf.

2. Test/QA Plan for the Verification Testing of Baghouse Filtration Products, ETS, Inc., Roanoke, VA, February 1999.

Appendix A

DESCRIPTION OF THE TEST RIG AND THE METHODOLOGY

DESCRIPTION OF THE TEST RIG AND METHODOLOGY

TEST APPARATUS

The tests were conducted in ETS's FEMA test apparatus (Figure A-1). The test apparatus consists of a brush-type dust feeder that disperses test dust into a vertical rectangular duct (raw-gas channel). The dust feed rate is continuously measured and recorded via an electronic scale located beneath the dust feed mechanism. The scale has a continuous read-out with a resolution of 10 g. A radioactive polonium-210 alpha source is used to neutralize the dust electrically before its entry into the raw-gas channel. An optical photo sensor monitors the concentration of dust and ensures that the flow is stable for the entire duration of the test. The optical photo sensor does not measure concentration. A portion of the gas flow is extracted from the raw-gas channel through the test filter, which is mounted vertically at the entrance to a horizontal duct (clean-gas channel). The clean-gas channel flow is separated in two gas streams, a sample stream and a bypass stream. An aerodynamic "Y" is used for this purpose. The aerodynamic "Y" is designed for isokinetic separation of the clean gas with 40 percent of the clean gas entering the sample-gas channel without change in gas velocity. The sample-gas channel contains an Andersen impactor for particle separation and measurement. The bypass channel contains an absolute filter. The flow within the two segments of the "Y" is continuously monitored and maintained at selected rates by adjustable valves. Two vacuum pumps maintain air flow through the raw-gas and clean-gas channels. The flow rates, and thus the G/C through the test filter, are kept constant and measured using mass flow controllers. A pressure transducer is used to measure the average residual pressure drop of the filter sample. The pressure transducer measures the differential pressure across the filter samples 3 seconds after the cleaning pulse. The pressure drop measurements are averaged as stated in Appendix C, section 4.4.1.[1] High-efficiency filters are installed upstream of the flow controllers and pumps to prevent contamination or damage caused by the dust. The cleaning system consists of a compressed-air tank set at 0.5 MPa (75 psi), a quick-action diaphragm valve, and a blow tube (25.4 mm [1.0 in.] dia.) with a nozzle (3 mm [0.12 in.] dia.) facing the downstream side of the test filter.

CONTROL TESTS

Two types of control tests were performed during the verification test series. The first was a dust characterization, which was performed at the beginning of the first verification test. The reference dust used during the verification tests was Pural NF aluminum oxide dust, which was oven dried for 2 hours and sealed in an airtight container prior to its insertion into the FEMA apparatus. The dust characterization results had to meet the requirements of a 1.5 µm maximum mass mean diameter and at least 66 percent less than 2.5 µm to continue the verification test series.

The original test dust specification was based on data available when the test protocol was first written. Through laboratory practices and information obtained from the dust manufacturer, it was determined that the original test protocol specification of the dust cannot be met on a consistent basis and, therefore, elected to proceed with the tests using the dust available at the time of testing. The verification test results did not appear to be significantly influenced by this shift to a broader size range for the test dust.

The second control test, the reference value test, is performed quarterly using the reference fabric and the FEMA apparatus. The reference value test determines the weight gain of the reference fabric as well as the maximum pressure drop. The results of the test verify that the FEMA apparatus is operating within the required parameters. The reference value test measurements must meet the following requirements of

weight gain of reference fabric equal to 0.93 ± 0.09 g and a reference fabric maximum pressure drop of 1.84 ± 0.18 cm w.g. to proceed with verification testing.

The results of the control tests are summarized in Table A-1.

Table A-1. Summary of Control Test Results

	Requirement	Measured Value	Met Requirements?
Mass Mean Diameter, µm	< 1.5	1.59	No
% Less than 2.5 µm	> 66	68.92	Yes
Mass Mean Diameter, µm (4.9/1)	< 1.5	1.61	No
% Less than 2.5 µm (4.9/1)	> 66	64.19	No
Weight Gain, g	0.93 ± 0.09	1.02	Yes
Maximum DP, cm w.g.	1.84 ± 0.18	1.90	Yes

ANALYSIS

The equations used for verification analysis are described below.

A_f = Exposed area of sample filter, m^2
C_{ds} = Dry standard outlet particulate concentration of total mass, g/dscm
$C_{2.5ds}$ = Dry standard outlet particulate concentration of PM $_{2.5}$.5, g/dscm
d = Diameter of exposed area of sample filter, m
F_a = Dust feed concentration corrected for actual conditions, g/m^3
F_s = Dust feed concentration corrected for standard conditions, g/dscm
G/C = Gas-to-cloth ratio, m/h
M_t = Total mass gain from Andersen impactor, g
$M_{2.5}$ = Total mass gain of particles equal to or less than 2.5 µm diameter from Andersen impactor, g. This value may need to be linearly interpolated from test data.
N = Number of filtration cycles in a given performance test period
P_{avg} = Average residual pressure drop, cm w.g.
P_i = Residual pressure drop for ith filtration cycle, cm w.g.
P_s = Absolute gas pressure as measured in the raw gas channel, mbar
Q_a = Actual gas flow rate, m^3/h
Q_{ds} = Dry standard gas flow rate, dscmh
$Q_{2.5ds}$ = Dry standard gas flow rate for 2.5 µm particles, dscmh
Q_{st} = Standard gas flow rate for a specific averaging time, t, dscmh
t = Specified averaging time or sampling time, s
t_c = Average filtration cycle time, s
T_s = Raw gas channel temperature, °F
w_f = Weight of dust in feed hopper following specified time, g. Because of vibrations causing short-term fluctuations to the feed hopper, it is recommended that this value be measured as a 1-min average.
w_i = Weight of dust in feed hopper at the beginning of the specified time, g. Because of vibrations causing short-term fluctuations to the feed hopper, it is recommended that this value be measured as a 1-min average.

Conversion factors and standard values used in the equations are listed below.

460	=	0 °F, in °R
1013	=	Standard atmospheric pressure, mbar
528	=	Standard temperature, °R

Area of Sample Fabric - A_f

$A_f = (\pi * d^2)/4$

Actual Gas Flow Rate - Q_a

$$Q_a = Q_{ds} * \left[\frac{(T_s + 460) * 1013}{P_s * 528} \right]$$

Gas-to-Cloth Ratio - G/C

$G/C = Q_a / A_f$

Standard Dust Feed Concentration - F_s, for a specified time - t

$F_s = (w_i - w_f) / (Q_{st} * t)$

Actual Raw Gas Dust Concentration - F_a

$$F_a = F_s * \left[\frac{(T_s + 460) * 1013}{P_s * 528} \right]$$

Dry Standard Clean Gas Particulate Concentration, Total Mass - C_{ds}

$C_{ds} = M_t / [Q_{ds} * t * (1 - \%H_2O/100)]$

Dry Standard Clean Gas Particulate Concentration, PM-2.5 - $C_{2.5ds}$

$C_{2.5ds} = M_{2.5} / [Q_{2.5ds} * t * (1 - \%H_2O/100)]$

Filtration Cycle Time - t_c

$t_c = t/N$

Average Residual Pressure Drop - P_{avg}

$P_{avg} = \Sigma P_i/N$

REFERENCES

1. Test/QA Plan for the Verification Testing of Baghouse Filtration Products, ETS, Inc., Roanoke, VA , February 1999.

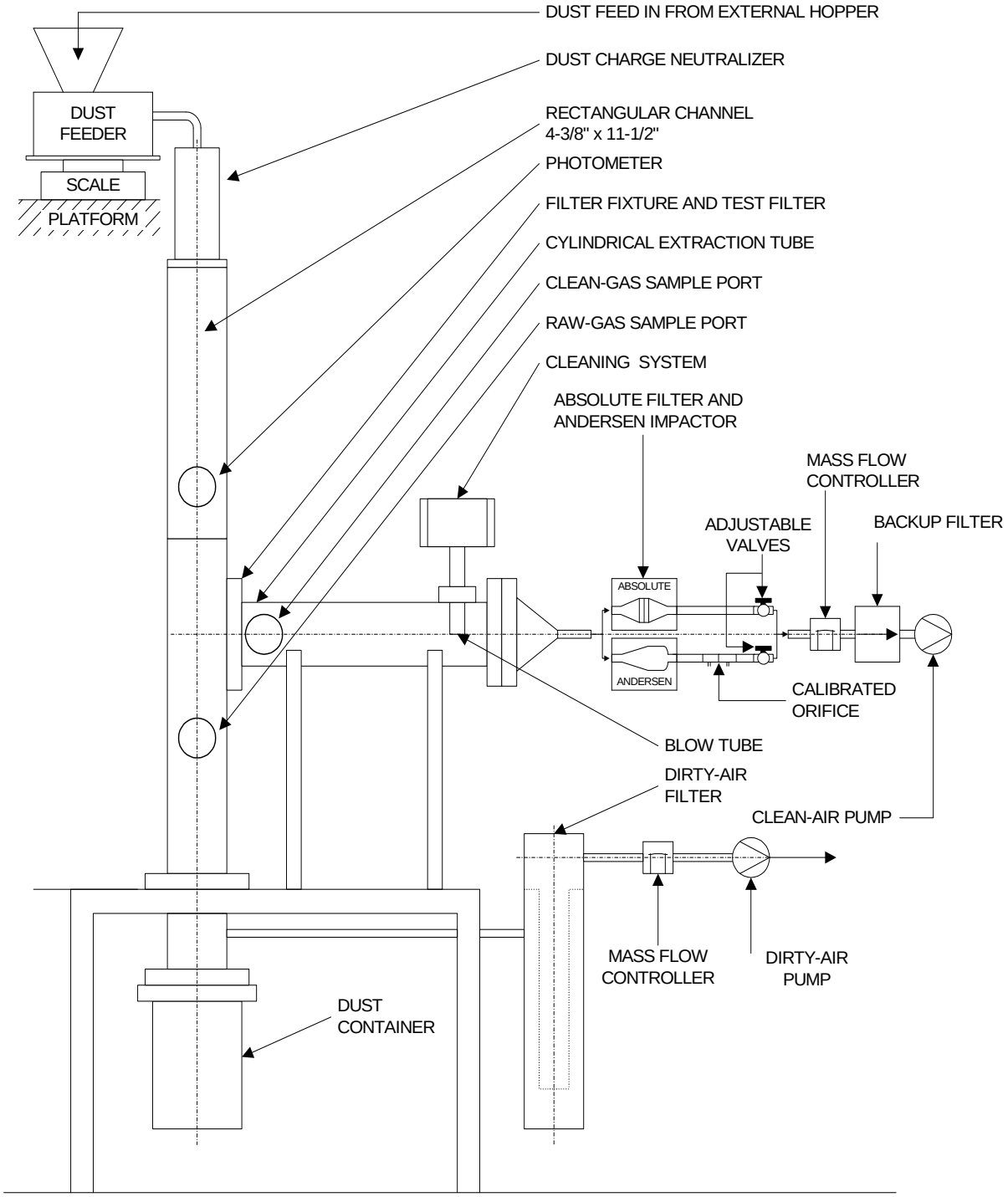


Figure A-1. Diagram of FEMA test apparatus

Appendix B

DATA ON CERTIFICATES OF CALIBRATION

Table B-1. Status of Instrument Calibrations for Baghouse Filtration Products Verification Tests.

Instrument	Measured Parameter	Manufacturer and Model No.	Serial No.	Certificate No.	Date of Certification	Certificate Expiration Date	NIST Traceable?	Current For Test?
High Resolution Balance	Impactor Substrate Weight	Precisa 262SMA-FR	16157	914	11/29/2000	11/29/2001	YES	YES
Low Resolution Balance	Sample Filter Weight	Mettler P 1210N	562968	913	11/29/2000	11/29/2001	YES	YES
2,000 g Weight	Dust Feed Weight Cell	Troemner 2,000 g	37672	152227B	11/29/2000	11/29/2001	YES	YES
100 g Weight	Low Resolution Balance	Troemner 100 g	37670	152227	11/29/2000	11/29/2001	YES	YES
1 g Weight	High Resolution Balance	Troemner 1 g	45300	161484	11/29/2000	11/29/2001	YES	YES
1 mg Weight	High Resolution Balance	Troemner 1 mg	37080	151748	11/29/2000	11/29/2001	YES	YES
Thermocouple	FEMA Temperature	LTG GmbH "K" Type	T-1	Calibrated Against Thermometer	01/03/2001	04/03/2001	YES	YES
	Mercury Thermometer*	VWR Scientific	3C2082	992117	12/29/1999	NA	YES	YES

(continued)

Table B-1. Status of Instrument Calibrations for Baghouse Filtration Products Verification Tests (continued).

Instrument	Measured Parameter	Manufacturer and Model No.	Serial No.	Certificate No.	Date of Certification	Certificate Expiration Date	NIST Traceable?	Current For Test?
Relative Humidity	Lab Relative Humidity	ACR Systems, Inc. SR2	66884	19655	11/23/2000	11/23/2001	YES	YES
Pressure Transducer	ΔP Across Sample Filter	Hastings 223BD-00010AABS	000320459	STDNN SET #4B	12/23/2000	12/23/2001	YES	YES
	Barometric Pressure	Hastings 223BD-00010AABS	145265	STDNN SET #4B	12/23/2000	12/23/2001	YES	YES
Flow Meters	Clean Gas	Hastings HFC-203	123917	Calibrated Against Dry Gas Meter	01/05/2001	04/05/2001	YES	YES
	Raw Gas	Hastings HFC-203	119148	Calibrated Against Dry Gas Meter	01/05/2001	04/05/2001	YES	YES
	Sample Gas	Hastings 223BD-00010 AABS	000320459	Calibrated Against Dry Gas Meter	01/05/2001	04/05/2001	YES	YES
	Dry Gas Meter*	Rockwell S-275	009548	Letter of 07/10/2000	07/10/2000	08/10/2001	YES	YES
Charge Neutralizer	Not applicable	NRD, LLC Nuclecel P-2031	A2AP708	4638	12/06/2000	12/07/2001	YES	YES

*This device is used locally to calibrate other instruments (for temperature or gas flow, as appropriate).
Note: Each of the certificates described in Table B-1 is on file at ETS, Inc.

Appendix C

VERIFICATION TESTING SHEETS

SUMMARY OF RESULTS AT 9.8 FPM

RUN ID.	**2V03-R1**	**2V03-R2**	**2V03-R3**	Average
FABRIC DESIGNATION	**DURAPEX ™ PET-1**	**DURAPEX ™ PET-3**	**DURAPEX ™ PET-5**	
MANUFACTURER	**PGI**	**PGI**	**PGI**	
DUST FEED	**Pural NF**	**Pural NF**	**Pural NF**	
QUICKCHECK				
Mass Mean Diameter	1.59			1.59
% Less than PM 2.5	68.92			68.92
CONDITIONING PERIOD				
Date Started	2/19/2001	2/20/2001	2/22/2001	
Time Started	14:23	14:20	14:37	
Time Ended	22:43	22:40	22:57	
Test Duration (min.)	500	500	500	500
RECOVERY PERIOD				
Date Started	2/20/2001	2/22/2001	2/23/2001	
Time Started	7:31	7:57	8:25	
Time Ended	7:34	8:00	8:28	
Test Duration (min.)	3	3	3	3
PERFORMANCE TEST PERIOD				
Date Started	2/20/2001	2/22/2001	2/23/2001	
Time Started	7:54	8:20	8:49	
Time Ended	13:54	14:20	14:49	
Test Duration (min.)	360	360	360	360
VERIFICATION TEST RESULTS				
Mean Outlet Particle Conc. PM 2.5 (g/dscm)	0.0000231	0.0000509	0.0000529	0.0000423
Mean Outlet Particle Conc. Total mass (g/dscm)	0.0000509	0.0000678	0.0000841	0.0000676
Initial Residual Pressure Drop (cm w.g.)	10.37	9.89	9.91	10.06
Change in Residual Pressure Drop (cm w.g.)	5.62	5.25	4.87	5.25
Average Residual Pressure Drop (cm w.g.)	13.85	13.07	12.82	13.25
Mass Gain of Filter Sample (g)	1.51	1.56	1.61	1.56
Average Filtration Cycle Time (s)	6	6	6	6

RTI/ETV PRELIMINARY TESTING
DUST CHARACTERIZATION - PURAL NF
ANDERSEN IMPACTOR PARTICLE SIZING
GRAVIMETRIC ANALYTICAL DATA AND RESULTS

RUN NUMBER: **2V03-1**
TEST DATE: 02/19/2001

Filter I.D. Sample I.D.	Wash Vol.(ml)	Stage	Tare Filter Mass (g)	Tare Beaker Mass (g)	Total Tare Mass (g)	Total Final Mass (g)	Mass Difference (g)	Negative Difference? (g)
VDI-00-71	50	Acetone Wash	NA	0	0	0	0.00000	NA
VDI-00-71-1		1	1.15591	0	1.15591	1.15631	0.00040	NA
VDI-00-71-2		2	1.18442	0	1.18442	1.18511	0.00069	NA
VDI-00-71-3		3	1.22655	0	1.22655	1.22877	0.00222	NA
VDI-00-71-4		4	1.04070	0	1.04070	1.04492	0.00422	NA
VDI-00-71-5		5	0.97607	0	0.97607	0.98315	0.00708	NA
VDI-00-71-6		6	1.29304	0	1.29304	1.30642	0.01338	NA
VDI-00-71-7		7	1.13341	0	1.13341	1.13950	0.00609	NA
VDI-00-71-8		8	1.11888	0	1.11888	1.12316	0.00428	NA
VDI-00-71-F		9	1.14997	0	1.14997	1.15574	0.00577	NA
						Total	0.04413	

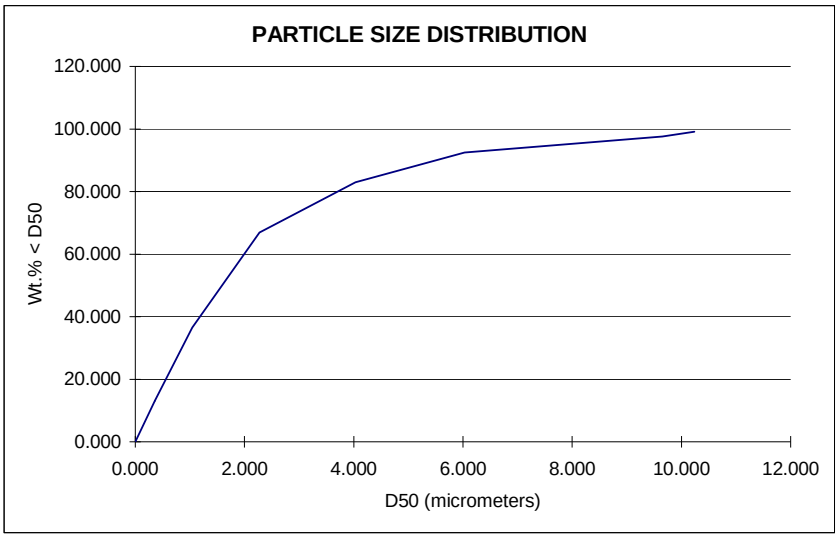
IMPACTOR PARTICLE SIZING RESULTS

Impactor Flow Rate: 0.187 cfm
Isokinetics: 106.84 %
Viscosity of Gas: 0.000163 poise

STAGE	Particulate Mass (g)	Cumulative % Less Than Diameter	D50 Cut Point (micrometers)*
1	0.00040	99.09	10.24
2	0.00069	97.53	9.65
3	0.00222	92.50	6.03
4	0.00422	82.94	4.03
5	0.00708	66.89	2.28
6	0.01338	36.57	1.04
7	0.00609	22.77	0.65
8	0.00428	13.08	0.36
9	0.00577		

Mass Mean Diameter, micrometers	1.59
% Less Than PM 2.5	68.92

* Calculated as an aerodynamic diameter using a particle density of 2.65 g/ml.



Dust Characterization

FOR TEST SERIES	**2V03-1**	
DUST TYPE	Pural NF	
DATE	02/19/2001	
START TIME	13:15	
END TIME	13:20	
STACK LENGTH	111	mm
STACK WIDTH	291	mm
STACK AREA	0.0323	m^2
NOZZLE I.D.	1.797	in.
	0.046	m
METER BOX GAMMA	0.9813	
BAROMETRIC PRESSURE	29.18	in. Hg
TEST DURATION	5	min.
METER VACUUM	2.0	in. Hg

DATA (FOR RAW GAS CHANNEL)

Actual Flow	5.87	m^3/hr
	3.46	cfm
Std. Flow	5.62	scm/hr
	3.31	scfm
Raw Gas Pressure	984.80	mbar
Sample Gas Temperature	24.5	° C
	76.1	° F

INTERMEDIATE RESULTS

Metered Volume	0.940	ft^3
Volume @ Std.Cond.	0.895	scf
Volume at Raw Gas Conditions	0.935	scf
Water	1.07	%
Isokinetics	106.8	%

METHOD 3 DATA

%O2	20.9	Md	28.84	
%CO2	0.0	Ms	28.72	
%CO	0.0	Ps	29.08	in. Hg
%N2	79.1			
O2+CO2	20.9			

POINT	STACK TEMP (° F)	DP (in. w.g.)	DH (in. w.g.)	METER VOLUME (liters)	METER TEMPERATURE INLET (° F)	OUTLET (° F)
1	76.1	1E-05	6.125	3217.09	69	69
				3243.70	74	69
			Volume Change:	26.61	70 (Avg. of 4 temps.)	

Md - Dry Molecular Weight
Ms - Molecular Weight in Stack
Ps - Static Pressure
DH - Orifice Pressure Drop
DP - Pressure Drop

Note: All measurements are primary measurements and might be converted in subsequent calculations.

VERIFICATION TESTING OF BAGHOUSE FILTRATION PRODUCTS
DETAILED SUMMARY OF DATA AND RESULTS

CONDITIONING TEST PERIOD

RUN ID.	2V03-R1	NUMBER OF PULSES	10000
FABRIC DESIGNATION	DURAPEX ™ PET-1	PULSE INTERVAL	3 s
MANUFACTURER	PGI		
DUST FEED	Pural NF	Moisture	1.07 %WV
DATE STARTED	2/19/2001		
TIME STARTED	14:23		
TIME ENDED	22:43		
TEST DURATION	500 min.		

QA/QC DATA

Test Duration			Dust Feed (g)			Average Gas Flow (sm^3/hr)			Avg. Temp	Avg Press	Dust Conc.	G/C Ratio
(min.)	Time		Initial	Final	Total	Raw	Clean	Total	(° C)	(mbar)	(g/dscm)	(m/h)
0-60	14:23	15:23	1728.7	1623.8	104.9	2.84	2.70	5.54	24.6	982.95	19.1	183.7
61-120	15:24	16:23	1623.8	1514.1	109.7	2.85	2.70	5.55	24.7	982.27	20.0	183.9
121-180	16:24	17:23	1514.1	1411.3	102.8	2.84	2.71	5.55	24.5	982.10	18.7	184.5
181-240	17:24	18:23	1411.3	1309.8	101.5	2.84	2.71	5.55	24.1	982.25	18.5	184.2
241-300	18:24	19:23	1309.8	1211.4	98.4	2.84	2.70	5.54	23.8	982.66	18.0	183.2
301-360	19:24	20:23	1211.4	1111.8	99.6	2.84	2.70	5.54	23.4	982.98	18.2	183.0
361-420	20:24	21:23	1111.8	1018.4	93.4	2.84	2.70	5.54	23.2	983.33	17.0	182.8
421-480	21:24	22:23	1018.4	925.8	92.6	2.84	2.70	5.54	23.0	983.52	16.9	182.6
441-500 *	21:44	22:43	984.0	892.9	91.1	2.84	2.70	5.54	22.9	983.52	16.6	182.5
AVERAGE FOR 500 MINUTE RAW DATA					100.3	2.84	2.70	5.54	23.9	982.79	18.3	183.4
ACCEPTANCE					100				25		18.4	180
					+/- 20				+/- 2		+/- 3.6	+/- 9.0

* Test duration is a rolling 60 minute average. The last 60 minute frame was determined by counting 60 minutes back from the last minute of the test.

DATA PROCESSING OPERATOR: _____

Sharon M. Winemiller - ETS, Inc.

VERIFICATION TESTING OF BAGHOUSE FILTRATION PRODUCTS
DETAILED SUMMARY OF DATA AND RESULTS

RECOVERY PERIOD

RUN ID.	2V03-R1	NUMBER OF PULSES	30
FABRIC DESIGNATION	DURAPEX ™ PET-1	AVG. PULSE INTERVAL	7 s
MANUFACTURER	PGI	AVG . RESIDUAL DP	989.83 Pa
DUST FEED	Pural NF	MAX. PRESSURE DROP	1000 Pa
DATE STARTED	2/20/2001		
TIME STARTED	7:31 *	Moisture	0.77 % WV
TIME ENDED	7:34		
TEST DURATION	3 min.		

QA/QC DATA

Test Duration				Dust Feed (g)			Average Gas Flow (sm^3/hr)			Avg. Temp	Avg Press	Dust Conc.	G/C Ratio
(min.)	Time			Initial	Final	Total	Raw	Clean	Total	(° C)	(mbar)	(g/dscm)	(m/hr)
1-3	7:32	*	7:34	913.1	883.3	29.8	2.82	2.72	5.54	21.8	983.04	5.4	183.3

* First minute is not considered in calculations due to equipment stabilization.

DATA PROCESSING OPERATOR: _____

Sharon M. Winemiller - ETS, Inc.

VERIFICATION TESTING OF BAGHOUSE FILTRATION PRODUCTS
DETAILED SUMMARY OF DATA AND RESULTS

PERFORMANCE TEST PERIOD

RUN ID.	2V03-R1	NUMBER OF PULSES	3599
FABRIC DESIGNATION	DURAPEX ™ PET-1	AVG. PULSE INTERVAL	6 s
MANUFACTURER	PGI	AVG. RESIDUAL DP	1356.70 Pa
DUST FEED	Pural NF	INITIAL RESIDUAL DP	1015.7 Pa
DATE STARTED	2/20/2001	CHANGE IN DP	550.6 Pa
TIME STARTED	7:54	MAX. PRESSURE DROP	1000 Pa
TIME ENDED	13:54		
TEST DURATION	360 min.	Moisture	0.77 %WV

QA/QC DATA

Test Duration			Dust Feed (g)			Average Gas Flow (sm^3/hr)				Avg. Temp	Avg Press	Dust Conc.	G/C Ratio
(min.)	Time		Initial	Final	Total	Raw	Clean	Total	Sample	(° C)	(mbar)	(g/dscm)	(m/h)
0-60	7:54	8:54	1675.5	1569.0	106.5	2.86	2.72	5.58	1.09	22.32	983.37	19.2	183.5
61-120	8:55	9:54	1569.0	1463.0	106.0	2.87	2.73	5.60	1.10	23.11	983.36	19.1	184.7
121-180	9:55	10:54	1463.0	1358.3	104.7	2.87	2.73	5.60	1.08	23.87	982.58	18.8	185.3
181-240	10:55	11:54	1358.3	1254.2	104.1	2.87	2.73	5.60	1.09	24.60	981.62	18.7	186.0
241-300	11:55	12:54	1254.2	1145.9	108.3	2.87	2.73	5.60	1.09	25.16	980.49	19.5	186.5
301-360	12:55	13:54	1145.9	1037.4	108.5	2.87	2.73	5.60	1.09	25.45	979.74	19.5	186.9
AVERAGE FOR 360 MINUTE RAW DATA					106.4	2.87	2.73	5.59	1.09	24.08	981.86	19.2	185.4
ACCEPTANCE					100					25		18.4	180
					+/- 20					+/- 2		+/- 3.6	+/- 9.0

GRAVIMETRIC DATA

IMPACTOR SUBSTRATES		SAMPLE FILTER	
Backup Filter (PM 2.5)	0.00015 g	Tare Mass	9.00 g
Total Mass Gain	0.00033 g	Final Mass	10.51 g
		Mass Gain	1.51 g

OUTLET CONCENTRATION

Total Volume Sampled	6.94 m^3
Mean Outlet Particle Concentration - PM 2.5	0.0000216 g/m^3
Mean Outlet Particle Concentration - Total Mass	0.0000475 g/m^3

DATA PROCESSING OPERATOR:

Sharon M. Winemiller - ETS, Inc.

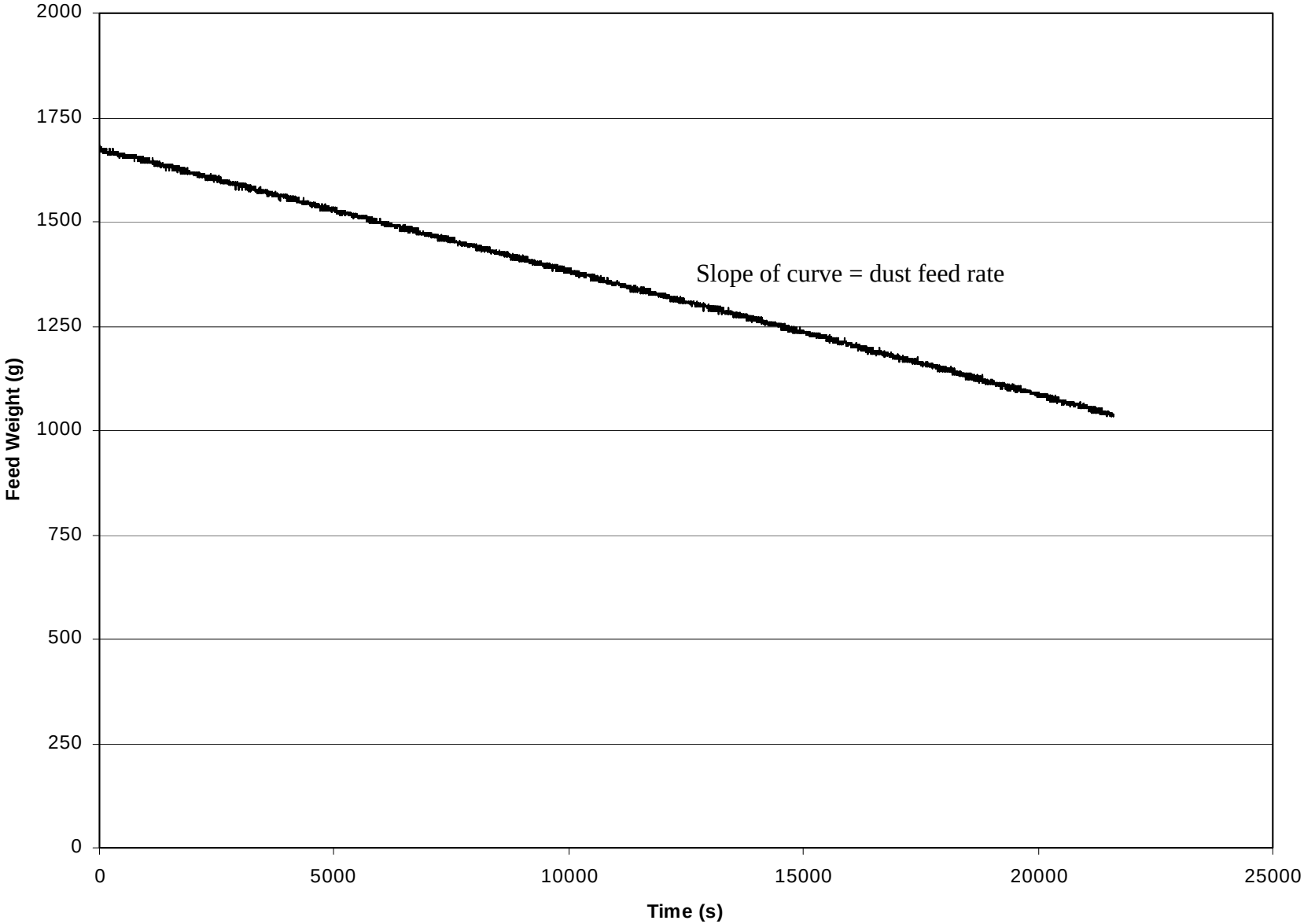


Figure C-1. Change in Pural NF dust scale reading with time during performance period 2V03-R1 at 9.8:1 filtration velocity.

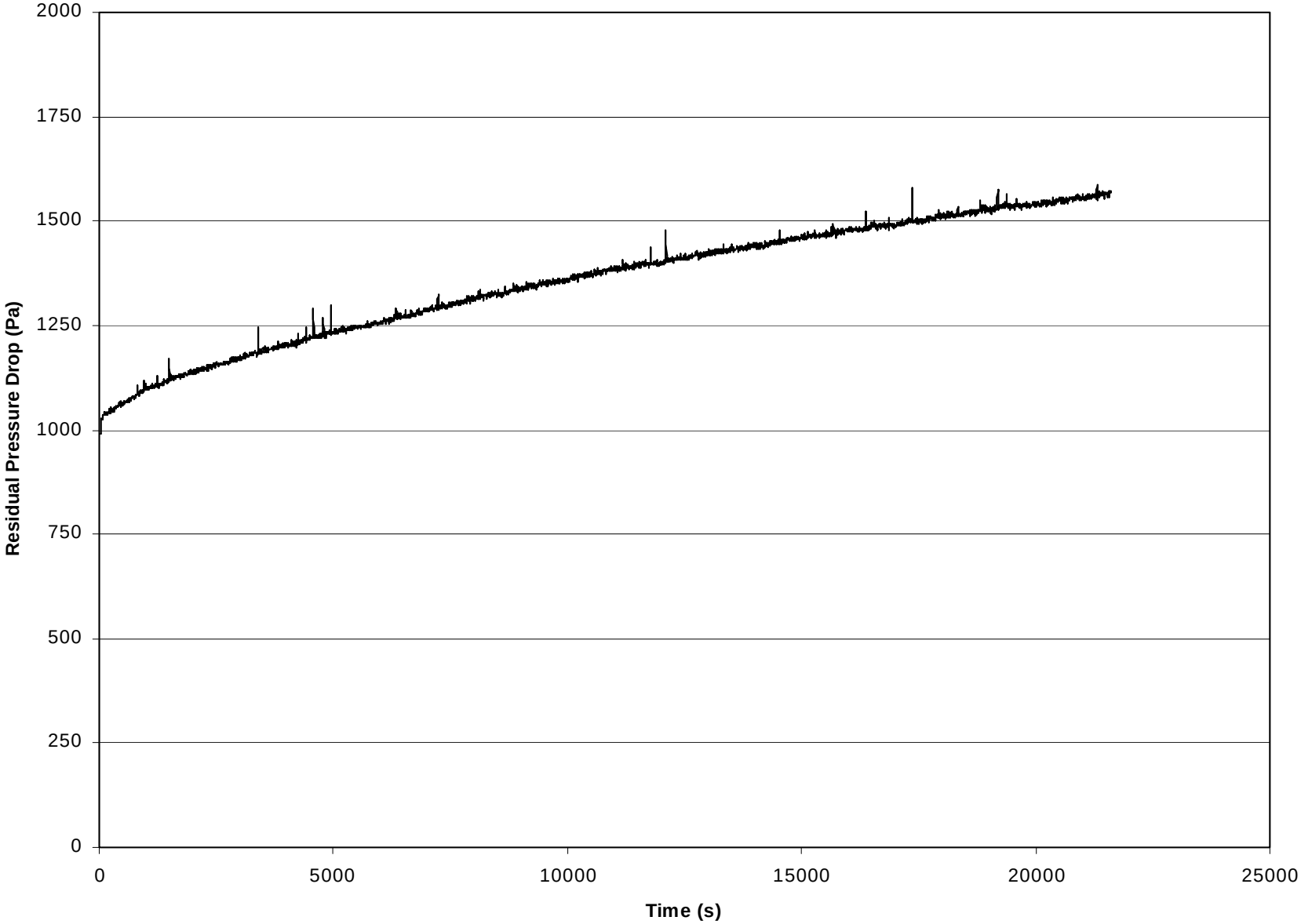


Figure C-2. Residual pressure drop across filter fabric during performance period 2V03-R1 at 9.8:1 filtration velocity.

VERIFICATION TESTING OF BAGHOUSE FILTRATION PRODUCTS
DETAILED SUMMARY OF DATA AND RESULTS

CONDITIONING TEST PERIOD

RUN ID.	2V03-R2	NUMBER OF PULSES	10000
FABRIC DESIGNATION	DURAPEX ™ PET-3	PULSE INTERVAL	3 s
MANUFACTURER	PGI		
DUST FEED	Pural NF	Moisture	1.06 %WV
DATE STARTED	2/20/2001		
TIME STARTED	14:20		
TIME ENDED	22:40		
TEST DURATION	500 min.		

QA/QC DATA

Test Duration			Dust Feed (g)			Average Gas Flow (sm^3/hr)			Avg. Temp	Avg Press	Dust Conc.	G/C Ratio
(min.)	Time		Initial	Final	Total	Raw	Clean	Total	(° C)	(mbar)	(g/dscm)	(m/h)
0-60	14:20	15:20	1800.7	1698.5	102.2	2.83	2.69	5.52	25.3	978.91	18.7	184.2
61-120	15:21	16:20	1698.5	1593.8	104.7	2.84	2.69	5.53	25.2	978.84	19.1	184.2
121-180	16:21	17:20	1593.8	1496.0	97.8	2.84	2.70	5.54	25.1	979.01	17.8	184.7
181-240	17:21	18:20	1496.0	1399.7	96.3	2.84	2.70	5.54	24.8	979.24	17.6	184.5
241-300	18:21	19:20	1399.7	1301.9	97.8	2.84	2.70	5.54	24.6	979.39	17.8	184.3
301-360	19:21	20:20	1301.9	1208.9	93.0	2.84	2.70	5.54	24.5	979.53	17.0	184.2
361-420	20:21	21:20	1208.9	1116.8	92.1	2.84	2.70	5.54	24.3	979.58	16.8	184.1
421-480	21:21	22:20	1116.8	1023.8	93.0	2.84	2.70	5.54	24.1	979.72	17.0	184.0
441-500 *	21:41	22:40	1082.5	993.9	88.6	2.84	2.70	5.54	24.1	979.63	16.2	184.0
AVERAGE FOR 500 MINUTE RAW DATA					96.8	2.84	2.70	5.54	24.7	979.28	17.7	184.2
ACCEPTANCE					100				25		18.4	180
					+/- 20				+/- 2		+/- 3.6	+/- 9.0

* Test duration is a rolling 60 minute average. The last 60 minute frame was determined by counting 60 minutes back from the last minute of the test.

DATA PROCESSING OPERATOR: _____

Sharon M. Winemiller - ETS, Inc.

VERIFICATION TESTING OF BAGHOUSE FILTRATION PRODUCTS
DETAILED SUMMARY OF DATA AND RESULTS

RECOVERY PERIOD

RUN ID.	2V03-R2	NUMBER OF PULSES	30
FABRIC DESIGNATION	DURAPEX ™ PET-3	AVG. PULSE INTERVAL	6 s
MANUFACTURER	PGI	AVG . RESIDUAL DP	968.03 Pa
DUST FEED	Pural NF	MAX. PRESSURE DROP	1000 Pa
DATE STARTED	2/22/2001		
TIME STARTED	7:57 *	Moisture	0.80 % WV
TIME ENDED	8:00		
TEST DURATION	3 min.		

QA/QC DATA

Test Duration (min.)	Time			Dust Feed (g) Initial	Final	Total	Average Gas Flow (sm^3/hr) Raw	Clean	Total	Avg. Temp (° C)	Avg Press (mbar)	Dust Conc. (g/dscm)	G/C Ratio (m/hr)
1-3	7:58	*	8:00	981.2	979.2	2.0	2.86	2.70	5.56	21.8	984.84	0.4	181.6

* First minute is not considered in calculations due to equipment stabilization.

DATA PROCESSING OPERATOR: _____

Sharon M. Winemiller - ETS, Inc.

VERIFICATION TESTING OF BAGHOUSE FILTRATION PRODUCTS
DETAILED SUMMARY OF DATA AND RESULTS

PERFORMANCE TEST PERIOD

RUN ID.	2V03-R2	NUMBER OF PULSES	3598
FABRIC DESIGNATION	DURAPEX ™ PET-3	AVG. PULSE INTERVAL	6 s
MANUFACTURER	PGI	AVG. RESIDUAL DP	1280.26 Pa
DUST FEED	Pural NF	INITIAL RESIDUAL DP	968.8 Pa
DATE STARTED	2/22/2001	CHANGE IN DP	514.6 Pa
TIME STARTED	8:20	MAX. PRESSURE DROP	1000 Pa
TIME ENDED	14:20		
TEST DURATION	360 min.	Moisture	0.8 %WV

QA/QC DATA

Test Duration			Dust Feed (g)			Average Gas Flow (sm^3/hr)				Avg. Temp	Avg Press	Dust Conc.	G/C Ratio
(min.)	Time		Initial	Final	Total	Raw	Clean	Total	Sample	(° C)	(mbar)	(g/dscm)	(m/h)
0-60	8:20	9:20	1740.1	1645.0	95.1	2.85	2.72	5.57	1.08	22.24	984.56	17.2	183.3
61-120	9:21	10:20	1645.0	1539.9	105.1	2.86	2.73	5.59	1.08	22.70	984.46	19.0	184.2
121-180	10:21	11:20	1539.9	1436.7	103.2	2.86	2.73	5.59	1.09	22.93	983.80	18.6	184.5
181-240	11:21	12:20	1436.7	1332.6	104.1	2.86	2.73	5.59	1.09	23.18	982.60	18.8	184.9
241-300	12:21	13:20	1332.6	1227.5	105.1	2.86	2.73	5.59	1.10	23.38	980.71	19.0	185.4
301-360	13:21	14:20	1227.5	1127.1	100.4	2.86	2.73	5.59	1.09	23.52	979.84	18.1	185.6
AVERAGE FOR 360 MINUTE RAW DATA					102.2	2.86	2.73	5.59	1.09	22.99	982.66	18.4	184.4
ACCEPTANCE					100					25		18.4	180
					+/- 20					+/- 2		+/- 3.6	+/- 9.0

GRAVIMETRIC DATA

IMPACTOR SUBSTRATES		SAMPLE FILTER	
Backup Filter (PM 2.5)	0.00033 g	Tare Mass	9.01 g
Total Mass Gain	0.00044 g	Final Mass	10.57 g
		Mass Gain	1.56 g

OUTLET CONCENTRATION

Total Volume Sampled	6.91 m^3
Mean Outlet Particle Concentration - PM 2.5	0.0000478 g/m^3
Mean Outlet Particle Concentration - Total Mass	0.0000637 g/m^3

DATA PROCESSING OPERATOR:

Sharon M. Winemiller - ETS, Inc.

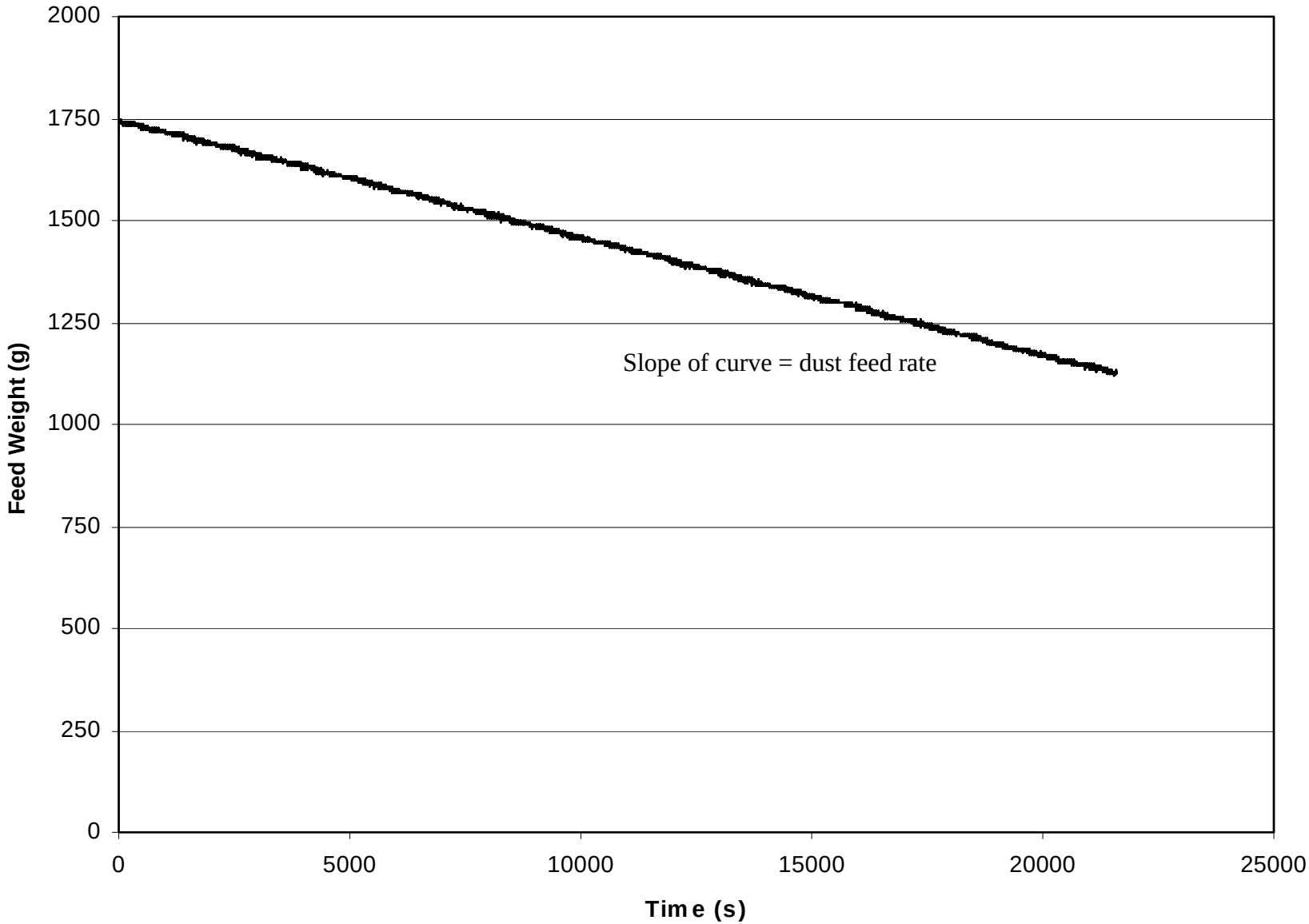


Figure C-3. Change in Pural NF dust scale reading with time during performance period 2V03-R2 at 9.8:1 filtration velocity.

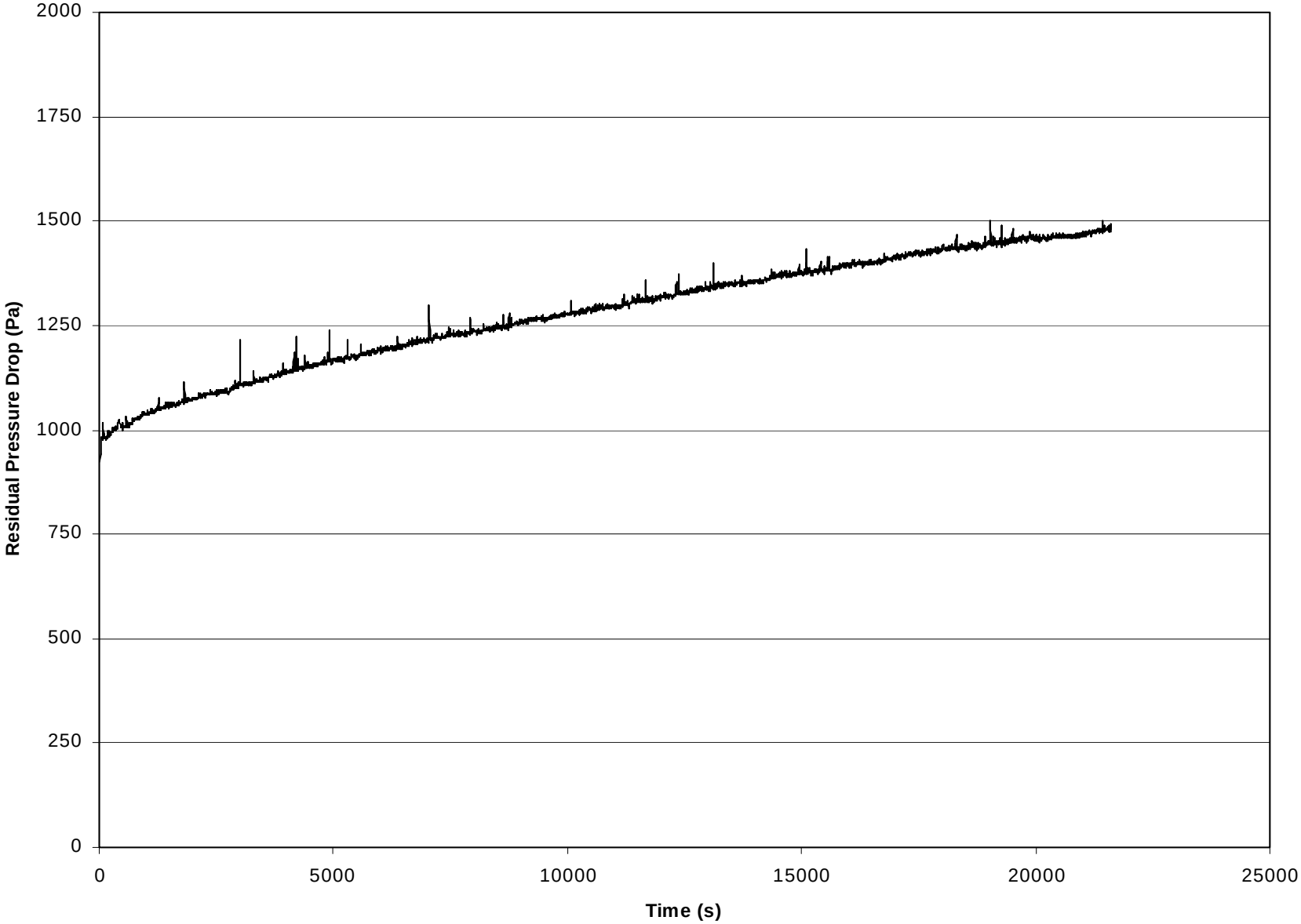


Figure C-4. Residual pressure drop across filter fabric during performance period 2V03-R2 at 9.8:1 filtration velocity.

VERIFICATION TESTING OF BAGHOUSE FILTRATION PRODUCTS
DETAILED SUMMARY OF DATA AND RESULTS

CONDITIONING TEST PERIOD

RUN ID.	2V03-R3	NUMBER OF PULSES	10000
FABRIC DESIGNATION	DURAPEX ™ PET-5	PULSE INTERVAL	3 s
MANUFACTURER	PGI		
DUST FEED	Pural NF	Moisture	0.89 %WV
DATE STARTED	2/22/2001		
TIME STARTED	14:37		
TIME ENDED	22:57		
TEST DURATION	500 min.		

QA/QC DATA

Test Duration			Dust Feed (g)			Average Gas Flow (sm^3/hr)			Avg. Temp	Avg Press	Dust Conc.	G/C Ratio
(min.)	Time		Initial	Final	Total	Raw	Clean	Total	(° C)	(mbar)	(g/dscm)	(m/h)
0-60	14:37	15:37	1806.5	1729.3	77.2	2.83	2.71	5.54	23.7	979.09	14.1	184.5
61-120	15:38	16:37	1729.3	1635.1	94.2	2.84	2.71	5.55	24.2	978.47	17.1	185.0
121-180	16:38	17:37	1635.1	1536.4	98.7	2.84	2.71	5.55	24.5	977.52	17.9	185.3
181-240	17:38	18:37	1536.4	1437.9	98.5	2.84	2.71	5.55	24.5	977.37	17.9	185.3
241-300	18:38	19:37	1437.9	1336.0	101.9	2.84	2.70	5.54	24.5	977.25	18.6	184.7
301-360	19:38	20:37	1336.0	1235.4	100.6	2.84	2.70	5.54	24.5	977.41	18.3	184.7
361-420	20:38	21:37	1235.4	1136.5	98.9	2.84	2.70	5.54	24.5	977.08	18.0	184.7
421-480	21:38	22:37	1136.5	1038.6	97.9	2.84	2.70	5.54	24.5	977.13	17.8	184.7
441-500 *	21:58	22:57	1100.6	1005.8	94.8	2.84	2.70	5.54	24.5	977.20	17.3	184.7
AVERAGE FOR 500 MINUTE RAW DATA					96.1	2.84	2.71	5.54	24.4	977.65	17.5	184.9
ACCEPTANCE					100 +/- 20				25 +/- 2		18.4 +/- 3.6	180 +/- 9.0

* Test duration is a rolling 60 minute average. The last 60 minute frame was determined by counting 60 minutes back from the last minute of the test.

DATA PROCESSING OPERATOR: _____

Sharon M. Winemiller - ETS, Inc.

VERIFICATION TESTING OF BAGHOUSE FILTRATION PRODUCTS
DETAILED SUMMARY OF DATA AND RESULTS

RECOVERY PERIOD

RUN ID.	2V03-R3	NUMBER OF PULSES	30
FABRIC DESIGNATION	DURAPEX ™ PET-5	AVG. PULSE INTERVAL	6 s
MANUFACTURER	PGI	AVG . RESIDUAL DP	975.97 Pa
DUST FEED	Pural NF	MAX. PRESSURE DROP	1000 Pa
DATE STARTED	2/23/2001		
TIME STARTED	8:25 *	Moisture	0.85 % WV
TIME ENDED	8:28		
TEST DURATION	3 min.		

QA/QC DATA

Test Duration (min.)	Time			Dust Feed (g) Initial	Final	Total	Average Gas Flow (sm^3/hr) Raw	Clean	Total	Avg. Temp (° C)	Avg Press (mbar)	Dust Conc. (g/dscm)	G/C Ratio (m/hr)
1-3	8:26	*	8:28	1003.1	1002.8	0.3	2.82	2.72	5.54	23.7	980.41	0.1	184.6

* First minute is not considered in calculations due to equipment stabilization.

DATA PROCESSING OPERATOR: _____

Sharon M. Winemiller - ETS, Inc.

VERIFICATION TESTING OF BAGHOUSE FILTRATION PRODUCTS
DETAILED SUMMARY OF DATA AND RESULTS

PERFORMANCE TEST PERIOD

RUN ID.	2V03-R3	NUMBER OF PULSES	3597
FABRIC DESIGNATION	DURAPEX ™ PET-5	AVG. PULSE INTERVAL	6 s
MANUFACTURER	PGI	AVG. RESIDUAL DP	1256.05 Pa
DUST FEED	Pural NF	INITIAL RESIDUAL DP	971.2 Pa
DATE STARTED	2/23/2001	CHANGE IN DP	477.2 Pa
TIME STARTED	8:49	MAX. PRESSURE DROP	1000 Pa
TIME ENDED	14:49		
TEST DURATION	360 min.	Moisture	0.85 %WV

QA/QC DATA

Test Duration			Dust Feed (g)			Average Gas Flow (sm^3/hr)				Avg. Temp	Avg Press	Dust Conc.	G/C Ratio
(min.)	Time		Initial	Final	Total	Raw	Clean	Total	Sample	(° C)	(mbar)	(g/dscm)	(m/h)
0-60	8:49	9:49	1713.7	1617.7	96.0	2.83	2.71	5.54	1.08	24.18	980.92	17.5	184.5
61-120	9:50	10:49	1617.7	1517.8	99.9	2.84	2.70	5.54	1.08	24.70	981.64	18.2	184.0
121-180	10:50	11:49	1517.8	1423.1	94.7	2.84	2.70	5.54	1.08	25.16	982.52	17.2	184.1
181-240	11:50	12:49	1423.1	1321.7	101.4	2.84	2.70	5.54	1.08	25.66	982.68	18.5	184.4
241-300	12:50	13:49	1321.7	1221.5	100.2	2.84	2.70	5.54	1.09	26.02	981.66	18.2	184.8
301-360	13:50	14:49	1221.5	1117.4	104.1	2.84	2.70	5.54	1.09	26.25	981.61	19.0	184.9
AVERAGE FOR 360 MINUTE RAW DATA					99.4	2.84	2.70	5.55	1.08	25.33	981.84	18.1	184.6
ACCEPTANCE					100 +/- 20					25 +/- 2		18.4 +/- 3.6	180 +/- 9.0

GRAVIMETRIC DATA

IMPACTOR SUBSTRATES		SAMPLE FILTER	
Backup Filter (PM 2.5)	0.00034 g	Tare Mass	8.94 g
Total Mass Gain	0.00054 g	Final Mass	10.55 g
		Mass Gain	1.61 g

OUTLET CONCENTRATION

Total Volume Sampled	6.90 m^3
Mean Outlet Particle Concentration - PM 2.5	0.0000493 g/m^3
Mean Outlet Particle Concentration - Total Mass	0.0000783 g/m^3

DATA PROCESSING OPERATOR:

Sharon M. Winemiller - ETS, Inc.

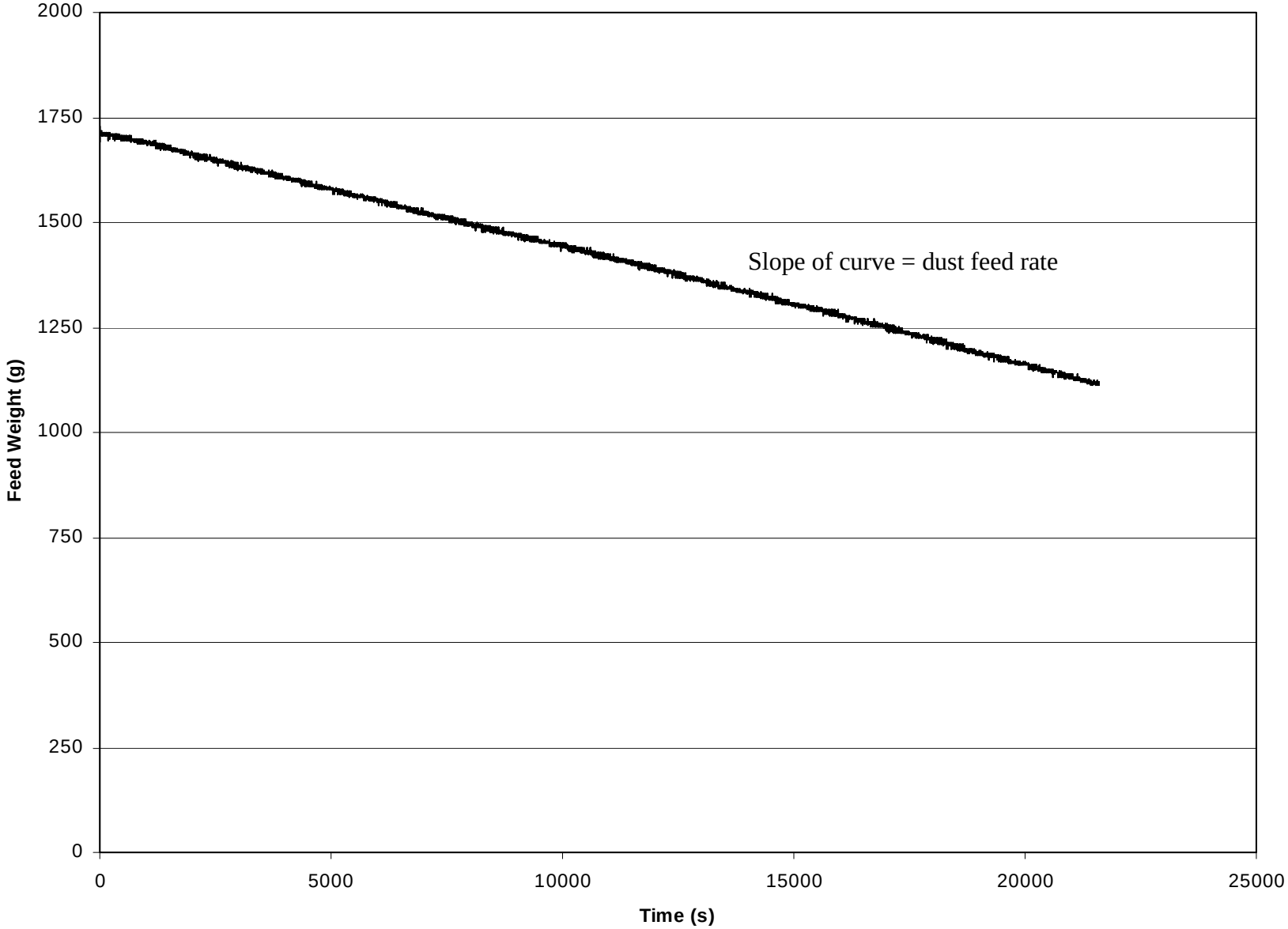


Figure C-5. Change in Pural NF dust scale reading with time during performance period 2V03-R3 at 9.8:1 filtration velocity.

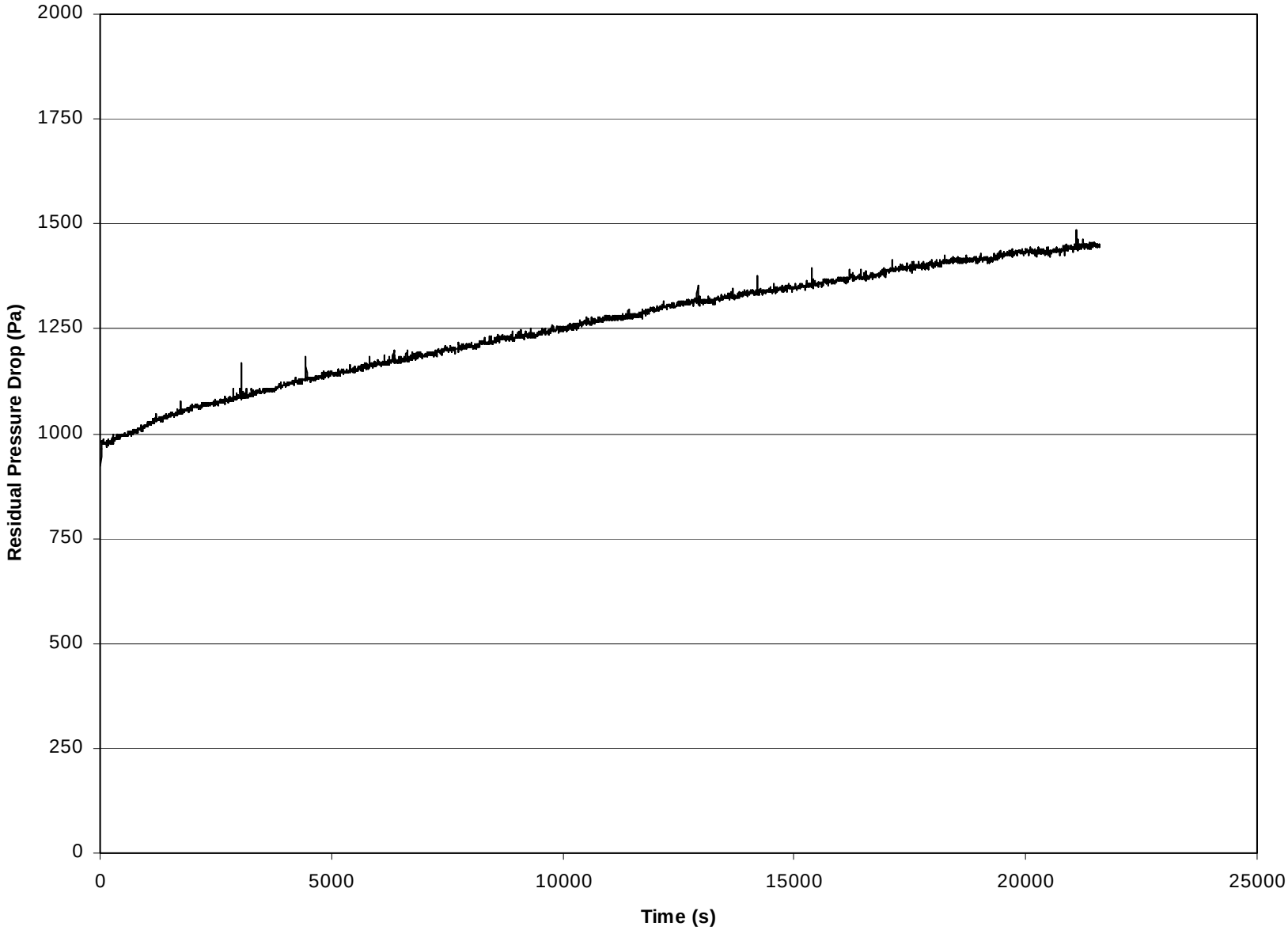


Figure C-6. Residual pressure drop across filter fabric during performance period 2V03-R3 at 9.8:1 filtration velocity.

VERIFICATION TESTING OF BAGHOUSE FILTRATION PRODUCTS
SUMMARY OF RESULTS AT 4.9 FPM

RUN ID.	**2V03-R4**	**2V03-R5**	**2V03-R6**	Average
FABRIC DESIGNATION	**DURAPEX ™ PET-2**	**DURAPEX ™ PET-4**	**DURAPEX ™ PET-6**	
MANUFACTURER	**PGI**	**PGI**	**PGI**	
DUST FEED	**Pural NF**	**Pural NF**	**Pural NF**	
QUICKCHECK				
Mass Mean Diameter	1.61			1.61
% Less than PM 2.5	64.19			64.19
CONDITIONING PERIOD				
Date Started	2/26/2001	2/28/2001	3/1/2001	
Time Started	13:48	9:14	15:23	
Time Ended	22:08	17:34	23:43	
Test Duration (min.)	500	500	500	500
RECOVERY PERIOD				
Date Started	2/27/2001	2/28/2001	3/2/2001	
Time Started	8:18	17:52	8:15	
Time Ended	11:12	21:12	11:42	
Test Duration (min.)	174	200	207	194
PERFORMANCE TEST PERIOD				
Date Started	2/27/2001	3/1/2001	3/2/2001	
Time Started	11:28	8:58	12:04	
Time Ended	17:28	14:58	18:04	
Test Duration (min.)	360	360	360	360
VERIFICATION TEST RESULTS				
Mean Outlet Particle Conc. PM 2.5 (g/dscm)	0.0000296	0.0000047	0.0000220	0.0000188
Mean Outlet Particle Conc. Total mass (g/dscm)	0.0000810	0.0000282	0.0001069	0.0000720
Initial Residual Pressure Drop (cm w.g.)	3.45	3.41	2.95	3.27
Change in Residual Pressure Drop (cm w.g.)	0.25	0.35	0.32	0.31
Average Residual Pressure Drop (cm w.g.)	3.60	3.60	3.12	3.44
Mass Gain of Filter Sample (g)	1.51	1.31	1.71	1.51
Average Filtration Cycle Time (s)	295	284	303	294

RTI/ETV PRELIMINARY TESTING
DUST CHARACTERIZATION - PURAL NF
ANDERSEN IMPACTOR PARTICLE SIZING
GRAVIMETRIC ANALYTICAL DATA AND RESULTS

RUN NUMBER: **2V03-4**
TEST DATE: 02/26/2001

Filter I.D. Sample I.D.	Wash Vol.(ml)	Stage	Tare Filter Mass (g)	Tare Beaker Mass (g)	Total Tare Mass (g)	Total Final Mass (g)	Mass Difference (g)	Negative Difference? (g)
VDI-00-74	50	Acetone Wash	NA	0	0	0	0.00000	NA
VDI-00-74-1		1	1.04851	0	1.04851	1.05143	0.00292	NA
VDI-00-74-2		2	1.08859	0	1.08859	1.08959	0.00100	NA
VDI-00-74-3		3	1.04955	0	1.04955	1.05310	0.00355	NA
VDI-00-74-4		4	1.25045	0	1.25045	1.25584	0.00539	NA
VDI-00-74-5		5	1.26463	0	1.26463	1.27263	0.00800	NA
VDI-00-74-6		6	1.05467	0	1.05467	1.06732	0.01265	NA
VDI-00-74-7		7	1.28307	0	1.28307	1.29283	0.00976	NA
VDI-00-74-8		8	1.21597	0	1.21597	1.22101	0.00504	NA
VDI-00-74-F		9	1.23269	0	1.23269	1.23936	0.00667	NA
						Total	0.05498	

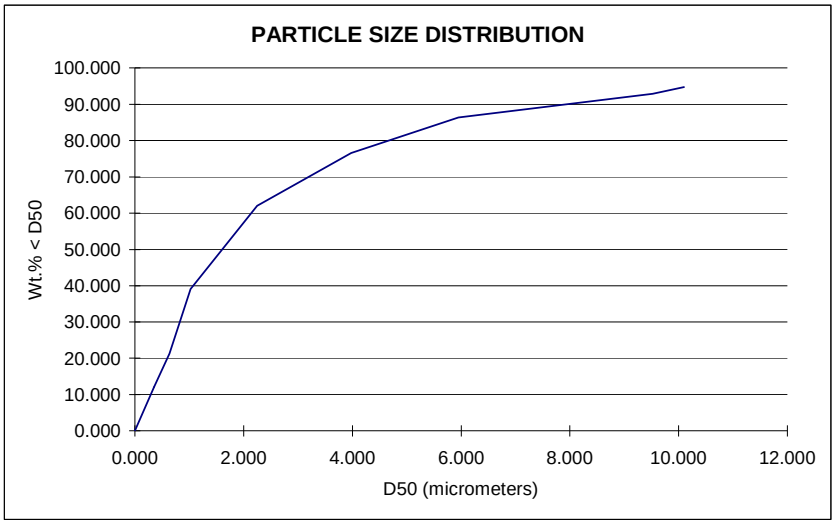
IMPACTOR PARTICLE SIZING RESULTS

Impactor Flow Rate: 0.192 cfm
Isokinetics: 110.26 %
Viscosity of Gas: 0.000163 poise

STAGE	Particulate Mass (g)	Cumulative % Less Than Diameter	D50 Cut Point (micrometers)*
1	0.00292	94.69	10.10
2	0.00100	92.87	9.52
3	0.00355	86.41	5.95
4	0.00539	76.61	3.98
5	0.00800	62.06	2.25
6	0.01265	39.05	1.03
7	0.00976	21.30	0.64
8	0.00504	12.13	0.35
9	0.00667		

Mass Mean Diameter, micrometers	1.61
% Less Than PM 2.5	64.19

* Calculated as an aerodynamic diameter using a particle density of 2.65 g/ml.



Dust Characterization

FOR TEST SERIES	**2V03-4**	
DUST TYPE	Pural NF	
DATE	02/26/2001	
START TIME	12:42	
END TIME	12:47	
STACK LENGTH	111	mm
STACK WIDTH	291	mm
STACK AREA	0.0323	m^2
NOZZLE I.D.	1.797	in.
	0.046	m
METER BOX GAMMA	0.9813	
BAROMETRIC PRESSURE	29.18	in. Hg
TEST DURATION	5	min.
METER VACUUM	2.0	in. Hg

DATA (FOR RAW GAS CHANNEL)

Actual Flow	5.84	m^3/hr
	3.44	cfm
Std. Flow	5.54	scm/hr
	3.26	scfm
Raw Gas Pressure	981.99	mbar
Sample Gas Temperature	26.3	° C
	79.4	° F

INTERMEDIATE RESULTS

Metered Volume	0.980	ft^3
Volume @ Std.Cond.	0.910	scf
Volume at Raw Gas Conditions	0.960	scf
Water	1.29	%
Isokinetics	110.3	%

METHOD 3 DATA

%O2	20.9	Md	28.84	
%CO2	0.0	Ms	28.70	
%CO	0.0	Ps	29.00	in. Hg
%N2	79.1			
O2+CO2	20.9			

POINT	STACK TEMP (° F)	DP (in. w.g.)	DH (in. w.g.)	METER VOLUME (liters)	METER TEMPERATURE INLET (° F)	OUTLET (° F)
1	79.4	1E-05	6.125	3365.46	84	81
				3393.21	88	82
			Volume Change:	27.75	84 (Avg. of 4 temps.)	

Md - Dry Molecular Weight
Ms - Molecular Weight in Stack
Ps - Static Pressure
DH - Orifice Pressure Drop
DP - Pressure Drop

Note: All measurements are primary measurements and might be converted in subsequent calculations.

VERIFICATION TESTING OF BAGHOUSE FILTRATION PRODUCTS
DETAILED SUMMARY OF DATA AND RESULTS

CONDITIONING TEST PERIOD

RUN ID.	2V03-R4	NUMBER OF PULSES	10000
FABRIC DESIGNATION	DURAPEX ™ PET-2	PULSE INTERVAL	3 s
MANUFACTURER	PGI		
DUST FEED	Pural NF	Moisture	1.19 %WV
DATE STARTED	2/26/2001		
TIME STARTED	13:48		
TIME ENDED	22:08		
TEST DURATION	500 min.		

QA/QC DATA

Test Duration			Dust Feed (g)			Average Gas Flow (sm^3/hr)			Avg. Temp	Avg Press	Dust Conc.	G/C Ratio
(min.)	Time		Initial	Final	Total	Raw	Clean	Total	(° C)	(mbar)	(g/dscm)	(m/h)
0-60	13:48	14:48	1705.2	1611.2	94.0	4.17	1.35	5.52	26.1	980.85	17.2	92.5
61-120	14:49	15:48	1611.2	1507.3	103.9	4.17	1.35	5.52	26.3	980.88	19.0	92.6
121-180	15:49	16:48	1507.3	1400.2	107.1	4.17	1.35	5.52	26.3	981.09	19.6	92.5
181-240	16:49	17:48	1400.2	1292.6	107.6	4.17	1.35	5.52	26.0	981.89	19.7	92.4
241-300	17:49	18:48	1292.6	1181.5	111.1	4.17	1.34	5.51	25.5	982.69	20.4	91.4
301-360	18:49	19:48	1181.5	1084.1	97.4	4.17	1.34	5.51	25.1	983.25	17.9	91.3
361-420	19:49	20:48	1084.1	982.0	102.1	4.18	1.34	5.52	24.9	983.84	18.7	91.2
421-480	20:49	21:48	982.0	889.0	93.0	4.18	1.34	5.52	24.7	984.32	17.1	91.1
441-500 *	21:09	22:08	951.2	854.9	96.3	4.18	1.34	5.52	24.7	984.39	17.7	91.1
AVERAGE FOR 500 MINUTE RAW DATA					102.0	4.17	1.34	5.52	25.6	982.43	18.7	91.8
ACCEPTANCE					100				25		18.4	180
					+/- 20				+/- 2		+/- 3.6	+/- 9.0

* Test duration is a rolling 60 minute average. The last 60 minute frame was determined by counting 60 minutes back from the last minute of the test.

DATA PROCESSING OPERATOR: _____

Sharon M. Winemiller - ETS, Inc.

VERIFICATION TESTING OF BAGHOUSE FILTRATION PRODUCTS
DETAILED SUMMARY OF DATA AND RESULTS

RECOVERY PERIOD - 4.9:1

RUN ID.	2V03-R4	NUMBER OF PULSES	30
FABRIC DESIGNATION	DURAPEX ™ PET-2	AVG. PULSE INTERVAL	348 s
MANUFACTURER	PGI	AVG . RESIDUAL DP	331.70 Pa
DUST FEED	Pural NF	MAX. PRESSURE DROP	1000 Pa
DATE STARTED	2/27/2001		
TIME STARTED	8:18 *	Moisture	0.78 % WV
TIME ENDED	11:12		
TEST DURATION	174 min.		

QA/QC DATA

Test Duration				Dust Feed (g)			Average Gas Flow (sm^3/hr)			Avg. Temp	Avg Press	Dust Conc.	G/C Ratio
(min.)	Time			Initial	Final	Total	Raw	Clean	Total	(° C)	(mbar)	(g/dscm)	(m/hr)
1-60	8:19	*	9:18	1516.4	1417.2	99.2	4.22	1.37	5.59	24.3	984.34	17.9	93.0
61-120	9:19		10:18	1414.8	1309.8	105.0	4.21	1.37	5.58	24.8	984.06	19.0	93.1
115-174	10:13		11:12	1315.5	1215.0	100.5	4.21	1.37	5.58	25.1	983.33	18.1	93.3

* First minute is not considered in calculations due to equipment stabilization.

DATA PROCESSING OPERATOR: _____

Sharon M. Winemiller - ETS, Inc.

VERIFICATION TESTING OF BAGHOUSE FILTRATION PRODUCTS
DETAILED SUMMARY OF DATA AND RESULTS

PERFORMANCE TEST PERIOD - 4.9:1

RUN ID.	2V03-R4	NUMBER OF PULSES	73
FABRIC DESIGNATION	DURAPEX ™ PET-2	AVG. PULSE INTERVAL	295 s
MANUFACTURER	PGI	AVG. RESIDUAL DP	352.74 Pa
DUST FEED	Pural NF	INITIAL RESIDUAL DP	337.8 Pa
DATE STARTED	2/27/2001	CHANGE IN DP	24.2 Pa
TIME STARTED	11:28	MAX. PRESSURE DROP	1000 Pa
TIME ENDED	17:28		
TEST DURATION	360 min.	Moisture	0.92 %WV

QA/QC DATA

Test Duration			Dust Feed (g)			Average Gas Flow (sm^3/hr)				Avg. Temp	Avg Press	Dust Conc.	G/C Ratio
(min.)	Time		Initial	Final	Total	Raw	Clean	Total	Sample	(° C)	(mbar)	(g/dscm)	(m/h)
0-60	11:28	12:28	1742.7	1649.7	93.0	4.16	1.35	5.51	1.07	25.68	982.25	17.0	92.2
61-120	12:29	13:28	1649.7	1549.2	100.5	4.17	1.35	5.52	1.08	26.22	980.54	18.4	92.6
121-180	13:29	14:28	1549.2	1442.0	107.2	4.17	1.35	5.52	1.08	26.63	979.48	19.6	92.8
181-240	14:29	15:28	1442.0	1329.4	112.6	4.17	1.35	5.52	1.08	26.75	978.04	20.6	93.0
241-300	15:29	16:28	1329.4	1218.3	111.1	4.17	1.35	5.52	1.07	26.49	977.24	20.3	93.0
301-360	16:29	17:28	1218.3	1114.4	103.9	4.17	1.35	5.52	1.08	26.00	976.62	19.0	92.9
AVERAGE FOR 360 MINUTE RAW DATA					104.7	4.17	1.35	5.52	1.08	26.30	979.03	19.2	92.7
ACCEPTANCE					100					25		18.4	180
					+/- 20					+/- 2		+/- 3.6	+/- 9.0

GRAVIMETRIC DATA

IMPACTOR SUBSTRATES		SAMPLE FILTER	
Backup Filter (PM 2.5)	0.00019 g	Tare Mass	8.88 g
Total Mass Gain	0.00052 g	Final Mass	10.39 g
		Mass Gain	1.51 g

OUTLET CONCENTRATION

Total Volume Sampled	6.91 m^3
Mean Outlet Particle Concentration - PM 2.5	0.0000275 g/m^3
Mean Outlet Particle Concentration - Total Mass	0.0000753 g/m^3

DATA PROCESSING OPERATOR:

Sharon M. Winemiller - ETS, Inc.

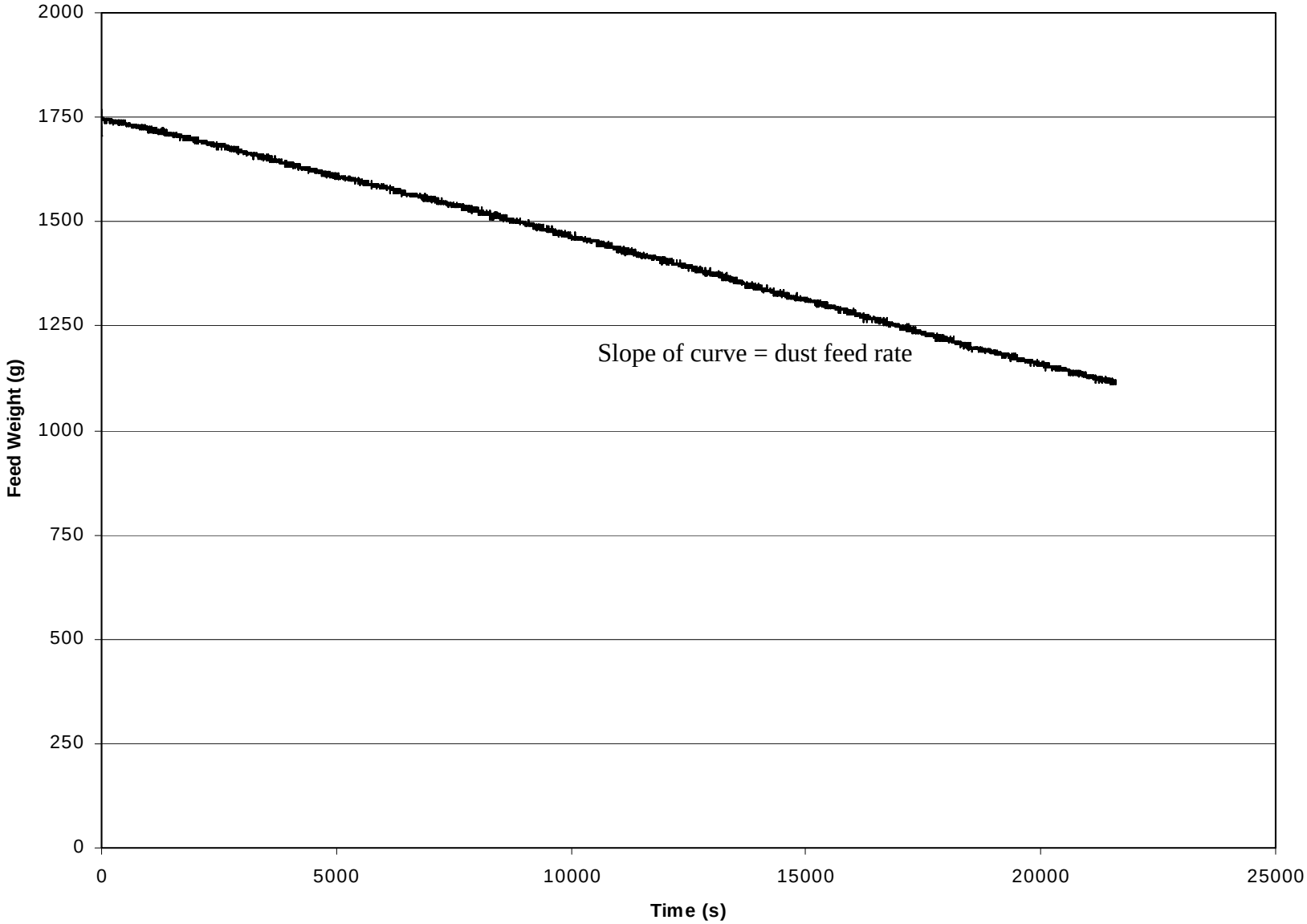


Figure C-7. Change in Pural NF dust scale reading with time during performance period 2V03-R4 at 4.9:1 filtration velocity.

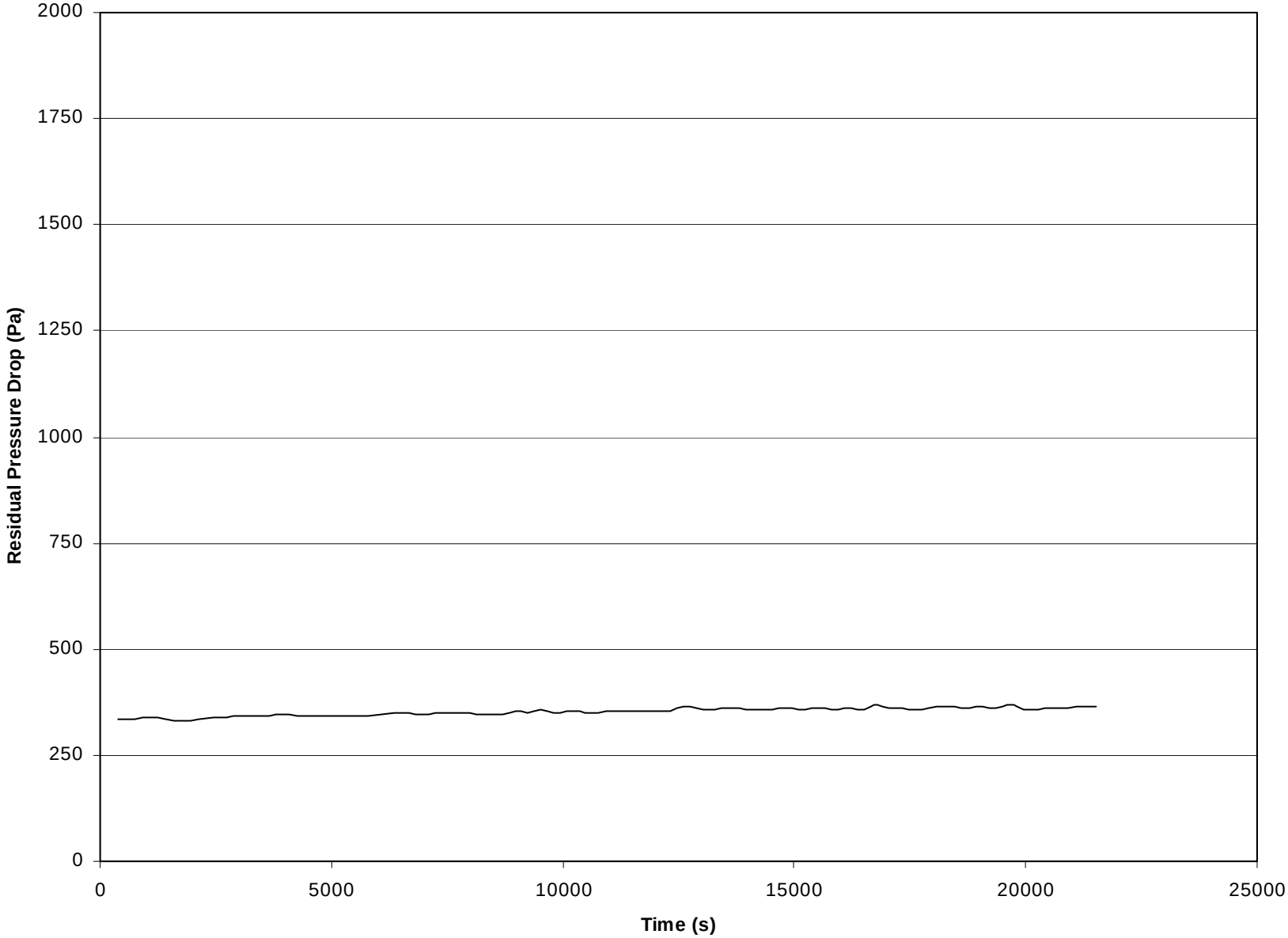


Figure C-8. Residual pressure drop across filter fabric during performance period 2V03-R4 at 4.9:1 filtration velocity.

VERIFICATION TESTING OF BAGHOUSE FILTRATION PRODUCTS
DETAILED SUMMARY OF DATA AND RESULTS

CONDITIONING TEST PERIOD - 4.9:1

RUN ID.	2V03-R5	NUMBER OF PULSES	10000
FABRIC DESIGNATION	DURAPEX ™ PET-4	PULSE INTERVAL	3 s
MANUFACTURER	PGI		
DUST FEED	Pural NF	Moisture	0.95 %WV
DATE STARTED	2/28/2001		
TIME STARTED	9:14		
TIME ENDED	17:34		
TEST DURATION	500 min.		

QA/QC DATA

Test Duration			Dust Feed (g)			Average Gas Flow (sm^3/hr)			Avg. Temp	Avg Press	Dust Conc.	G/C Ratio
(min.)	Time		Initial	Final	Total	Raw	Clean	Total	(° C)	(mbar)	(g/dscm)	(m/h)
0-60	9:14	10:14	1724.2	1643.6	80.6	4.17	1.36	5.53	23.7	977.62	14.7	92.7
61-120	10:15	11:14	1643.6	1553.8	89.8	4.18	1.36	5.54	24.2	977.75	16.4	92.9
121-180	11:15	12:14	1553.8	1460.7	93.1	4.18	1.36	5.54	24.8	976.86	17.0	93.1
181-240	12:15	13:14	1460.7	1361.3	99.4	4.18	1.36	5.54	25.2	976.11	18.1	93.4
241-300	13:15	14:14	1361.3	1264.1	97.2	4.18	1.35	5.53	25.5	975.21	17.7	92.8
301-360	14:15	15:14	1264.1	1159.7	104.4	4.18	1.35	5.53	25.6	974.57	19.1	92.9
361-420	15:15	16:14	1159.7	1054.5	105.2	4.18	1.35	5.53	25.5	974.20	19.2	92.9
421-480	16:15	17:14	1054.5	950.5	104.0	4.18	1.35	5.53	25.3	973.50	19.0	93.0
441-500 *	16:35	17:34	1018.8	916.5	102.3	4.17	1.35	5.52	25.2	973.57	18.7	92.9
AVERAGE FOR 500 MINUTE RAW DATA					96.9	4.18	1.35	5.53	25.0	975.65	17.7	92.9
ACCEPTANCE					100 +/- 20				25 +/- 2		18.4 +/- 3.6	180 +/- 9.0

* Test duration is a rolling 60 minute average. The last 60 minute frame was determined by counting 60 minutes back from the last minute of the test.

DATA PROCESSING OPERATOR: _____

Sharon M. Winemiller - ETS, Inc.

VERIFICATION TESTING OF BAGHOUSE FILTRATION PRODUCTS
DETAILED SUMMARY OF DATA AND RESULTS

RECOVERY PERIOD - 4.9:1

RUN ID.	2V03-R5	NUMBER OF PULSES	30
FABRIC DESIGNATION	DURAPEX ™ PET-4	AVG. PULSE INTERVAL	401 s
MANUFACTURER	PGI	AVG . RESIDUAL DP	320.67 Pa
DUST FEED	Pural NF	MAX. PRESSURE DROP	1000 Pa
DATE STARTED	2/28/2001		
TIME STARTED	17:52 *	Moisture	1.02 % WV
TIME ENDED	21:12		
TEST DURATION	200 min.		

QA/QC DATA

Test Duration				Dust Feed (g)			Average Gas Flow (sm^3/hr)			Avg. Temp	Avg Press	Dust Conc.	G/C Ratio
(min.)	Time			Initial	Final	Total	Raw	Clean	Total	(° C)	(mbar)	(g/dscm)	(m/hr)
1-60	17:53	*	18:52	1597.6	1497.2	100.4	4.14	1.34	5.48	24.7	974.28	18.5	92.1
61-120	18:53		19:52	1497.1	1393.4	103.7	4.14	1.34	5.48	24.5	974.65	19.1	91.9
121-180	19:53		20:52	1393.5	1296.1	97.4	4.14	1.34	5.48	24.3	974.86	17.9	91.8
141-200	20:13		21:12	1363.3	1264.5	98.8	4.14	1.34	5.48	24.2	974.89	18.2	91.8

* First minute is not considered in calculations due to equipment stabilization.

DATA PROCESSING OPERATOR: _____

Sharon M. Winemiller - ETS, Inc.

VERIFICATION TESTING OF BAGHOUSE FILTRATION PRODUCTS
DETAILED SUMMARY OF DATA AND RESULTS

PERFORMANCE TEST PERIOD - 4.9:1

RUN ID.	2V03-R5	NUMBER OF PULSES	76
FABRIC DESIGNATION	DURAPEX ™ PET-4	AVG. PULSE INTERVAL	284 s
MANUFACTURER	PGI	AVG. RESIDUAL DP	352.80 Pa
DUST FEED	Pural NF	INITIAL RESIDUAL DP	333.8 Pa
DATE STARTED	3/1/2001	CHANGE IN DP	34.5 Pa
TIME STARTED	8:58	MAX. PRESSURE DROP	1000 Pa
TIME ENDED	14:58		
TEST DURATION	360 min.	Moisture	0.68 %WV

QA/QC DATA

Test Duration			Dust Feed (g)			Average Gas Flow (sm^3/hr)				Avg. Temp	Avg Press	Dust Conc.	G/C Ratio
(min.)	Time		Initial	Final	Total	Raw	Clean	Total	Sample	(° C)	(mbar)	(g/dscm)	(m/h)
0-60	8:58	9:58	1722.8	1640.3	82.5	4.15	1.34	5.49	1.06	23.15	973.08	15.1	91.6
61-120	9:59	10:58	1640.3	1544.5	95.8	4.16	1.35	5.51	1.07	23.95	973.09	17.5	92.6
121-180	10:59	11:58	1544.5	1446.1	98.4	4.16	1.35	5.51	1.07	24.62	972.73	18.0	92.8
181-240	11:59	12:58	1446.1	1341.6	104.5	4.16	1.35	5.51	1.07	25.04	971.79	19.1	93.0
241-300	12:59	13:58	1341.6	1241.4	100.2	4.16	1.35	5.51	1.07	25.33	971.20	18.3	93.2
301-360	13:59	14:58	1241.4	1141.0	100.4	4.16	1.35	5.51	1.07	25.57	970.22	18.3	93.3
AVERAGE FOR 360 MINUTE RAW DATA					97.0	4.16	1.35	5.51	1.07	24.61	972.02	17.7	92.8
ACCEPTANCE					100 +/- 20					25 +/- 2		18.4 +/- 3.6	180 +/- 9.0

GRAVIMETRIC DATA

IMPACTOR SUBSTRATES		SAMPLE FILTER	
Backup Filter (PM 2.5)	0.00003 g	Tare Mass	9.13 g
Total Mass Gain	0.00018 g	Final Mass	10.44 g
		Mass Gain	1.31 g

OUTLET CONCENTRATION

Total Volume Sampled	6.85 m^3
Mean Outlet Particle Concentration - PM 2.5	0.0000044 g/m^3
Mean Outlet Particle Concentration - Total Mass	0.0000263 g/m^3

DATA PROCESSING OPERATOR:

Sharon M. Winemiller - ETS, Inc.

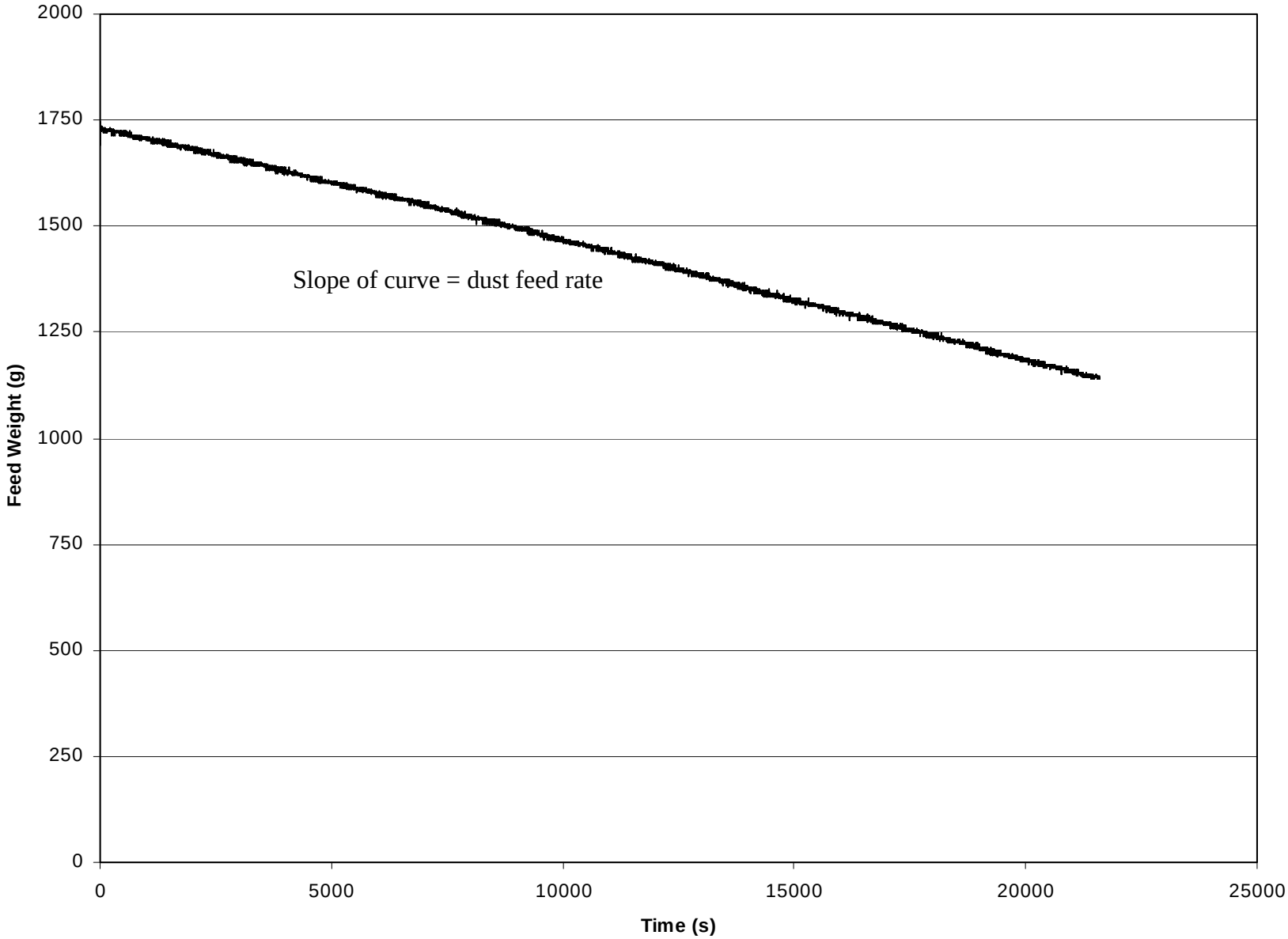


Figure C-9. Change in Pural NF dust scale reading with time during performance period 2V03-R5 at 4.9:1 filtration velocity.

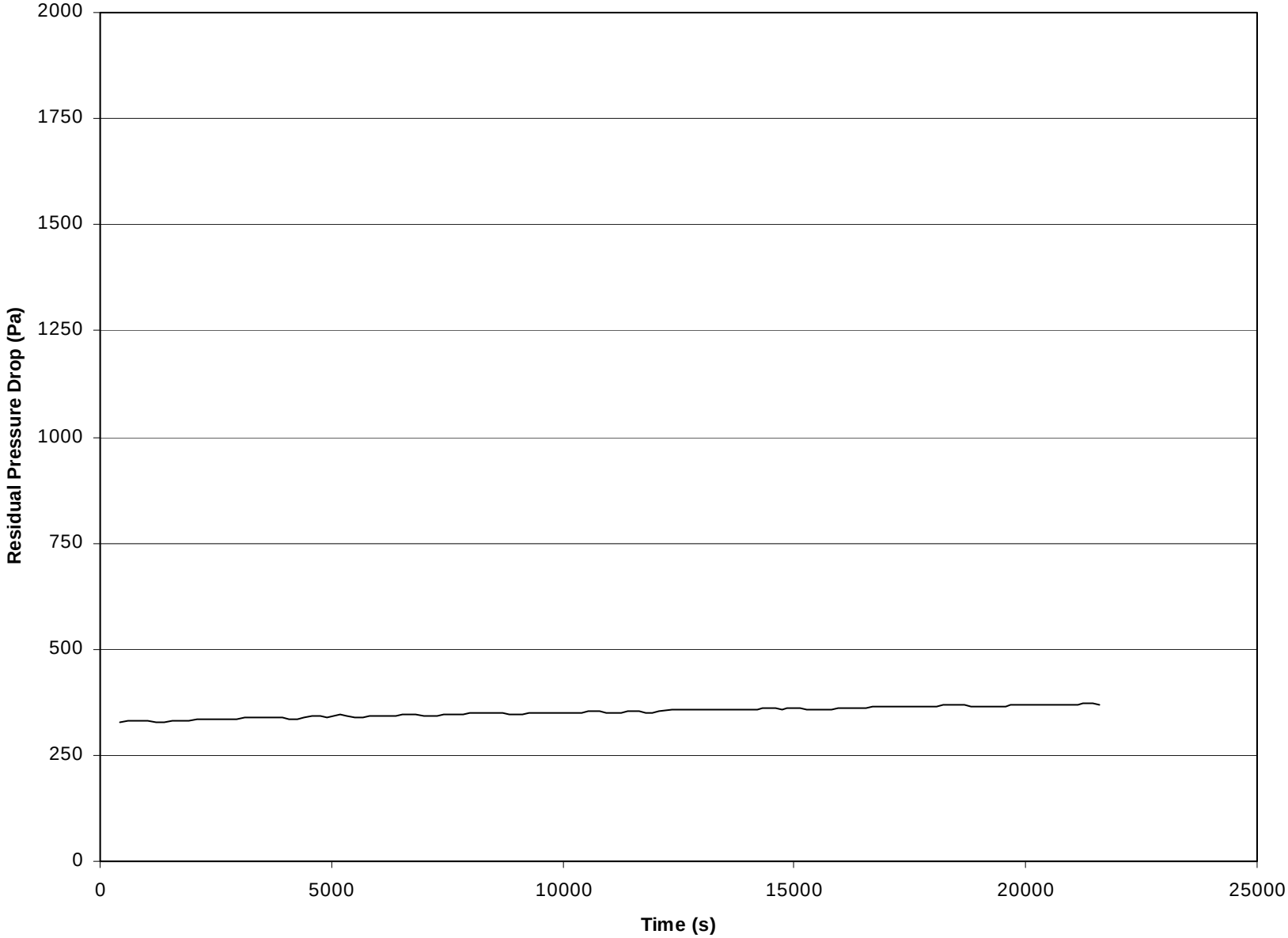


Figure C-10. Residual pressure drop across filter fabric during performance period 2V03-R5 at 4.9:1 filtration velocity.

VERIFICATION TESTING OF BAGHOUSE FILTRATION PRODUCTS
DETAILED SUMMARY OF DATA AND RESULTS

CONDITIONING TEST PERIOD - 4.9:1

RUN ID.	2V03-R6	NUMBER OF PULSES	10000
FABRIC DESIGNATION	DURAPEX ™ PET-6	PULSE INTERVAL	3 s
MANUFACTURER	BHF1031-6		
DUST FEED	Pural NF	Moisture	0.91 %WV
DATE STARTED	3/1/2001		
TIME STARTED	15:23		
TIME ENDED	23:43		
TEST DURATION	500 min.		

QA/QC DATA

Test Duration			Dust Feed (g)			Average Gas Flow (sm^3/hr)			Avg. Temp	Avg Press	Dust Conc.	G/C Ratio
(min.)	Time		Initial	Final	Total	Raw	Clean	Total	(° C)	(mbar)	(g/dscm)	(m/h)
0-60	15:23	16:23	1694.0	1605.1	88.9	4.12	1.34	5.46	25.4	969.07	16.4	92.7
61-120	16:24	17:23	1605.1	1511.0	94.1	4.13	1.33	5.46	25.3	968.95	17.4	92.0
121-180	17:24	18:23	1511.0	1411.8	99.2	4.13	1.33	5.46	25.0	969.11	18.3	91.9
181-240	18:24	19:23	1411.8	1317.4	94.4	4.13	1.33	5.46	24.7	969.88	17.4	91.7
241-300	19:24	20:23	1317.4	1223.4	94.0	4.13	1.33	5.46	24.4	969.78	17.4	91.7
301-360	20:24	21:23	1223.4	1131.5	91.9	4.13	1.33	5.46	24.2	969.69	17.0	91.6
361-420	21:24	22:23	1131.5	1040.0	91.5	4.13	1.33	5.46	24.0	968.56	16.9	91.6
421-480	22:24	23:23	1040.0	951.8	88.2	4.13	1.33	5.46	23.9	967.72	16.3	91.7
441-500 *	22:44	23:43	1008.7	920.9	87.8	4.13	1.33	5.46	23.9	967.67	16.2	91.7
AVERAGE FOR 500 MINUTE RAW DATA					92.8	4.13	1.33	5.46	24.6	969.04	17.1	91.8
ACCEPTANCE					100 +/- 20				25 +/- 2		18.4 +/- 3.6	180 +/- 9.0

* Test duration is a rolling 60 minute average. The last 60 minute frame was determined by counting 60 minutes back from the last minute of the test.

DATA PROCESSING OPERATOR: _____

Sharon M. Winemiller - ETS, Inc.

VERIFICATION TESTING OF BAGHOUSE FILTRATION PRODUCTS
DETAILED SUMMARY OF DATA AND RESULTS

RECOVERY PERIOD - 4.9:1

RUN ID.	2V03-R6	NUMBER OF PULSES	30
FABRIC DESIGNATION	DURAPEX ™ PET-6	AVG. PULSE INTERVAL	414 s
MANUFACTURER	PGI	AVG . RESIDUAL DP	273.73 Pa
DUST FEED	Pural NF	MAX. PRESSURE DROP	1000 Pa
DATE STARTED	3/2/2001		
TIME STARTED	8:15 *	Moisture	0.84 % WV
TIME ENDED	11:42		
TEST DURATION	207 min.		

QA/QC DATA

Test Duration				Dust Feed (g)			Average Gas Flow (sm^3/hr)			Avg. Temp	Avg Press	Dust Conc.	G/C Ratio
(min.)	Time			Initial	Final	Total	Raw	Clean	Total	(° C)	(mbar)	(g/dscm)	(m/hr)
1-60	8:16	*	9:15	1619.2	1533.7	85.5	4.14	1.34	5.48	23.4	965.94	15.7	92.7
61-120	9:16		10:15	1539.6	1451.2	88.4	4.14	1.34	5.48	24.0	965.80	16.3	92.8
121-180	10:16		11:15	1450.2	1354.9	95.3	4.14	1.34	5.48	24.5	965.64	17.5	93.0
148-207	10:43		11:42	1408.1	1310.0	98.1	4.14	1.34	5.48	24.5	965.60	18.0	93.0

* First minute is not considered in calculations due to equipment stabilization.

DATA PROCESSING OPERATOR: _____

Sharon M. Winemiller - ETS, Inc.

VERIFICATION TESTING OF BAGHOUSE FILTRATION PRODUCTS
DETAILED SUMMARY OF DATA AND RESULTS

PERFORMANCE TEST PERIOD - 4.9:1

RUN ID.	2V03-R6	NUMBER OF PULSES	71
FABRIC DESIGNATION	DURAPEX ™ PET-6	AVG. PULSE INTERVAL	303 s
MANUFACTURER	PGI	AVG. RESIDUAL DP	305.92 Pa
DUST FEED	Pural NF	INITIAL RESIDUAL DP	289.2 Pa
DATE STARTED	3/2/2001	CHANGE IN DP	31 Pa
TIME STARTED	12:04	MAX. PRESSURE DROP	1000 Pa
TIME ENDED	18:04		
TEST DURATION	360 min.	Moisture	0.95 %WV

QA/QC DATA

Test Duration			Dust Feed (g)			Average Gas Flow (sm^3/hr)				Avg. Temp	Avg Press	Dust Conc.	G/C Ratio
(min.)	Time		Initial	Final	Total	Raw	Clean	Total	Sample	(° C)	(mbar)	(g/dscm)	(m/h)
0-60	12:04	13:04	1762.5	1672.4	90.1	4.11	1.34	5.45	1.07	24.61	965.24	16.7	92.8
61-120	13:05	14:04	1672.4	1576.1	96.3	4.12	1.34	5.46	1.07	24.75	965.00	17.8	92.9
121-180	14:05	15:04	1576.1	1473.0	103.1	4.12	1.34	5.46	1.07	24.90	964.89	19.1	93.0
181-240	15:05	16:04	1473.0	1374.7	98.3	4.12	1.34	5.46	1.07	25.05	965.33	18.2	93.0
241-300	16:05	17:04	1374.7	1274.3	100.4	4.12	1.34	5.46	1.07	25.12	965.42	18.6	93.0
301-360	17:05	18:04	1274.3	1167.8	106.5	4.12	1.34	5.46	1.06	24.99	965.77	19.7	92.9
AVERAGE FOR 360 MINUTE RAW DATA					99.1	4.12	1.34	5.46	1.07	24.90	965.27	18.3	92.8
ACCEPTANCE					100 +/- 20					25 +/- 2		18.4 +/- 3.6	180 +/- 9.0

GRAVIMETRIC DATA

IMPACTOR SUBSTRATES		SAMPLE FILTER	
Backup Filter (PM 2.5)	0.00014 g	Tare Mass	9.09 g
Total Mass Gain	0.00068 g	Final Mass	10.80 g
		Mass Gain	1.71 g

OUTLET CONCENTRATION

Total Volume Sampled	6.91 m^3
Mean Outlet Particle Concentration - PM 2.5	0.0000203 g/m^3
Mean Outlet Particle Concentration - Total Mass	0.0000985 g/m^3

DATA PROCESSING OPERATOR:

Sharon M. Winemiller - ETS, Inc.

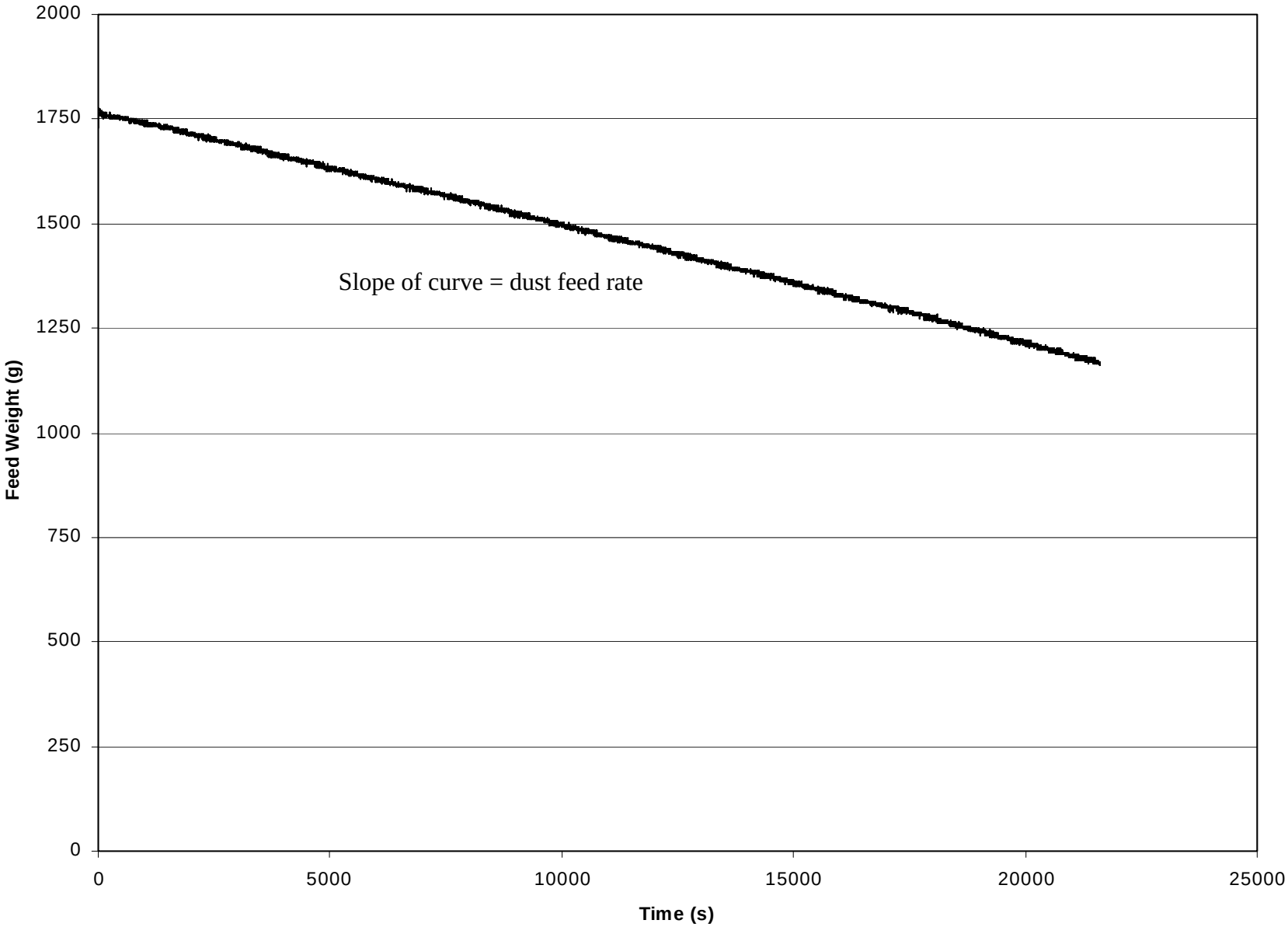


Figure C-11. Change in Pural NF dust scale reading with time during performance period 2V03-R6 at 4.9:1 filtration velocity.

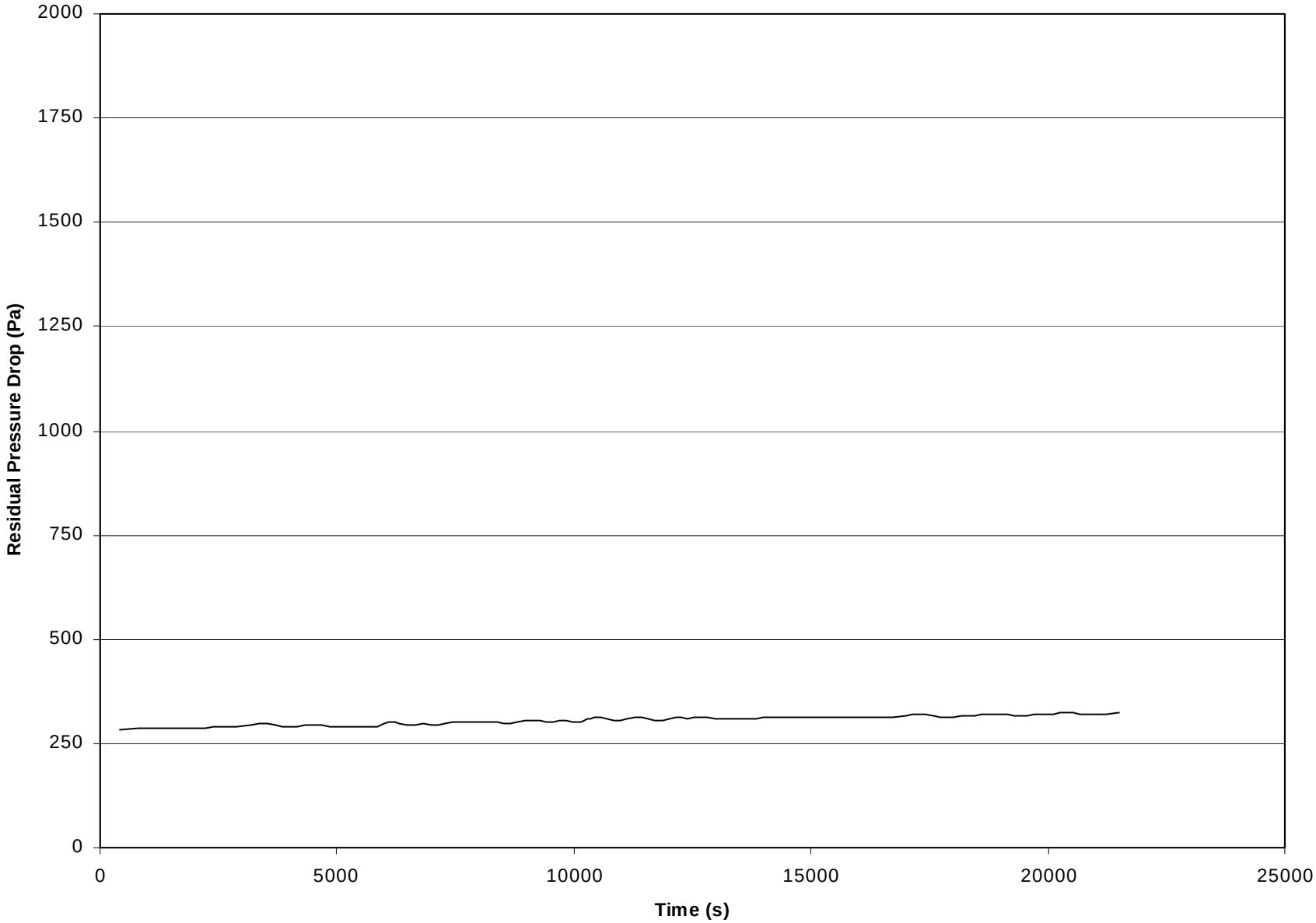


Figure C-12. Residual pressure drop across filter fabric during performance period 2V03-R6 at 4.9:1 filtration velocity.

Appendix D

FABRIC MANUFACTURE'S SUBMITTAL AND REQUEST LETTERS

Polymer Group, Inc.

201 N. Church St. Suite 619B, Mooresville, NC 28115

January 23, 2001

RE: Environmental Technology Verification Program for Baghouse Filtration Products

ETS, Inc.
1401 Municipal Rd. N. W.
Roanoke, VA 24012-1309
Phone: 540-265-0004
Fax: 540-265-0131

Dear Mr. Jack Mycock:

We have read your Environmental Technology Verification Program for Baghouse Filtration Products and would like to participate in your round 2 testing. Enclosed please find nine samples (18" x 36"). These samples were taken from a production run and two different rolls, and are representative of what is supplied to customers. Nine samples were randomly selected as follows:

1. APEX® BHF1031-1 – on the right side at 202 yards from outside toward inside of the 250-yards roll of PGI's APEX® BHF1031-#4.
2. APEX® BHF1031-2 – in the middle at 202 yards from outside toward inside of the 250-yards roll of PGI's APEX® BHF1031-#4.
3. APEX® BHF1031-3 – on the right side at 203 yards from outside toward inside of the 250-yards roll of PGI's APEX® BHF1031-#4.
4. APEX® BHF1031-4 – in the middle at 203 yards from outside toward inside of the 250-yards roll of PGI's APEX® BHF1031-#4.
5. APEX® BHF1031-5 – on the right side at 77 yards from outside toward inside of the 250-yards roll of PGI's APEX® BHF1031-#5.
6. APEX® BHF1031-6 – in the middle at 77 yards from outside toward inside of the 250-yards roll of PGI's APEX® BHF1031-#5.
7. APEX® BHF1031-7 – in the middle at 80 yards from outside toward inside of the 250-yards roll of PGI's APEX® BHF1031-#5.
8. APEX® BHF1031-8 – in the middle at 135 yards from outside toward inside of the 250-yards roll of PGI's APEX® BHF1031-#5.
9. APEX® BHF1031-9 – on the left at 135 yards from outside toward inside of the 250-yards roll of PGI's APEX® BHF1031-#5.

The PGI's APEX® BHF1031 is a non scrim-supported 10 oz/yd^2 100 percent Polyester nonwoven fabrics. The sample material was made on October 2000. All nine samples were

properly labeled as required in your program including the manufacturer's model number, year and month of manufacture, and cake side. Please inform us about the testing results upon completion of your testing program and recommend if other than your standard testing conditions might be suitable for such a filter medium. Thank you very much for conducting this program.

Best regards,

Per Lindblom
Director, Sales, Marketing, and New Product Development

Ping Hao
Manager, New Product Development

Enclosures:
1. Signed memorandum for participating in Environmental Technology Verification Program for Baghouse Filtration Products.
2. Nine randomly selected samples (18" x 36").
3. Purchasing order for conducting the testing program.

PGI

Mr. Jack Farmer, Director
Air Pollution Control Technology Verification Center
RTI
PO Box 12194
Research Triangle Park, NC 27709-2194

Dear Mr. Farmer:

Thank you for your letter from July 5, 2001, which included the copy of the Environmental Technology Verification draft report for Apex® BHF1030 fabric.

We have studied the report closely and found it to be accurate and very well put together. The only change we wish to make in the report is to substitute all references to "Apex® BHF 1030" with "Durapex™ PET". "Durapex™ PET" is the brand name of "Apex® BHF 1030", everything else is equal.

We will very aggressively use "Durapex™" in our marketing. The ETV report will be an extremely important tool in our marketing communication strategy, hence making the change very important.

I realize this will be an inconvenience but I hope you can comply with our request to make the name change.

Please, do not hesitate to contact me if you have any questions.

Sincerely,

Per Lindblom