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The Nucleus of Quality Air Monitoring Programs

RADIOIODINE COLLECTION FILTER EFFICIENCY TESTING PROGRAM

at

F&J SPECIALTY PRODUCTS, INC.

by

FRANK M. GAVILA

12th Annual RETS/REMP Workshop

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I. Radioiodine Collection Cartridges Efficiency Testing Program

The key elements of the F&J quality assurance program for the manufacture of TEDA impregnated charcoal and silver zeolite cartridges utilized in the collection of airborne radioactive iodine species in power plant atmospheres include the following:

1. Testing is performed on every batch of adsorbent material
2. Testing is performed at different flow rates in order to have representative data across the flow range utilized by power plant personnel.
3. Integration of new batch data from individual batches into data of all previous batches.
4. Development of data for different sampling scenarios
5. Determination of "Pressure Drop" data vs. flowrate for each type of adsorbent material.
6. Creation of graphical representation of the collection efficiency vs. flow data and determination of mathematical equations that represent the efficiency vs. flow relationship.

Eighty percent (80%) of testing is performed on the filter geometries that represent 80% of the production quantity.

Radioiodine Collection Cartridges are available in various geometries, contain various adsorbents, and the specific adsorbents are available in various mesh sizes. Typical cartridge geometries available from F&J are listed in Table I below:

TABLE I
RADIOIODINE COLLECTION FILTER GEOMETRIES

Nominal Dimensions	Material	F&J Geometry
2 ¼"D ×1" H	Plastic Cased	C, CS and CSM Series
2 ¼"D ×1" H	Plastic Cased	B Series
2 ¼"D ×1" H	Metal Cased	M Series
2 ¼"D ×1" H	Metal Cased	M.5 Series (WGRM Monitor)
3.43"D × 1.23"H	Plastic Cased	3X1 Series
3.2"D × 2.2"H	Plastic Cased	3X2 Series
1.63"D × 0.76"H	Plastic Cased	Lapel Filter Series
1.24"D × 1.11"H	Plastic Cased	744/844 Series (Victoreen Monitor)

Refer to the filter dimension diagrams in Appendix A.

Typical adsorbents that may be utilized in the various geometries listed in Table I above are listed in Table II below:

TABLE II
TYPICAL ADSORBENTS AND MESH SIZES AVAILABLE

TEDA Impregnated Carbon (5% by Wt. TEDA)		**Silver Zeolite (37% by Wt. AG.)**	**Silver Impregnated Silica Gel (12% by Wt. AG.)**
	U.S. Sieve	U.S. Sieve	U.S. Sieve
TEDA-1	8×16	16×40	10×16
TEDA-2	30×50	30×50	
TEDA-3	20×40	50×80	
TEDA-4	12×20		

Refer to Appendix B for a graphical representation of particle sizes.

Product Specifications

Each Radioiodine Collection Cartridge manufactured by F&J has detailed specifications indicating physical and performance specifications for the product. A typical set of specifications for a TEDA impregnated charcoal cartridge and a silver zeolite cartridge is presented in Appendix C.

II. Standardized Testing

Utilization of these filters (or any other filters) requires determination of an efficiency value for the physical conditions typically experienced during field sampling operations. Physical parameters that are of importance with respect to radioiodine collection filter cartridges are provided in Table III below:

TABLE III
Key Parameters of Radioiodine Collection Filter Cartridge Efficiencies

1) Adsorbent bed thickness
2) Flow rate of pollutant stream passing through filter
3) Temperature of pollutant stream
4) Specific pollutant species
5) Relative humidity of pollutant stream
6) Type of adsorbent
7) Mesh size of adsorbent in filter
8) Sample duration
9) Bed compaction

Nuclear industry standards, which are applicable to the testing of nuclear grade gas phase adsorbents for radioiodine adsorption capabilities are contained in ASTM D 3803, 1989. These standard test procedures, as modified, have been utilized by F&J SPECIALTY PRODUCTS, INC. to establish the radioiodine collection cartridge efficiency performance criteria for filter cartridges manufactured by F&J. The standard ASTM D 3803, 1989 test conditions are listed in Table IV below.

TABLE IV
ASTM D 3803, 1989 PARAMETERS

1)	Pressure	1 atm
2)	Temperature	30ºC
3)	Pre-equilibration Period	16 hours
4)	Equilibration Period	120 minutes
5)	CH_3I concentration (I-131)	1.75 mg/m^3
6)	Loading Duration	60 minutes
7)	Post Sweep Period	60 minutes
8)	Bed Depth	2”
9)	Velocity of Gas Stream	11.6 to 12.8 m/min.
10)	Relative Humidity	95%

F&J modifies ASTM D 3803, 1989 for its radioiodine cartridge-testing program in the following manner:

1) The 2” bed depth is modified to the bed depth of the specific filter cartridge geometry

2) Variable flow rates are utilized to determine the relationship of radioiodine collection efficiency vs. flow rate for each specific filter cartridge manufactured by F&J.

3) Various sample durations were utilized to represent typical field sampling scenarios of short-term grab sampling, daily sampling and weekly sampling.

4) F&J also measures the pressure drop at the test flow rate and develops curves and equations which illustrate the relationship of differential pressure as a function of flow rate for different adsorbent media.

F&J's test conditions for its various sampling scenarios are listed in Table V below:

TABLE V
TEST CONDITIONS FOR F&J SAMPLING SCENARIOS

PARAMETERS	SHORT-TERM	INTERMEDIATE-TERM	LONG-TERM
Pre-equilibration period (hrs.)	None	16	16
Equilibration period (hrs.)	None	2	2
Loading duration (hrs.)	1	1	1
Post sweep duration (hrs.)	1	1	168
CH_3I concentration (mg/m^3)	1.75	1.75	1.75
Pressure (atm)	1	1	1
Bed depth	Actual filter	Actual filter	Actual filter
Flow rate	~14 to 198 LPM	~14 to 198 LPM	~14 to 198 LPM
Temperature (ºC)	30	30	30
Relative Humidity (%)	90-95	95	95

NOTE: Actual filter cartridges, randomly selected from stock, that are offered for sale to customers were utilized for these tests in lieu of only testing the adsorption media in a standardized fixture having a bed depth of 2".

C. Analysis of Testing Data

The F&J program began in 1984; thus data has been accumulated for many batches of adsorbent materials.

F&J determines equations that represents the data of collection efficiency vs. flow rate and has available graphical curves and equations for CFM and LPM flow rate values.

Typical equations for TEDA impregnated charcoal and silver zeolite cartridges are presented in Appendix D. These equations for efficiency vs. flowrate curves are generally quadratic equations. They represent for the most recent multiple batch equations in CFM and LPM units. These equations apply to only F&J products and cannot be utilized for products made by other companies.

The differential pressure vs. flow rate equations are also quadratic equations. Refer to Appendix E for a typical graphical representation of a pressure vs. flow rate curve for a TEDA impregnated charcoal filter.

III. Factors Affecting Efficiencies of Radioiodine Collection Cartridges

Several trends for efficiencies test data have been established with respect to radioiodine adsorption characteristics of radioiodine collection cartridges manufactured by F&J. These trends are listed in Table VI below:

TABLE VI

(A) Species Impact
Collection efficiency of I_2 is greater than the collection efficiency of CH_3I (g)

(B) Temperature Impact
Efficiency increases with an increase in temperature of the air flow

(C) Relative Humidity Impact
Efficiency decreases with an increase in relative humidity

(D) Flow Rate Impact
Efficiency decreases with increase in flow rate

(E) Bed Depth Impact
Efficiency increases with an increase in bed depth of the cartridge

(F) Sample Duration Impact
Efficiency generally decreases with an increase in sample duration

(G) Particle Size Impact
Efficiency increases with a decrease in particle size of the adsorbent

To illustrate the impact of several of the above parameters on collection efficiency, refer to the data illustrated in the following graphs.

Graphs A-1 and A-2 are plots of radioiodine collection efficiency vs. flow rates for four different mesh sizes of TEDA impregnated carbons and three different mesh sizes of silver zeolite in a similar filter cartridge geometry. As expected, the CH_3I efficiency decreases with increasing flowrate and the efficiency is greater for the smaller particle size material at any particular flow rate.

Graphs B-1 and B-2 are plots of radioiodine efficiency vs. flow rate for three different sampling scenarios utilizing a specific TEDA impregnated carbon and Silver Zeolite, respectively, in the same filter cartridge geometry.

Graph C-1 is a plot of radioiodine efficiency vs. flow rate for two different bed depths utilizing the same filter geometry with respect to area, adsorbent and mesh size. The greater bed depth has the greater efficiency, as expected. The TE3.5M cartridge (1.62" bed depth) and the TE3M cartridge (1.0: bed depth) are compared in this example.

IV. F&J Quality Assurance and Quality Control Program

F&J has merged its former 10CFR50 Appendix B and NQA-1, 1994 QA programs into the internationally recognized ISO 9001 Quality Management System (Refer to Appendix F for a copy of F&J's certification). F&J also has implemented a quality process control analysis into its manufacturing operations. Key parameters that are monitored in this program are cartridge diameter, cartridge height and cartridge weight. Typical data collected on a daily basis is illustrated by Appendix F.

F&J subsequently evaluates the data to determine if product quality is within acceptable criteria and determines what action is required to continually improve the manufacturing process.

The Quality Process Control analysis also includes defect analysis. The types of rejects encountered in the manufacturing process are identified and quantitatively documented. From this analysis action is taken to implement methods to further reduce the defects by either (1) improving the compatibility of the components (2) improving operating/manufacturing procedures or (3) improving in the quality of the assembly personnel by implementing new training procedures and training sessions. Refer to Appendix G for an illustration of a typical data collection sheet for defect analysis.

The filter cartridge utilized in the General Atomics (Sorrento Electronics) Wide Range Gas Monitors are generally the model M geometry (2 ½"D ×1"H) and the M.5 geometry (2 ½"D × 1"H).

The WRGM radioiodine collection filters quality control monitoring includes the following:

1) 100% QC on diameter and height criteria
2) ~3% QC on weight criteria
3) 100% QC on visual inspection of key parameters
4) ~10% on leakage test
5) 100% QC on underfill/overfill inspection

F&J individually seals each filter cartridge in a 4 mil polybag identifying the model number, the mesh size, the batch number and shelf life expiration date. The color coded labels also indicate the mesh size of the TEDA impregnated carbon filters.

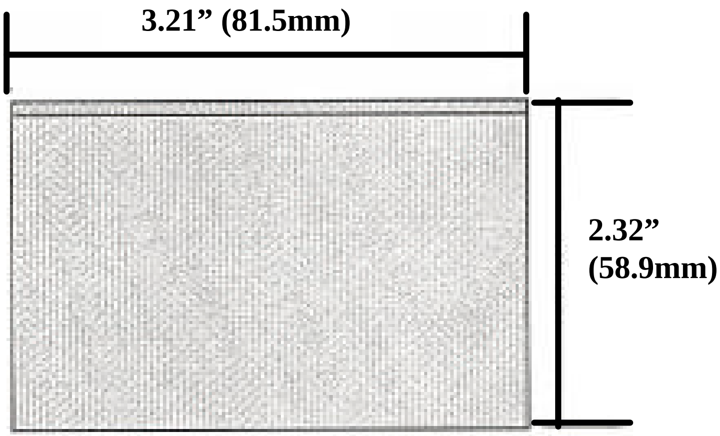
F&J's objective in its filter manufacturing process is to produce high quality filter cartridges, which have consistent and reproducible characteristics that are technically supported by good documentation detailing their radioiodine collection efficiencies vs. flow rate.

All of F&J's plastic cased TEDA impregnated charcoal filters are incineration approved by GTS Duratek and bear the incineration label on the filter.

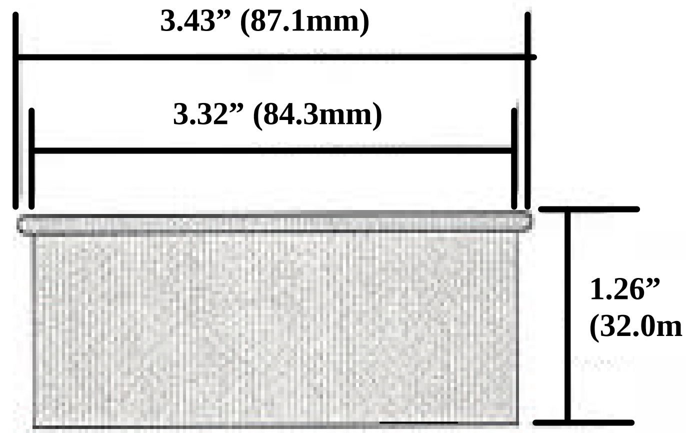
Appendix A

F&J Filter Dimension Diagrams

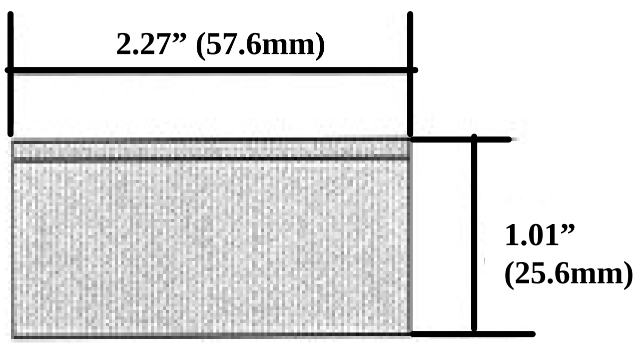
3.21"D × 2.32" H SERIES
PLASTIC CASING



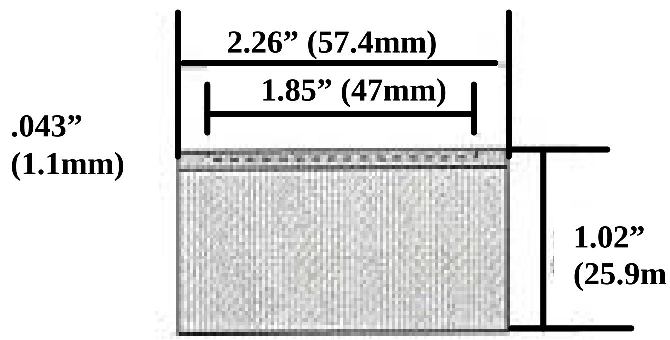
3.43"D × 1.23" H SERIES
PLASTIC CASING



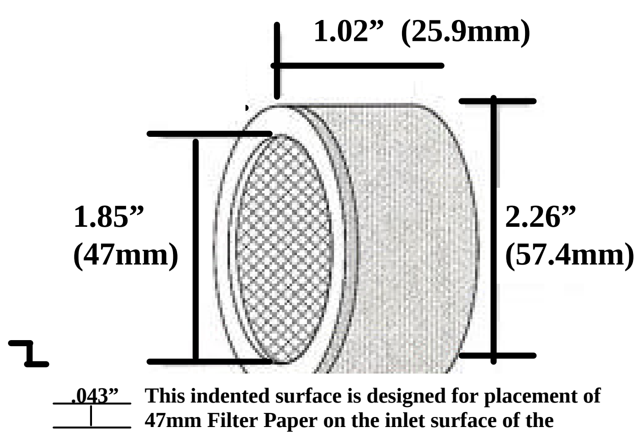
CS SERIES
PLASTIC CASING



CSM SERIES
PLASTIC CASING

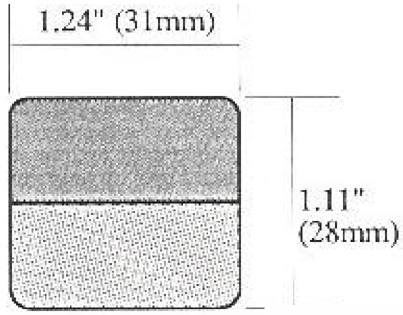


CSM SERIES
ISOMETRIC VIEW

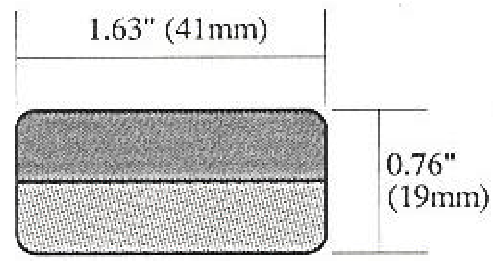


This indented surface is designed for placement of 47mm Filter Paper on the inlet surface of the charcoal cartridge

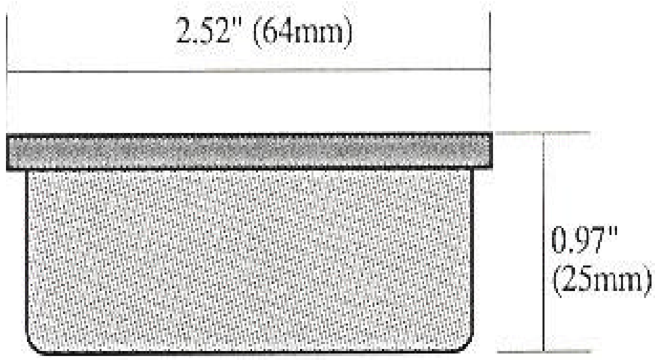
VICTOREEN MONITOR FILTER
MODEL FJ744-FJ844
PLASTIC CASING



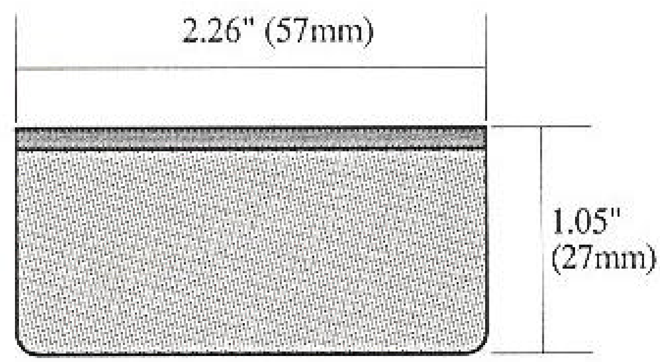
LAPEL MONITOR FILTER
MODEL FJ433-FJ434
PLASTIC CASING



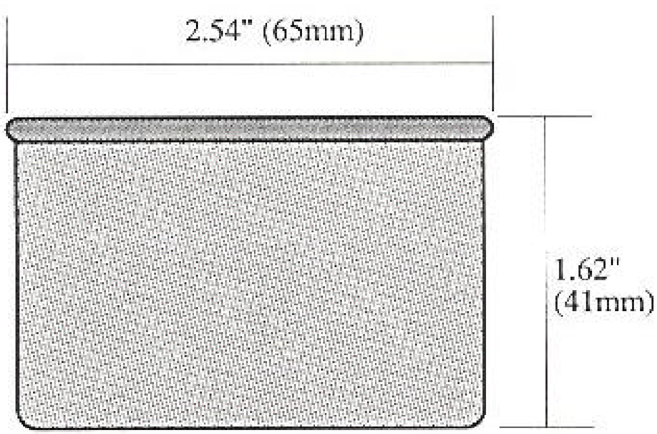
MODEL "B" SERIES
PLASTIC CASING



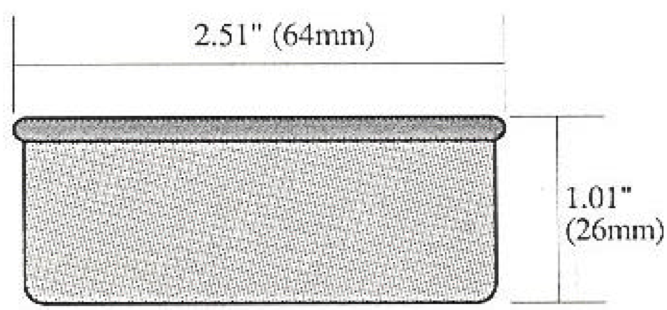
MODEL "C" SERIES
PLASTIC CASING



MODEL "M.5" SERIES
METAL CASING



MODEL "M" SERIES
METAL CASING



Appendix B

Graphical Representation of Particle Sizes

Activated Carbon Particulate Selector

To determine approximate mesh size of an activated carbon sample, compare representative particles of the largest and smallest size to the printed solid circles. Mesh size is given in two numbers, e.g., "6x10." The first number is a mesh slightly larger than the largest representative particle, and the second is a mesh slightly smaller than the smallest particle. Normal manufacturing tolerances allow for a few non- representative particles in each sample.

STANDARD MESH		OPENING		PARTICLE
Tyler	U.S.	mm.	inches	
4	4	4.70	0.185	●
6	6	3.33	.131	●
8	8	2.36	.094	●
10	12	1.65	.065	●
12	14	1.40	.056	●
14	16	1.17	.047	●
16	18	0.991	.039	●
20	20	.833	.033	●
24	25	.701	.028	●
28	30	.589	.023	●
32	35	.495	.020	●
35	40	.417	.016	●
42	45	.351	.014	●
48	50	.295	.012	●
60	60	.246	.0097	●
80	80	.175	.0069	●
100	100	.147	.0058	
150	140	.104	.0041	
200	200	.074	0029	
250	230	.061	.0024	
325	325	.043	.0017	
400	400	.038	.0015	

Appendix C

Typical Specifications for TEDA Impregnated Charcoal and Silver Zeolite Cartridges

TECHNICAL SPECIFICATIONS
TEDA IMPREGNATED CHARCOAL FILTERS
2-1/4" D X 1" H
F&J PRODUCT CODE: TE3C

CERTIFIED

CHARCOAL MESH SIZE:	**20 X 40 Mesh**
CHARCOAL TYPE:	**Coconut Shell Carbon**
TEDA IMPREGNATION:	**5% By Weight**
DIMENSIONS:	**D = 2.26" +/- 0.01"** **H = 1.05" +/- 0.01"**
CASING:	**Plastic Cased**
FILTER LABELING:	**Color coded YELLOW to distinguish it from other material types and indicating flow direction.**
PERFORMANCE TEST DATA:	**% CH_3I vs. flow rate from 0.5 CFM to 10 CFM as per ASTM D 3803-1989.**
QUALITY ASSURANCE REQUIREMENTS:	**ISO 9001-1994 QA PROGRAM** **Statistical process control program for diameter and height parameters.**
INDIVIDUAL FILTER PACKAGE:	**Sealed Individually in plastic bags with Model #, Batch # ID and mesh size. The expiration date is labeled on the bag.**
INTERMEDIATE PACKAGING:	**50 Filters/Box (6 lbs.)**
EXTERIOR PACKAGING:	**200 or 250 Filters/Case (24 or 30 lbs.)**
INCINERATION APPROVAL:	**Yes** **By: GTS Duratek** **Oak Ridge, TN**

TECHNICAL SPECIFICATIONS
SILVER ZEOLITE
2-1/4" D X 1" H
F&J PRODUCT CODE: AGZC35

CERTIFIED

ADSORBENT MESH SIZE:	**30 X 50 Mesh**
ADSORBENT TYPE:	**Silver Zeolite**
SILVER IMPREGNATION:	**37% Ag By Weight**
DIMENSIONS:	**D = 2.26" $\pm$ 0.01"** **H = 1.05" $\pm$ 0.01"**
CASING:	**Plastic Cased**
FILTER LABELING: **material types and**	**Color coded BLUE to distinguish it from other** **indicating flow direction.**
PERFORMANCE TEST DATA:	**% CH_3I vs flow rate from 0.5 CFM to** **5 CFM as per ASTM D3803-1989.**
QUALITY ASSURANCE REQUIREMENTS:	**ISO 9001-1994 QA PROGRAM** **Statistical process control program for** **diameter and height parameters.**
INDIVIDUAL FILTER PACKAGE:	**Sealed Individually in plastic bags with** **Model #, Batch # ID and mesh size. The** **expiration date is labeled on the bag.**
INTERMEDIATE PACKAGING:	**50 Filters/Box (6 lbs.)**
EXTERIOR PACKAGING:	**200 or 250 Filters/Case (24 or 30 lbs.)**
INCINERATION APPROVAL:	**N/A**

Appendix D

Typical Equations for Efficiency vs. Flow Rate for F&J Products

Equations for Methyl Iodide Collection Efficiency vs. Flowrate for TEDA Impregnated Charcoal Cartridges and Silver Zeolite Cartridges Applicable to Series C, CS, CSM, B and M

Short-Term Sampling Scenario

Adsorbent Type	X = CFM Equations	X = LPM Equations
AGZ58	$y = -0.3725x^2 + 0.8855x + 99.328$	$y = -0.0005x^2 + 0.0313x + 99.328$
TEDA-1	$y = 0.3845x^2 – 7.1557x + 106.04$	$y = 0.0005x^2 – 0.2529x + 106.04$
TEDA-2	$y = -0.4758x^2 + 0.8722x + 99.689$	$y = -0.0006x^2 + 0.0308 + 99.689$
TEDA-3	$y = -0.1253x^2 – 3.4068x + 101.52$	$y = -0.0002x^2 – 0.1188x + 101.54$
TEDA-4	$y = -1.06x^2 + 3.43x + 97.24$	$y = -0.0013x^2 + 0.1212x + 97.24$

Intermediate-Term Sampling Scenario

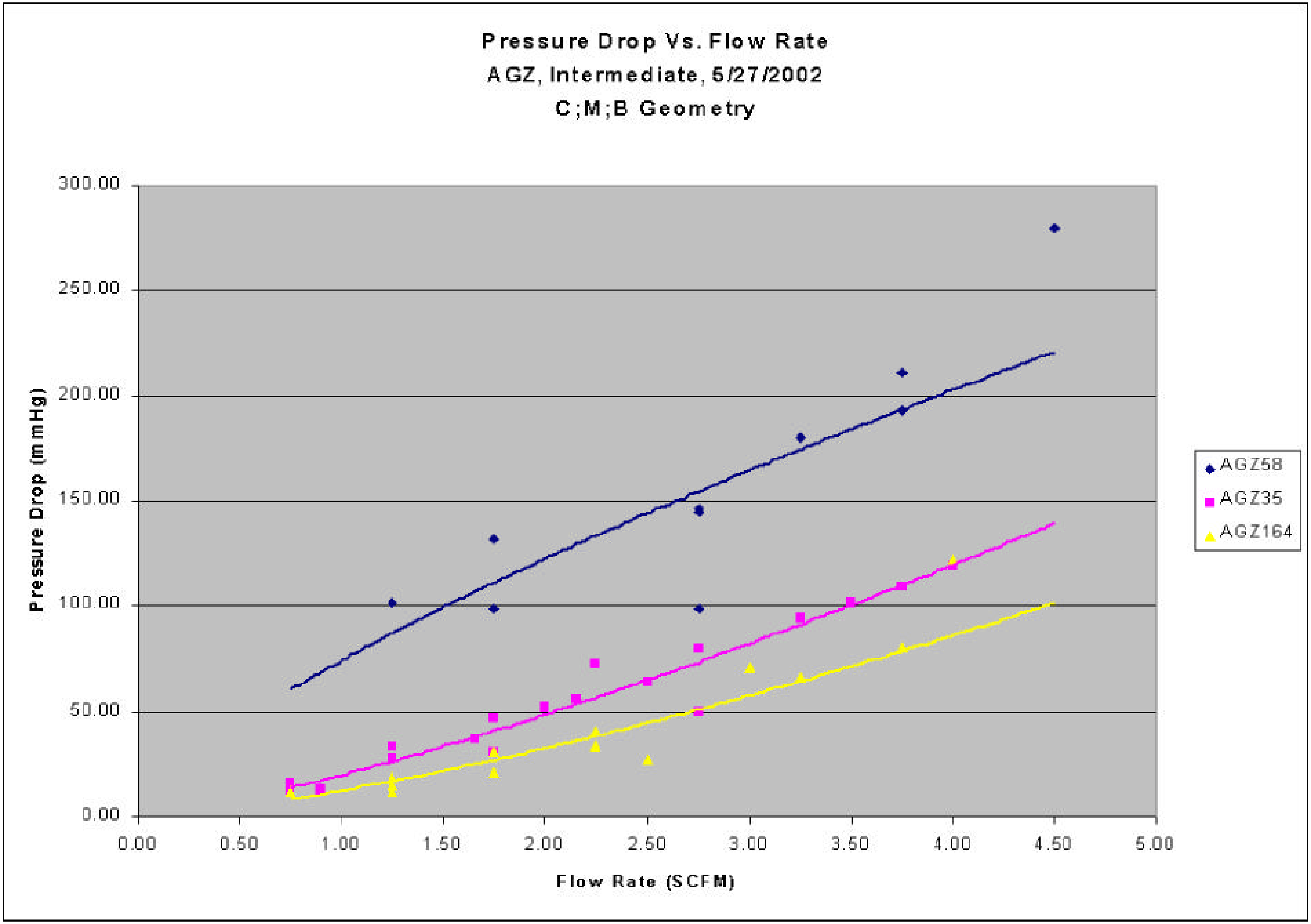
Adsorbent Type	X = CFM Equations	X = LPM Equations
AGZ164	$y = 0.2946x^2 – 7.2553x + 105.73$	$y = 0.0004x^2 –0.2562x + 105.73$
AGZ35	$y = 0.0845x^2 – 4.0033x + 103.36$	$y = 0.0001x^2 –0.1414x + 103.36$
AGZ58	$y = 0.39x^2 – 1.4622x + 101.06$	$y = -0.00007x^2 –0.018x + 100.36$
TEDA-1	$y = 1.8549x^2 – 20.107x + 107.86$	$y = 0.0023x^2 –0.7102x + 107.86$
TEDA-2	$y = 0.2646x^2 – 0.3535x + 100.45$	$y = -0.0003x^2 –0.0125x + 100.45$
TEDA-3	$y = 0.0467x^2 – 4.3026x + 104.13$	$y = 0.00006x^2 –0.1519x + 104.13$
TEDA-4	$y = 3.5938x^2 – 26.102x + 110.58$	$y = 0.0045x^2 –0.922x + 110.59$

Long-Term Sampling Scenario

Adsorbent Type	X = CFM Equations	X = LPM Equations
TEDA-1	$y = 2.295x^2 – 20.365x + 103.33$	$y = 0.0029x^2 –0.7192x + 103.33$
TEDA-2	$y = -0.1414x^2 – 0.3481x + 99.923$	$y = -0.0002x^2 –0.0123x + 99.923$
TEDA-3	$y = -0.4928x^2 – 1.3921x + 100.91$	$y = -0.0006x^2 –0.0492x + 100.91$
TEDA-4	$y = -1.22x^2 – 6.23x + 100.49$	$y = -0.0015x^2 –0.2211x + 100.52$

Appendix E

Typical Graphical Representation for Differential Pressure vs. Flow Rate


Pressure Drop Vs. Flow Rate
AGZ, Intermediate, 5/27/2002
C;M;B Geometry
Pressure Drop (mmHg)
300.00
250.00
200.00
150.00
100.00
50.00
0.00
0.00
0.50
1.00
1.50
2.00
2.50
3.00
3.50
4.00
4.50
5.00
Flow Rate (SCFM)
AGZ58
AGZ35
AGZ164

Appendix F

Typical Quality Control Data Collected Regularly During Production

F&J QA INSPECTION SHEET

STI-2 STRUCTURAL TESTING INSPECTION FOR METAL FILTERS

ALL ERRORS MUST BE LINED THROUGH, CORRECTED, INITIALED, AND DATED

TIME: 8:00 (AM) OR PM — F&J BATCH / LOT #: I-2524

DATE: 01-10-02 — PRODUCT CODE: TE3M

CHECK MEASURING DEVICES BEFORE AND AFTER MEASURING RANDOM SAMPLE OF PRODUCTION RUN

STANDARD: 1.00000 IN.	STANDARD: 4.00000 IN.	STANDARD: 100.00 g
STANDARD'S SERIAL #: 932092	STANDARD'S SERIAL #: 940171	STANDARD'S SERIAL #: B
MEASURED VALUE: 1.0000 IN.	MEASURED VALUE: 4.0000 IN.	MEASURED VALUE: 100.00 g

CALIPER'S SERIAL #: 0001712 — SCALE'S SERIAL #: SV-19025

GEOMETRY — CAN: M1 — PL #: IM65112 — LID: M — PL #: IM68944

	HEIGHT (INCHES)	DIAMETER (INCHES)	WEIGHT (GRAMS)
1	1.0185	2.5180	58.49
2	1.0160	2.5170	58.72
3	1.0155	2.5165	58.92
4	1.0150	2.5150	58.52
5	1.0125	2.5185	58.68
6	1.0175	2.5170	58.23
7	1.0130	2.5190	58.29
8	1.0150	2.5170	59.04
9	1.0165	2.5185	58.44
10	1.0180	2.5160	58.83
AVERAGE:	1.0158	2.5173	58.62
DESIGN RANGE:	1.01 ± .01	2.51 ± .01	—
MAXIMUM:	1.0185	2.5190	59.04
MINIMUM:	1.0125	2.5150	58.23
RANGE:	0.0060	0.0040	0.81
ACCEPTABLE (Y/N):	Y	Y	Y

1.00000" CALIPER CHECK	4.00000" CALIPER CHECK	100.00g WEIGHT SCALE CHECK
MEASURED VALUE: 1.0000 IN.	MEASURED VALUE: 4.0000 IN.	MEASURED VALUE: 100.00 g

DAILY RESULTS:

PRODUCED: 517 — # GOOD: 500

DEFECTIVE: 17 — % DEFECTIVE: 2.91 %

DEFECTS: (BY QUANTITY AND DESCRIPTION)

UNDER FILLED: 8 — OVERFILLED: 0 — CRACKED LID: 0

UNDERSIZE DIA: 0 — OVERSIZE DIA: 0 — OTHER: OVER SIZE HEIGHT (9)

COMPLETED BY (INITIALS): Marin Sanzol — DATE: 01-10-02

PRODUCTION SUPERVISOR (INITIALS): [initials] — DATE: 1-10-02

Appendix G

Typical Defect Analysis Data Collection Sheet

F&J QA DEFECT DATA LOG

DEFECT DATA LOG FOR METAL FILTERS

ALL ERRORS MUST BE LINED THROUGH, CORRECTED, INITIALED AND DATED

DATE	DAYS	CAN P/N	LID P/N	SCREEN P/N	RING P/N	F PAPER DIA. & THICK	ASSEMBLED ITEM P/N	TOTAL QTY PRODUCED	TOTAL QTY GOOD	TOTAL QTY OF DEFECTS	% DEFECTIVE	LEAKAGE	UNDER FILL	OVER FILL	OVER SIZE DIA.	OVER SIZE HEIGHT	SCREEN TRAPPED	OTHER
01/07/02	MON	MI	M	FI2375	R.R.M 4.5M	CG275/.015	TE3M	509	500	9	1.76%	0	1	0	0	5	2	1
01/08/02	TUE	MI	M	FI2375	R.R.M 4.5M	CG275/.015	TE3M	507	500	7	1.38%	0	2	0	0	4	1	0
01/09/02	WED	MI	M	FI2375	R.R.M 4.5M	CG275/.015	TE3M	507	500	7	1.38	0	3	0	0	2	2	0
01/10/02	THU	MI	M	FI2375	R.R.M 4.5M	CG275/.015	TE3M	515	500	15	2.91%	0	8	0	0	7	0	0
	FRI																	
	TOTAL																	

COMPLETED BY [signature] DATE 01-10-02

PRODUCTION SUPERVISOR (INITIALS) [initials] DATE 1-10-02

PQ006 Rev 2 5/26/2000

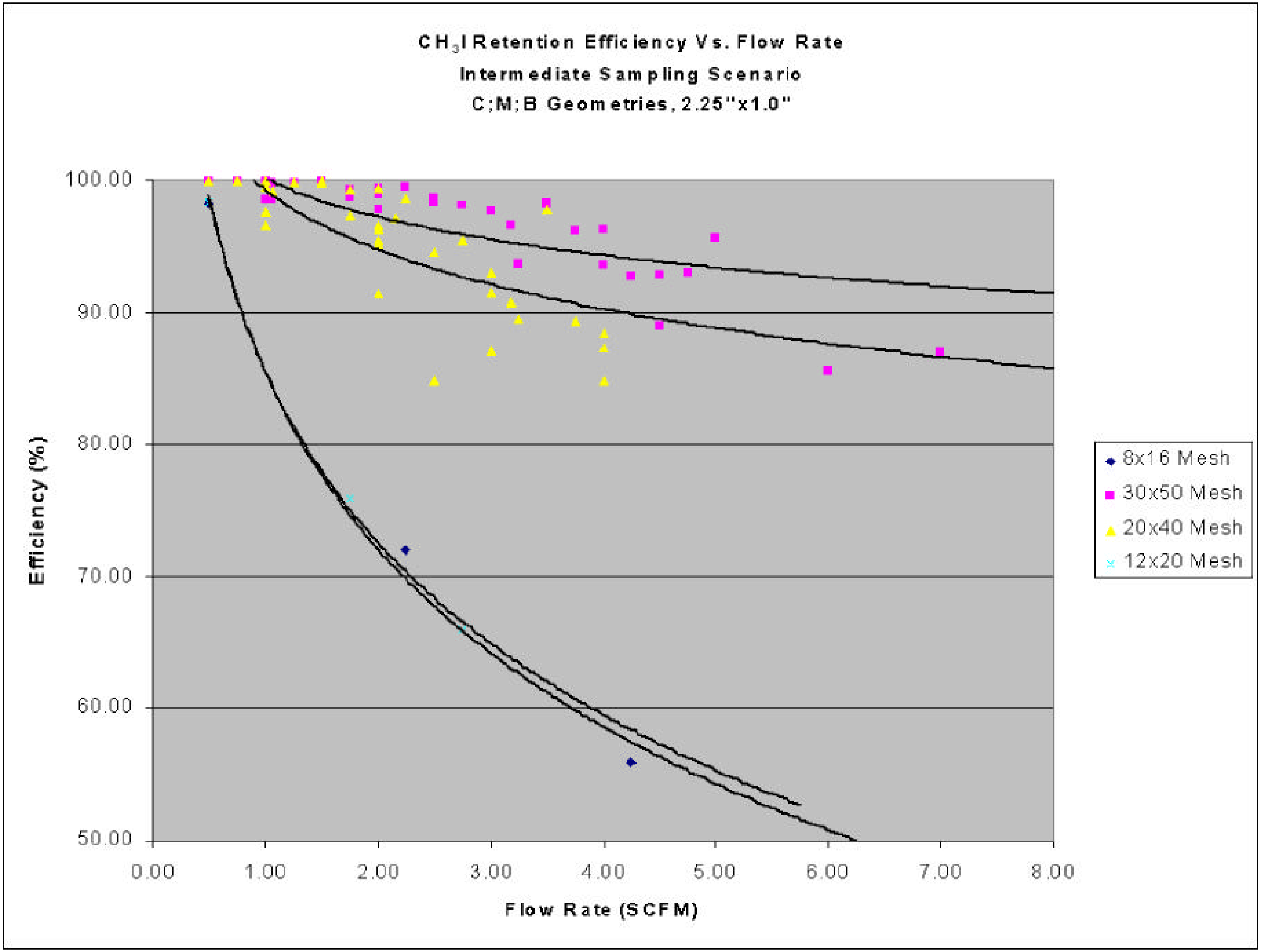
Graph A-1 and A-2

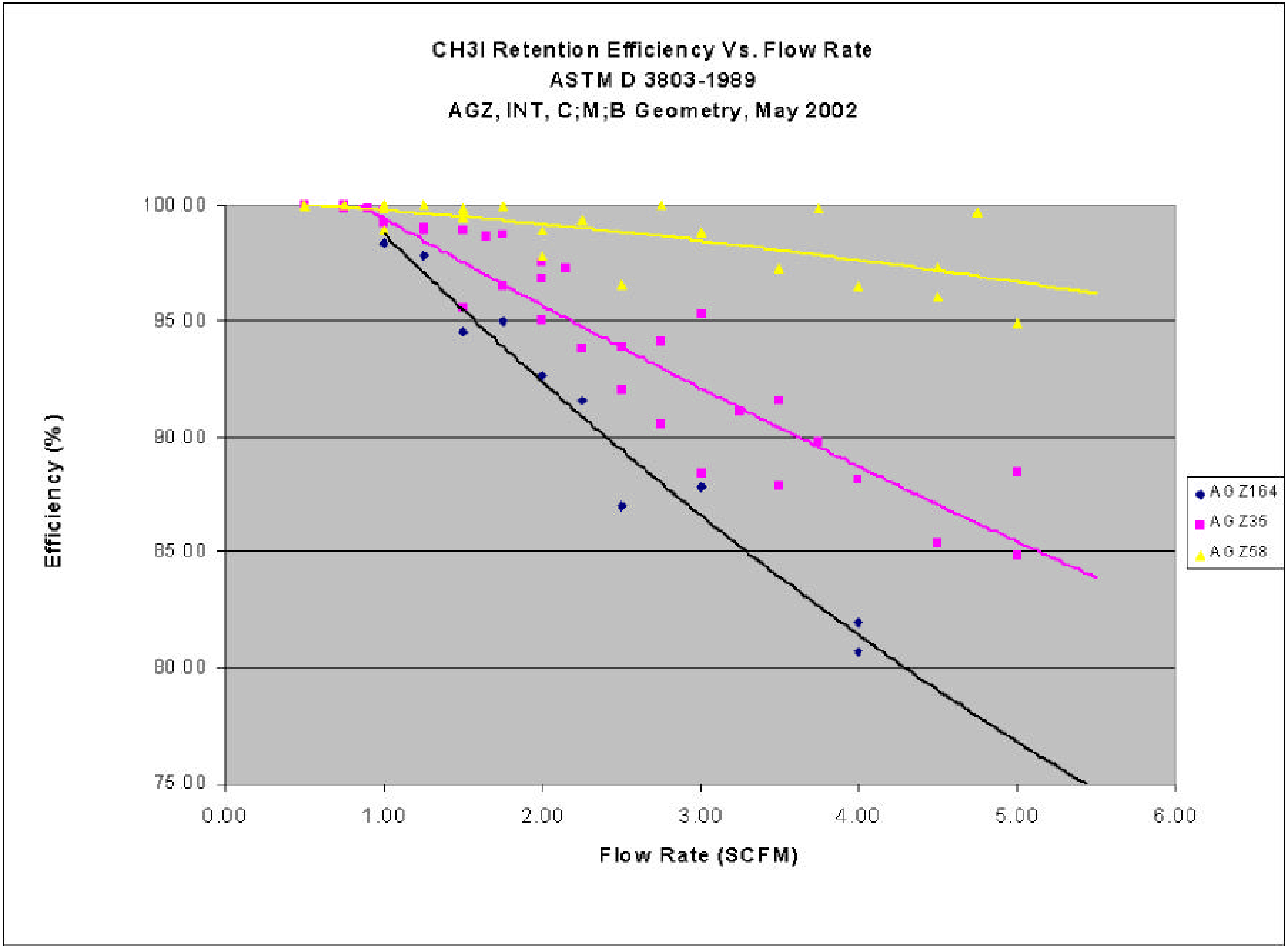
A-1

Graphical Representation of CH_3I Collection Efficiency vs. Flow Rate for Four Different Mesh Sizes of TEDA Carbons

A-2

Graphical Representation of CH_3I Collection Efficiency vs. Flow Rate for Three Different Silver Zeolite Mesh Sizes

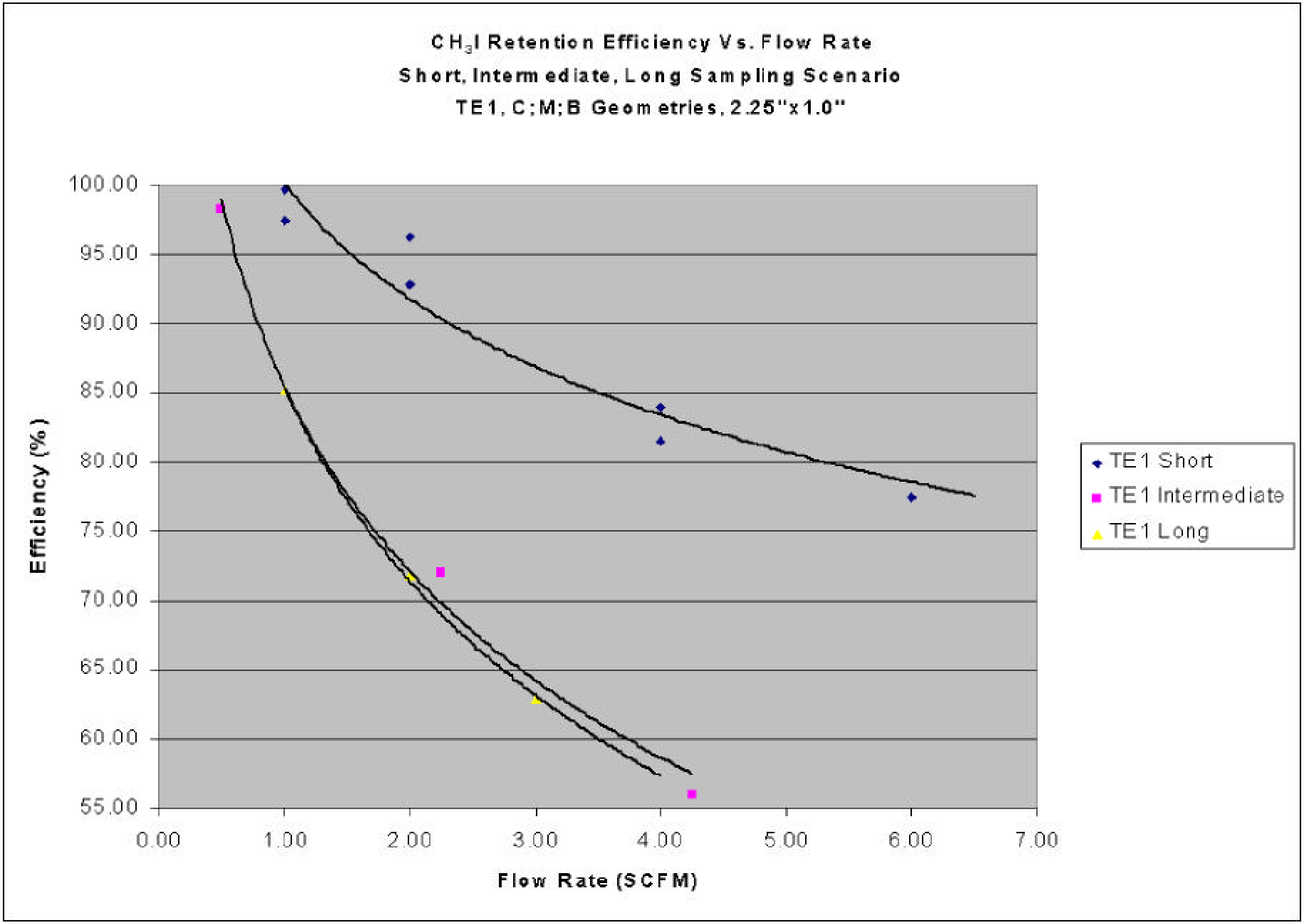

CH3I Retention Efficiency Vs. Flow Rate
Intermediate Sampling Scenario
C;M;B Geometries, 2.25"x1.0"
Efficiency (%)
100.00
90.00
80.00
70.00
60.00
50.00
0.00
1.00
2.00
3.00
4.00
5.00
6.00
7.00
8.00
Flow Rate (SCFM)
8x16 Mesh
30x50 Mesh
20x40 Mesh
12x20 Mesh

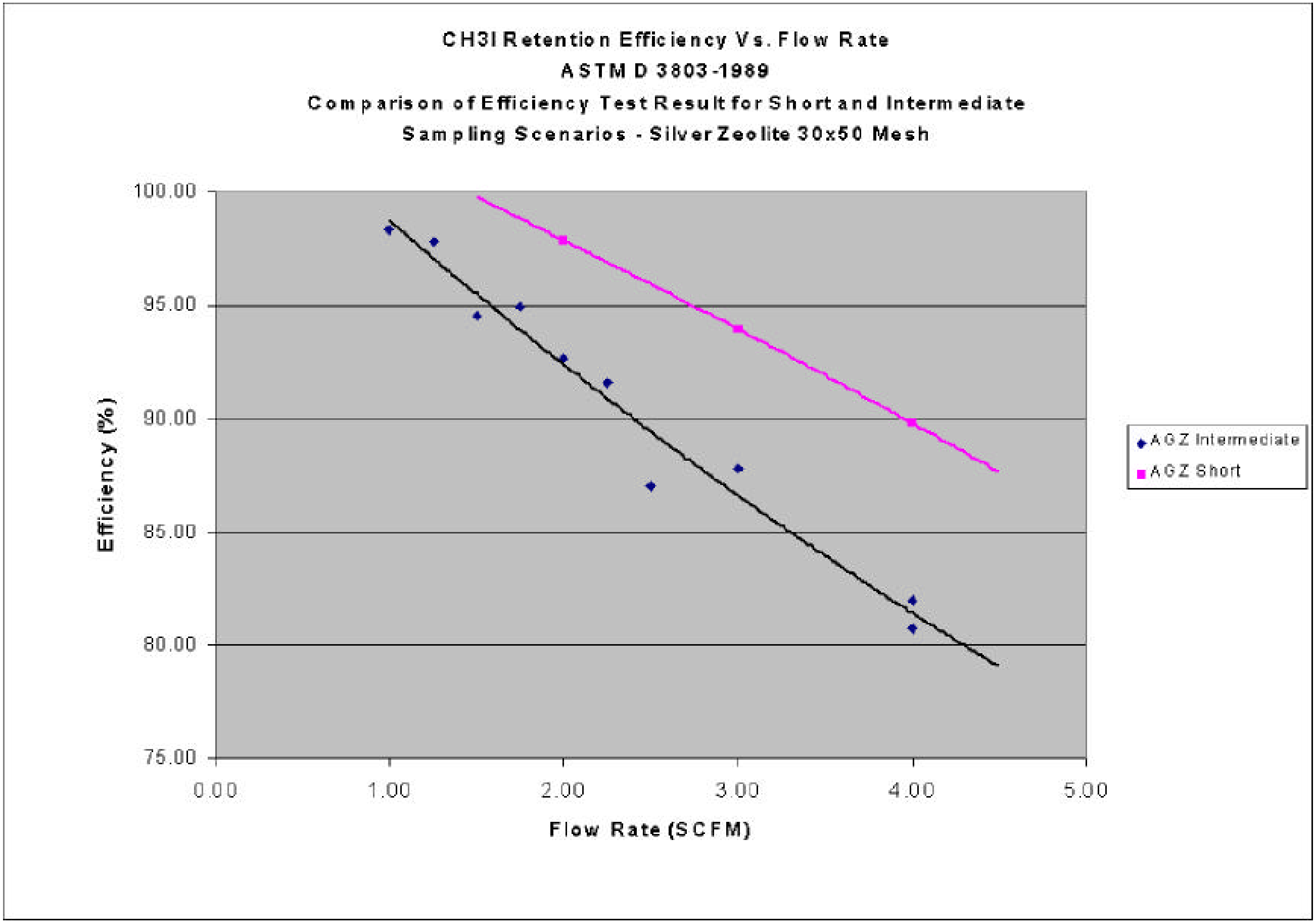

CH3I Retention Efficiency Vs. Flow Rate
ASTM D 3803-1989
AGZ, INT, C;M;B Geometry, May 2002
Efficiency (%)
100.00
95.00
90.00
85.00
80.00
75.00
0.00
1.00
2.00
3.00
4.00
5.00
6.00
Flow Rate (SCFM)
AGZ164
AGZ35
AGZ58

Graph B-1 and B-2

B-1
Graphical Representation of CH_3I Collection Efficiency vs. Flow Rate for Three Different Sampling Scenarios for TEDA Carbon

B-2
Graphical Representation of CH_3I Collection Efficiency vs. Flow Rate for Two Different Sampling Scenarios for Silver Zeolite

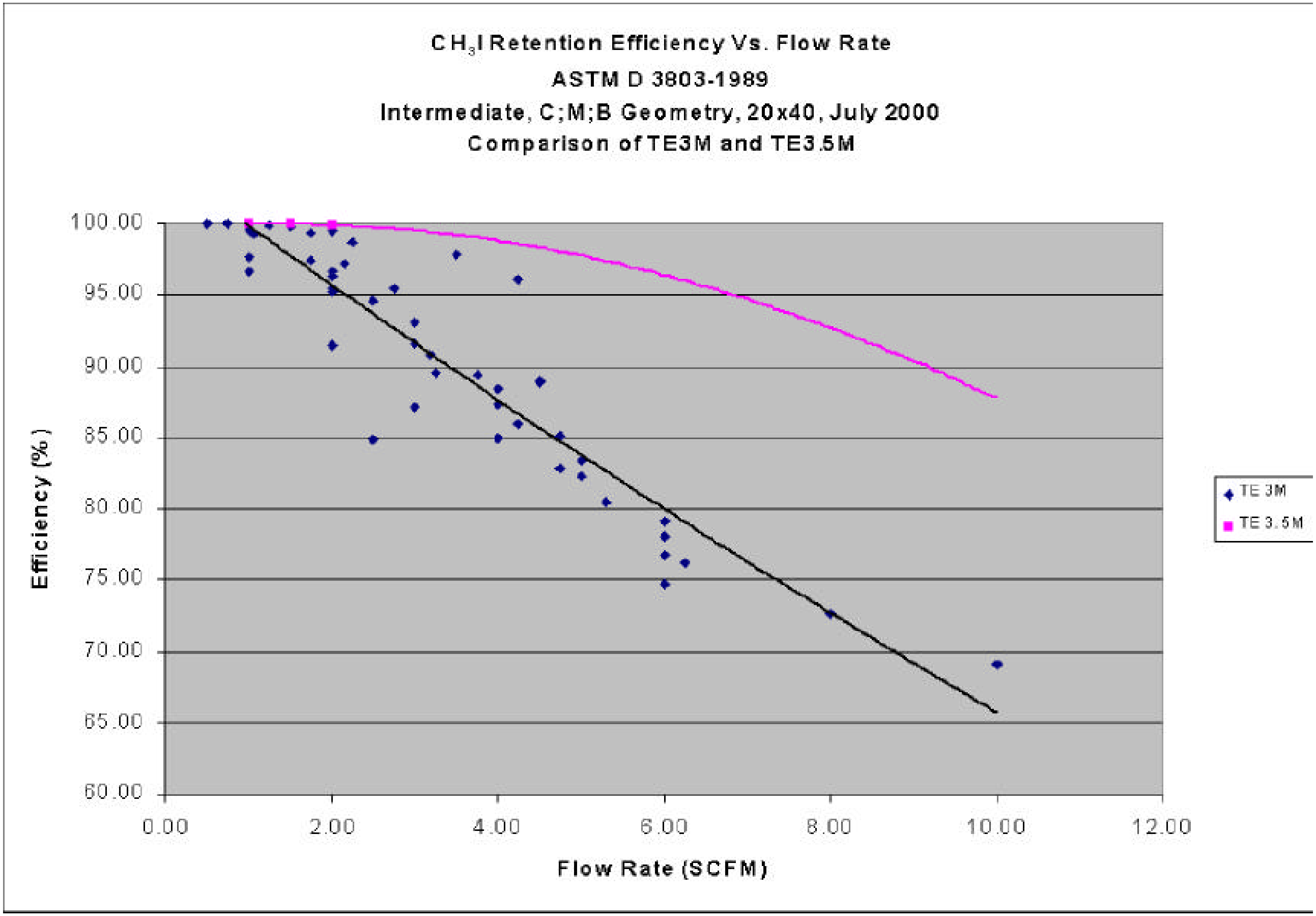

CH3I Retention Efficiency Vs. Flow Rate
Short, Intermediate, Long Sampling Scenario
TE1, C;M;B Geometries, 2.25"x1.0"
Efficiency (%)
100.00
95.00
90.00
85.00
80.00
75.00
70.00
65.00
60.00
55.00
0.00
1.00
2.00
3.00
4.00
5.00
6.00
7.00
Flow Rate (SCFM)
TE1 Short
TE1 Intermediate
TE1 Long



CH3I Retention Efficiency Vs. Flow Rate
ASTM D 3803-1989
Comparison of Efficiency Test Result for Short and Intermediate
Sampling Scenarios - Silver Zeolite 30x50 Mesh
Efficiency (%)
100.00
95.00
90.00
85.00
80.00
75.00
0.00
1.00
2.00
3.00
4.00
5.00
Flow Rate (SCFM)
AGZ Intermediate
AGZ Short

Graph C-1

Graphical Representation of Radioiodine Collection Efficiency vs. Flow Rate for Two Different Bed Depths Utilizing the same Filter Geometry


CH_3I Retention Efficiency Vs. Flow Rate
ASTM D 3803-1989
Intermediate, C;M;B Geometry, 20x40, July 2000
Comparison of TE3M and TE3.5M
Efficiency (%)
100.00
95.00
90.00
85.00
80.00
75.00
70.00
65.00
60.00
0.00
2.00
4.00
6.00
8.00
10.00
12.00
Flow Rate (SCFM)
TE 3M
TE 3.5M