FR AP-42 Section 11.14
Reference 9
Report Sect.
Reference 9

WESTON Work Order No. 6423-01-01

FRIT UNIT NO. 2
SCRUBBER NO. 2
PARTICULATE EMISSION TEST REPORT
CHI-VIT CORPORATION
LEESBURG, ALABAMA
APRIL 1991

Prepared For:

CHI-VIT CORPORATION
EWING GAP ROAD
LEESBURG, ALABAMA 35983

APPROVED FOR TRANSMITTAL
APRIL 1991

Prepared By:

Roy F. Weston, Inc.
1635 Pumphrey Avenue
Auburn, AL 36830

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SECTION 1. INTRODUCTION

SECTION 1. INTRODUCTION

Roy F. Weston, Inc. (WESTON) was retained by the CHI-VIT Corporation (CHI-VIT) to conduct particulate emission testing on the Frit Unit No. 2 - Scrubber No. 2 at the Leesburg, Alabama mill. The purpose of the testing was to demonstrate compliance with Alabama Department of Environmental Management (ADEM) permit limitations.

WESTON performed the particulate testing on 11 April 1991 with a test team comprised of Mr. Tim Smith and Mr. Mitch Newman. Mr. Joe Oven was the WESTON Project Manager and Dr. Bruce Ferguson served as the Project Director. Appendix A includes a copy of the project summary and personnel resumes. Mr. Bobby Grimes of CHI-VIT coordinated the testing with mill operations and served as WESTON's technical contact throughout the effort. Mr. John Hughes of ADEM was present during testing.

Section 2 of this report presents the results of testing. Section 3 describes testing procedures and provides guidelines for data interpretation. Field and laboratory data, calculations, and general project information are provided in the appendices.

SECTION 2. RESULTS AND DISCUSSION

WESTON

SECTION 2. RESULTS AND DISCUSSION

Table 2.1 summarizes the results of the particulate emission testing performed on 11 April 1991 on the Frit Unit No. 2 - Scrubber No. 2 at the CHI-VIT mill in Leesburg, Alabama. Field and laboratory data are provided in Appendices B and C, respectively. Sample calculations are presented in Appendix D.

TABLE 2.1. EMISSION DATA - FRIT UNIT NO. 2 - SCRUBBER NO. 2

	RUN 1	RUN 2	RUN 3	MEAN
Date	04/11/91	04/11/91	04/11/91	----
Time Began	1010	1300	1447	----
Time Ended	1116	1404	1551	----
Stack Gas				
Temperature, °F	148	144	148	147
Velocity, ft/sec	40.1	40.1	40.2	40.1
Moisture, %	21.1	21.6	23.9	22.2
CO_2 Concentration, %	2.0	2.3	3.0	2.4
O_2 Concentration, %	17.0	16.7	16.0	16.6
Volumetric Flow Rate				
@ Stack Conditions, $\times 10^4$ ft^3/min	1.34	1.34	1.35	1.34
@ Standard Conditions[a], $\times 10^3$ ft^3/min	9.29	9.26	8.95	9.17
Production Rate, ton/hr	1	1	1	1
Particulate				
Isokinetic Sampling Rate, %	108	103	101	104
Concentration, gr/ft^3 @ Standard Cond.[a]	0.037	0.032	0.035	0.035
Emission Rate, lb/hr	3.0	2.6	2.7	2.7
Permit Limit[b], lb/hr	----	----	----	3.59

[a]68°F, 29.92 in. Hg

[b]3.59 (Production Rate)$^{0.62}$

SECTION 3. SOURCE TESTING METHODOLOGY

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3.1. PROCEDURES

Testing was performed using the reference methods identified below.

Parameter	Reference Method
Volumetric Flow	1, 2
Gas Composition (CO_2 and O_2)	3
Moisture Content	4
Particulate Concentration	5

The most current revision of each method (as described in the Federal Register) was used. The following paragraphs summarize the protocol.

Volumetric Flow

The sampling points were selected in accordance with EPA Reference Method 1 so that a representative sample of stack gas was taken. The traverse points were located in the centers of equal area zones. The number of zones was determined by the stack dimensions and the number of stack diameters upstream and downstream from the sampling points to the nearest disturbance.

The velocity of the gas stream was determined according to EPA Reference Method 2 by reading the instantaneous velocity head with an inclined manometer at each sampling point with a calibrated S-type pitot tube attached adjacent to the sample nozzle. The stack pressure was measured with the static side of the pitot tube. A calibrated pyrometer was used to measure stack temperature at each sampling point.

Gas Composition

Carbon dioxide and oxygen concentrations were determined using EPA Reference Method 3. A grab sample of gas was taken on the source and analyzed with a Fyrite analyzer. The molecular weight of the gas was calculated using the moisture, oxygen, and carbon dioxide contents.

Moisture Content

The preliminary moisture content was determined by estimation. The final moisture content was determined by measuring the amount of condensed moisture in the impingers of the particulate sampling train, as described in EPA Reference Method 4. The moisture content used for calculating the gas stream flow rate was the lower of the measured moisture or the moisture value based on saturated conditions.

Particulate Concentration

The particulate emission testing was conducted using EPA Reference Method 5. The Method 5 sampling train used during testing was manufactured by NuTech. The sampling points were selected in accordance with EPA Reference Method 1 described above. An S-type pitot tube was connected to the sample nozzle so that an instantaneous velocity head was measured at each sampling point during each test run. The stack temperature was also measured at each point.

Three runs (each of approximately 60 minutes duration) were performed. The gas stream was sampled isokinetically at each sampling point by adjusting the sample flow rate to correspond to the measured velocity at each point.

The probe and nozzle were washed with acetone to remove adhering particulate matter after each run. The filter was removed from the holder and stored in aluminum foil until analyzed. The filter holder was then rinsed with acetone. This rinse was added to the probe rinse. Liquid levels were marked, and the container was sealed and labeled for transport to the laboratory.

The mass of particulate matter collected was analyzed in the laboratory by evaporating the solvent in a tared beaker and then weighing the residue. The filter tare weight and solvent blank corrections were subtracted from the final weight to give the weight of the particulate matter collected. The total weight was used to calculate the particulate concentration. All weight measurements were made on the same Mettler balance (accurate to 0.1 mg).

The mean temperatures of the stack gas and the dry gas meter were used in calculating the final data. The mean isokinetic sampling rate, the stack gas velocity, and the volumetric flow rate were calculated from the mean of the square roots of the velocity pressure measured at each traverse point during sampling.

3.2. QUALITY CONTROL

Throughout the entire project, a high level of quality control was maintained to ensure the accuracy of the data. The test personnel were experienced in the use of the instrumentation, the procedures, and the quality control requirements. Resumes of the personnel involved in the project are included in Appendix A. The following paragraphs briefly summarize the quality control associated with the project.

General

All data were recorded at the time of collection on preprinted data sheets. Data transfers were minimized. All samples were prepared for shipment, and chain-of-custody was maintained from the sampling technician to the analyst. Calculations were performed (where possible) with preprogrammed calculators, and all calculations were verified by a second person. The report was reviewed and approved by the Project Manager prior to transmittal. In general, all accepted quality control standards and practices recommended by the reference methods were followed.

Volumetric Flow

The stack was measured with a certified tape to an accuracy of 0.15 inch. The velocity and sampling traverse points were marked on the probe with heat resistant glass fiber tape.

The pitot tubes used to measure the velocity pressures were geometrically calibrated on a routine basis. The pyrometer used to measure the stack gas temperature and all thermocouples for intermediate measurements were also calibrated routinely with respect to standard thermometers. At the completion of the test, all equipment was visually inspected and damage was not found.

Gas Composition

Quality control on oxygen analyses by EPA Reference Method 3 involved the analysis of ambient air before and after every sixth sample. If the measured oxygen concentration was less than 20.8 percent, the Fyrite chemicals were changed before proceeding.

WESTON participated satisfactorily in the most recent EPA Audit Sample for Reference Method 3.

Moisture Content

Quality control of the moisture analysis involved the accurate measurement of the gas flow and the accurate determination of the moisture condensed in the sampling train. A graduated cylinder was used to measure the volume of water in each impinger before and after sampling. The silica gel was weighed, before and after its use, to the nearest 0.1 gram with

a triple beam balance. The difference in measurement was considered to be the moisture collected.

Particulate Concentration

The dry gas meter used to measure the sample volume was calibrated before and after sampling. The calibration obtained was within the required specifications each time. Meter calibration work sheets are presented in Appendix F.

WESTON participated satisfactorily in the most recent dry gas meter audit supplied by the EPA. Those data are on file at WESTON.

WESTON uses Class S weights to verify the accuracy of the balance. The Class S weight is weighed when the filters are tared and when the final weighings are made. Any significant difference in the actual weight and measured weight indicates a problem with the balance, and the balance is repaired before proceeding.

An acetone and filter blank were analyzed at the same time as the samples. The mass collected on the filters and the mass in the probe wash were corrected by the blank measurements.

The rate of sample collection was determined to be within ten percent of the isokinetic rate, thus indicating the validity of the sample collection.

APPENDIX A. PROJECT SUMMARY AND PERSONNEL RESUMES

PROJECT SUMMARY

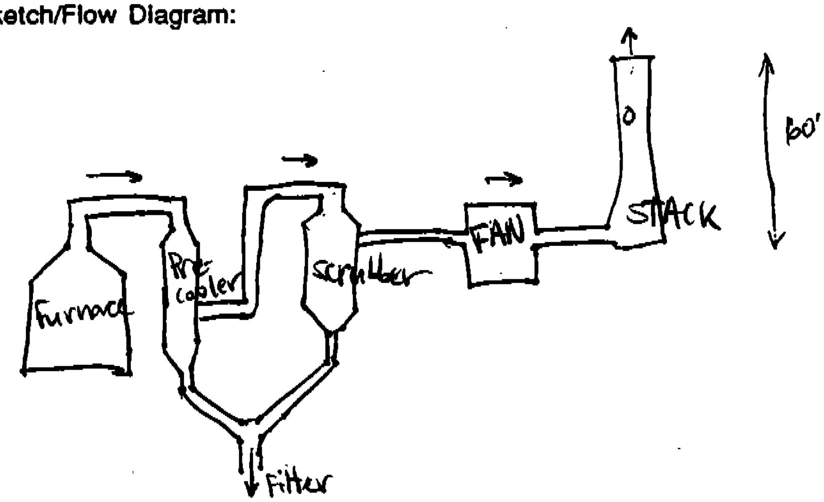
CLIENT CHI-VIT WORK ORDER NO. 6423-01-01
LOCATION Leesburg, Alabama
WESTON PROJECT PERSONNEL Tim Smith, Mitch Newman
Client Contact(s) Mr. Bobby Grimes Tel No. (205) 526 8522
Tel No. (205) 526-8080 Fax

Regulatory Personnel
Process Description

Process Vendor(s)

Item	Manufacturer	Rated Capacity

Process Sketch/Flow Diagram:



Miscellaneous Information

Page ______ of ______ Test Team Leader Tim Smith Date 4/12/91

PROJECT SUMMARY

CLIENT CHI-VIT WORK ORDER NO. 6423-01-01

DATE/TIME	ACTION TAKEN
4/10/91 9:00	Leave Auburn
13:30	Arrive at Plant and begin to set-up Frit Unit No. 2 -
	Scrubber No. 2 Preliminary velocity
18:00	Leave Plant
4/11/91 6:30	Arrive at Plant and finish set-up
	have trouble with Hot box filter heater connection.
10:10	Start first Run
	John Hughes from ADEM arrives
10:16	finish first Run
13:00	Start Second Run
14:04	finish Second Run. John Hughes leaves
14:47	Start third Run
15:51	Finish third run and begin to load
	the Van.
17:15	Leave for B'ham to pick up Scott.
20:30	Arrive at Auburn

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WESTON MANAGERS DESIGNERS/CONSULTANTS

BRUCE B. FERGUSON, Ph.D., CIH

Registration

Certified Industrial Hygienist, ABIH

Fields of Competence

Overall direction and management of projects; extensive experience in air quality testing and studies; industrial hygiene investigations and air quality studies; professional services associated with management of hazardous waste and asbestos; expert witness for environmental matters; research projects associated with chromatographic analysis and reduced sulfur analysis.

Experience Summary

Broadly based experience as a consultant and researcher. Extensive training in environmental regulations in all media; compliance management project experience in pulp and paper, chemicals and petrochemicals, oil and gas production, food and electronics manufacturing. Dr. Ferguson has directed more than 800 source emission tests for hydrocarbons and sulfur species from petroleum refineries, kraft pulp mills and steel mills. Directed over 250 routine emission tests at refineries, foundries, pharmaceutical plants, magnetic tape coating plants and high density urban areas. Directed over 400 tests utilizing EPA Reference Methods of Particulate, NOx, SO2, and other routine compounds.

Credentials

B. S., Chemistry/Mathematics -- Athens College (1968)

M. S., Physical Chemistry -- Vanderbilt University (1973)

Ph.D., Physical Chemistry -- Vanderbilt University (1974)

American Chemical Society

Air Pollution Control Association

Employment History

1983-Present	WESTON
1977-1983	Harmon Engineering and Testing
1974-1977	PBR Electronics
1972-1973	College Grove Smelter

BRUCE B. FERGUSON, Ph.D., CIH
(continued)

Key Projects

Project Manager for site assessments and surveys for the Navy Assessment and Control of Installation Pollutants (NACIP) program. Projects were conducted in South Carolina, Tennessee and Texas. The multi-faceted programs encompassed a variety of waste disposal practices and waste site locations at various Naval Installations.

Served as Project Manager for a $517,000 three year NASA contract at Marshall Space Flight Center in Alabama. He directed the efforts of seven full time people to monitor contamination of controlled environments, compressed gases, fuel, life support gases, source emissions, wastewater, plating solutions and rocket booster propellants. As Senior Scientist on the project, he developed a technique to trap and analyze hydrocarbons from contaminated areas in the sub ppb range.

Project Director for asbestos survey and abatement project for the development of methods/technology for containment and/or remedial action at Wright-Patterson Air Force Base. Such methods involve testing, identification and recording of potential hazards, documentation and program implementation.

Principal-in-Charge for a full-scale asbestos survey of 10 U. S. Army installations covering 2.2 million sq. ft. in the Republic of Korea. Major work tasks included the characterization of various hazards and prioritization of recommendations for the development of treatment methods.

Served as Principal Investigator for a U. S. Army Project to develop a transportable gas chromatograph-mass spectrometer. The instrument was used to monitor emissions from solid rocket firings.

Served as Principal Scientist for two EPA contracts in Research Triangle Park, North Carolina. He directed laboratory and field evaluations of EPA Reference Methods 15 and 16. Other tasks under these contracts involved long-term evaluation of process rate monitors; review and editing of QA procedures for EPA Reference Methods 13A and 13B; long-term laboratory and field evaluation of CO and H_2S CEM's and report review.

Principal Investigator for a multi-year EPA contract for development of source tests methodology for reduced sulfur compounds at kraft pulp mills and petroleum refineries. Tasks assigned involved evaluating methodology, developing new methodology and field validating the new procedures. As a result of the contract, new methodology was presented in the Federal Register.

Served as Project Director for a project requiring claims documentation testing on an indoor air quality cleaning device. Testing was performed on the device in a closed chamber to demonstrate the reduction and removal deficiency for such compounds as light weight hydrocarbons, formaldehyde, sulfur dioxide, hydrogen sulfide and other common pollutants. The project resulted in information submitted to the Federal Trade Commission to document the manufacturer's claim.

Served as Project Director for developing VOC emission inventories and for defining Reasonably Available Control Technology (RACT) for VOC emissions; developed permit documentation for VOC incinerators and conducted equipment evaluation and cost studies for projects. These projects have been performed for such clients as Upjohn Chemical, Republic Steel, Richmond Gravure, Southern Wood Piedmont and International Paper Company.

BRUCE B. FERGUSON, Ph.D., CIH
(continued)

Prepared RCRA-required ground water sampling, monitoring and compliance plans for companies such as Prestolite, Wolverine, Courtaulds, Fruehauf and TR Miller Company in Alabama; Merck Pharmaceuticals, International Paper Company and Mount Pine Wood Treating in Texas, Missouri, Virginia, Georgia, Mississippi, Louisiana and Arkansas.

Directed efforts of two commercial laboratories to obtain accreditation for all parameters by the American Industrial Hygiene Association. Directed the firm's participation in the NIOSH proficiency analytical testing programs and the EPA Round Robin test programs, and subsequent accreditation under the National Institute of Standards and Technology's (NIST) National Voluntary Laboratory Accreditation Program (NVLAP).

Publications

Elam, D. E. and B. B. Ferguson. (1985) "Quality Assurance Aspects of Total Reduced Sulfur Continuous Emission Monitoring Systems." Continuous Emission Monitor Specialty Conference of the Air Pollution Control Association. Baltimore, MD.

Ferguson, B. B. (1985) "TRS Continuous Emission Monitoring in the Pulp and Paper Industry - One Year Later." Engineering Foundation Conference on Source Testing, Santa Barbara, CA.

Margeson, J. H., J. E. Knoll, M. R. Midgett, B. B. Ferguson and P. J. Schworer. (1985) "A Manual Method for Measurement of Reduced Sulfur Compounds." J. of the Air Pollution Control Association, 35(12), 1280.

Elam, D. E. and B. B. Ferguson. (1983) "Quality Assurance Requirements of Total Reduced Sulfur Emission Testing." Specialty Conference on Measurement and Monitoring of Non-Criteria (Toxic) Contaminants in Air. Air Pollution Control Association, Chicago, IL.

Ferguson, B. B. (1982) "Role of Analytical Laboratory in Hazardous Waste Management." The Second Ohio Environmental Engineering Conference.

Reece, J. W., A. R. Barbin, J. D. Sterrett and B. B. Ferguson. (1981) "Cyclonic Flow in a Venturi." The 2nd Symposium on Flow: Its Measurement and Control in Science and Industry. St. Louis, MO. Sponsored by ASME and ISA.

JOSEPH E. OVEN, P.E.

Registration

Registered Professional Engineer in the State of Michigan.

Fields of Competence

Management, supervision, and performance of air quality testing; evaluation of air quality control equipment.

Experience Summary

Over 17 years of professional experience in air quality control activities. Involved in air quality control emission testing in accordance with EPA, NIOSH and NCASI test methodology. Major experience in studies; specifications; bid evaluations; engineering; performance analysis and testing of air quality control equipment such as electrostatic precipitators, fabric filters, mechanical collectors and scrubbers for power plants and industrial boilers.

Credentials

B. S., Mechanical Engineering -- Rochester Institute of Technology (1970)

Air and Waste Management Association (AWMA)

Employment History

1988-Present	WESTON
1973-1988	Gilbert Commonwealth, Inc.
1971-1973	Newport News Shipbuilding
1970-1971	Pratt & Whitney Aircraft

Key Projects

Hanna Steel Corporation, Fairfield, Alabama - Project Manager. This project involved VOC capture and destruction efficiency tests on a steel coating (paint) line. VOC emissions from the coater are captured, then destroyed in an incinerator and catalyst bed system. Testing followed guidelines in the EPA VOC Capture Efficiency protocol which required construction of an enclosure around the coater. VOC emissions were measured at five locations simultaneously at the enclosure and incinerator/catalyst bed system.

Sony Magnetic Products, Dothan, Alabama - Project Manager. Sony operates a hazardous waste-derived fuel fired boiler at their magnetic tape division in Dothan, Alabama. The waste fuel enters the boiler in solid and/or liquid form. WESTON conducted a trail burn to demonstrate compliance with Alabama regulations concerning the destruction removal efficiency (DRE) of organic compounds in the boiler, and measurement of particulate matter in the stack. The DRE testing involved spiking of the waste fuel with a Principle Organic Hazardous Compound (POHC), and determination of concentrations of the POHC in the stack using a VOST sampling train.

JOSEPH E. OVEN, P.E.
(continued)

Inland Fisher Guide Division of General Motors, West Monroe, Louisiana - Project Manager. Two projects were completed on automotive lens coating processes. One project involved an emission inventory and complete material balance of a butyl acetate carbon adsorption system to demonstrate that system fugitive VOC emissions were less than 10 percent of butyl acetate purchases. A second project involved VOC testing and material balance of a lens coating system using a variety of solvents. VOC emissions were characterized and quantified for use in the possible addition of a VOC collection system.

Leer Southeast, Inc., Georgia - Project Engineer. Conducted VOC emissions evaluation and RACT determination study for Leer, Inc. in Georgia. Specific duties included review of VOC emissions inventory and technical and economic investigations to determine the most cost-effective and technically feasible method to reduce VOC emissions.

Public Service of Indiana - Supervising Engineer. Conducted an electrostatic precipitator inspection program on a life extension project for a 100MW unit for Public Service of Indiana. Responsibilities included inspection of two electrostatic precipitators and preparation of reports recommending physical and operational improvements.

Electric Power Research Institute - New York State - Supervising Engineer. Supervised air quality control activities for the Electric Power Research Institute's (EPRI) High Sulfur Test Center located at the Somerset Station of New York State Electric and Gas. Prepared equipment and systems specifications, bid evaluations and system design descriptions for wet and dry flue gas desulfurization systems, including particulate control and waste handling systems. Supervised engineer/owner/vendor liaison for all air quality control equipment.

University of Wisconsin - Project Engineer. Coordinated air quality control activities for the University of Wisconsin Charter Street Heating Plant. Conducted particulate control studies for three 100,000 lb/hr stoker fired boilers with recommendations to retrofit shake/deflate fabric filters. Prepared specifications and bid evaluations for procurement of the fabric filters.

Central Illinois Light Company - Supervising Engineer. Supervised air quality control activities for Central Illinois Light Company projects. Directed and coordinated electrostatic precipitator and flue gas desulfurization system procurement activities for a new 450MW coal-fired power plant.

Publications

Oven, J. E. and S. P. Yambor, (1982). "Overview of Air Quality Control Projects," presented at Joint Power Generation conference, Denver.

Oven, J. E. and L. H. Haines, (1979). "Ash/FGD Waste Disposal Options," presented at American Power Conference, Chicago.

Oven, J. E. and A. Ansari, (1980). "Ash/FGD Waste Disposal," Combustion Magazine.

TIM T. SMITH

Fields of Competence

EPA reference method source sampling and air quality testing; report preparation and writing; quality assurance and quality control.

Experience Summary

Experienced in EPA Reference Method 1, 2, 3, 3A, 4, 5, 6C, 7E, and 10 which involves particulate. CO, CO_2, O_2, SO_2, and NO_x continuous monitoring and compliance testing.

Credentials

B.S., Chemistry -- Auburn University (1990)

Employment History

1990-Present WESTON

Key Projects

Served as test team leader for compliance testing of CO and NO_x emissions.

Served as test team member for Performance Standard Testing (PST) of NO_x, CO, SO_2, CO_2, and O_2 emissions.

Served as test team leader and member for particulate emissions testing of various sources of the Kraft paper process including power furnace, recovery furnace, lime kiln, and waste wood furnace.

Served as test team member for Chlorine, Chlorine dioxide, and Chloroform compliance testing.

APPENDIX B. FIELD DATA

PARTICULATE CALCULATIONS

Client: CHI-VIT
Location: Leesburg, Alabama
WESTON Project No.: 6423-01-01
Source: Frit Unit No. 2
Scrubber No. 2

INPUT DATA

Run Number		1	2	3	Mean
Date		4/11/91	4/11/91	4/11/91	---
Time Began		1010	1300	1447	---
Time Ended		1116	1404	1551	---
Sampling Time, min	(Theta)	60	60	60	60
Stack Diameter, in.	(Dia)	32	32	32	32
Barometric Pressure, in. Hg	(Pb)	30.10	30.10	30.10	30.10
Static Pressure, in. H2O	(Pg)	0.35	0.35	0.38	0.36
Pitot Tube Coefficient	(Cp)	0.84	0.84	0.84	0.84
Meter Correction Factor	(Y)	1.010	1.010	1.010	1.010
Nozzle Diameter, in.	(Dn)	0.248	0.248	0.248	0.248
Meter Volume, ft^3	(Vm)	36.875	35.310	33.740	35.308
Meter Temperature, °F	(tm)	88	91	99	93
Meter Orifice Pressure, in. H2O	(Delta H)	1.214	1.096	1.055	1.122
Volume H2O Collected, mL	(Vlc)	205.0	210.3	230.4	215.2
CO2 Concentration, %	(CO2)	2.0	2.3	3.0	2.4
O2 Concentration, %	(O2)	17.0	16.7	16.0	16.6
Average Sq Rt Velo Head, (in. H2O)^½	((Delta P)^½)avg	0.6428	0.6431	0.6406	0.6422
Stack Temperature, °F	(ts)	148	144	148	147
Particulate Collected, g	(Mn)	0.0876	0.0719	0.0727	0.0774
Moisture Fraction (at Saturation)	(Bws)	0.239	0.216	0.239	0.231

CALCULATED DATA

Stack Area, ft^2	(As)	5.59	5.59	5.59	5.59
Stack Pressure, in. Hg	(Ps)	30.13	30.13	30.13	30.13
Standard Meter Volume, ft^3	(Vmstd)	36.173	34.490	32.466	34.376
Standard Water Volume, ft^3	(Vwstd)	9.649	9.899	10.845	10.131
Moisture Fraction (Measured)	(Bws)	0.211	0.223	0.250	0.228
Moisture Fraction (lower sat/meas)	(Bws)	0.211	0.216	0.239	0.222
Mol. Wt. of Stack Gas, lb/lb-mole	(Ms)	26.7	26.7	26.5	26.6
Average Stack Gas Velocity, ft/sec	(Vs)	40.1	40.1	40.2	40.1
Stack Gas Flow @ Stack Cond, ft^3/min	(Qa)	1.34E+04	1.34E+04	1.35E+04	1.34E+04
Stack Gas Flow @ Std Cond, ft^3/min	(Qs)	9.29E+03	9.26E+03	8.95E+03	9.17E+03
Isokinetic Sampling Rate, %	(%I)	108	103	101	104
Particulate Conc @ Std Cond, gr/ft^3	(Cs)	0.037	0.032	0.035	0.035
Particulate Emission, lb/hr	(PMR)	3.0	2.6	2.7	2.7

√ mmo

FIELD DATA

CLIENT: CHI-[illegible] Corp SOURCE: FRIT UNIT NO. 2 SCRUBBER NO. 2 RUN NO.: One

DATE: 4/11/91 WORK ORDER NO.: 6423-01-01 TEST PERSONNEL: SMITH, [illegible]

SAMPLE CONSOLE/CASE: A07 ORIFICE ΔH@: 1.885 METER CORR. (Y): 1.010

NOZZLE DIA. (IN.) PRETEST: .248, .248, .248, .248 avg POSTTEST: .248, .248, .248, .248

STACK DIA. (IN.): 32 PROBE LENGTH/TYPE: 3'/SS PROBE ID NO.: 3-1 PITOT TUBE ID NO.: P21 Cp: .84

SAMPLING TYPE: M5 FILTER NO.: CZ1302 CONDENSATE: 205.0 ml

AMBIENT TEMP (°F): 65 BAROMETRIC PRES. (IN.HG): 30.10 STATIC (IN.H_2O): +.35

SAMPLE TRAIN: PITOT TUBE LEAK CHECK:

PRETEST LEAK RATE (Ft³/MIN): 0.005 @ (IN.HG): 12 PRETEST CHECK: OK

POSTTEST LEAK RATE (Ft³/MIN): 0.014 @ (IN.HG): 5 POSTTEST CHECK: OK

		RUN 1	RUN 2	RUN 3	AVG.	AMBIENT
METHOD OF COLLECTION: Grab Sample	% CO_2	2.0	2.0	2.0	2.0	0
ANALYTICAL METHOD: Fyrite	% O_2	17.0	17.0	17.0	17.0	20.8

Port/Point No.	Elapsed Test Time (Min)	Clock Time (24Hr)	DGM Reading V_M(Ft³)	ΔP (In.H_2O)	ΔH (In.H_2O)	Stack Temp (°F)	Probe Temp (°F)	Hot Box Temp (°F)	Dryer Temp (°F)	DGM Temp (°F)	Sample Train Vac (In.Hg)
1/1	0	10:10	32.497	.39	1.14	146	254	232	57	86	2
2	3		34.410	.39	1.14	148	254	237	48	87	2
3	6		36.300	.36	1.05	150	252	240	48	88	2
4	9		38.190	.35	1.02	150	254	246	52	89	2
5	12		39.880	.35	1.02	150	255	246	53	90	2
6	15		41.625	.49	1.43	150	254	239	57	90	2
7	18		43.630	.54	1.58	148	251	244	58	90	2
8	21		45.610	.54	1.58	147	248	246	58	90	2
9	24		47.610	.47	1.37	143	246	239	57	90	2
10	27		49.580	.36	1.05	141	246	245	56	90	2
2/1	30		51.387	.34	.99	145	254	242	58	89	2
2	33		53.020	.35	1.02	147	254	243	54	88	2
3	36		54.650	.34	.99	150	253	240	52	88	2
4	39		56.360	.33	.96	150	252	240	50	88	2
5	42		57.940	.38	1.11	149	253	246	49	87	2
6	45		59.700	.46	1.34	148	252	243	49	88	2
7	48		61.630	.48	1.40	149	252	246	48	87	2
8	51		63.590	.49	1.43	149	252	244	48	87	2
9	54		65.540	.48	1.40	148	252	245	47	87	2
10	57		67.480	.43	1.26	141	253	238	49	87	
Final	60	11:16	69.372								

NET SAMPLE TIME	DGM READING	AVG √ΔP	AVG ΔH	AVG STACK TEMP (°F)	AVG DGM TEMP (°F)
60	36.8750	.6428	1.2140	147.5	88.3

K = 2.92

$$\Delta H = \Delta P[(893.94)(C_p)^2(FDA)^2(\Delta H@)(Dn)^4\left(\frac{T_m}{T_s}\right)]$$

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FIELD DATA

CLIENT: CHI - VIT SOURCE: FRIT UNIT NO. 2 SCRUBBER NO. 2 RUN NO.: TWO

DATE: 4/11/91 WORK ORDER NO.: 6423-01-01 TEST PERSONNEL: Smith, Newman

SAMPLE CONSOLE/CASE: A07 ORIFICE ΔH@: 1.885 METER CORR. (Y): 1.010

NOZZLE DIA. (IN.) PRETEST: .248₁, .248₂, .248₃, .248 avg POSTTEST: .248₁, .248₂, .248₃, .248 avg

STACK DIA. (IN.): 32 PROBE LENGTH/TYPE: 3'/SS PROBE ID NO.: 3-1 PITOT TUBE ID NO.: P21 Cp: .84

SAMPLING TYPE: MS FILTER NO.: C21303 CONDENSATE: 210.3 mL

AMBIENT TEMP (°F): 69.0 BAROMETRIC PRES. (IN.HG): 30.10 STATIC (IN.H_2O): + .35

SAMPLE TRAIN: PITOT TUBE LEAK CHECK:

PRETEST LEAK RATE (Ft^3/MIN): 0.008 @ (IN.HG): 12 PRETEST CHECK: OK

POSTTEST LEAK RATE (Ft^3/MIN): 0.005 @ (IN.HG): 5 POSTTEST CHECK: OK

METHOD OF COLLECTION: Grab Sample
ANALYTICAL METHOD: Fyrite

	RUN 1	RUN 2	RUN 3	AVG.	AMBIENT
$\%CO_2$	2.0	2.0	2.0	2.3	0.0
$\%O_2$	17.0	16.0	17.0	16.7	20.8

Port/ Point No.	Elapsed Test Time (Min)	Clock Time (24 Hr)	DGM Reading V_M(Ft³)	Δ P (In.H_2O)	Δ H (In.H_2O)	Stack Temp (°F)	Probe Temp (°F)	Hot Box Temp (°F)	Dryer Temp (°F)	DGM Temp (°F)	Sample Train Vac (In.Hg)
1/1	0	~~12:50~~ 13:00	69.910	.37	.97	142	255	237	63	85	2
2	3		71.615	.36	.95	144	255	244	56	87	2
3	6		73.330	.34	.89	148	255	248	58	89	2
4	9		74.975	.33	.87	147	253	237	53	89	2
5	12		76.570	.35	.92	144	253	240	53	89	2
6	15		78.200	.48	1.26	144	251	241	53	89	2
7	18		79.965	.52	1.37	143	252	244	54	90	2
8	21		81.940	.50	1.32	143	250	245	54	90	2
9	24		83.790	.46	1.21	143	250	247	54	90	2
10	27		85.850	.38	1.00	141	253	243	66	92	2
2/1	30		88.048	.41	1.08	144	255	237	63	91	2
2	33		89.735	.40	1.05	145	254	242	54	91	2
3	36		91.430	.38	1.00	146	253	242	53	91	2
4	39		93.120	.36	.95	146	254	245	53	91	2
5	42		94.750	.36	.95	146	254	247	53	91	2
6	45		96.300	.49	1.29	146	253	242	54	92	3
7	48		98.050	.53	1.39	146	254	247	53	92	3
8	51		99.910	.52	1.37	145	255	240	53	93	3
9	54		101.780	.48	1.26	143	255	247	54	94	3.5
10	57		103.620	.31	.82	137	254	278	55	94	3
Final	60	14:04	105.220								

NET SAMPLE TIME	DGM ΔREADING	AVG $\sqrt{\Delta P}$	AVG ΔH	AVG STACK TEMP (°F)	AVG DGM TEMP (°F)
60	35.3100	.6431	1.0960	144.2	90.5

K = 2.63

ΔH

$$\Delta H = \Delta P[(893.94)(C_p)^2(FDA)^2(\Delta H@)(Dn)^4\left(\frac{T_m}{T_s}\right)]$$

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2 03

WESTON

FIELD DATA

CLIENT CHI-VIT SOURCE FRIT UNIT NO. 2 SCRUBBER NO. 2 RUN NO. THREE

DATE 4/4/91 WORK ORDER NO. 6423-01-01 TEST PERSONNEL SMITH, McNamara

SAMPLE CONSOLE/CASE A07 ORIFICE ΔH@ 1.885 METER CORR. (Y) 1.010

NOZZLE DIA. (IN.) PRETEST .248, .248, .248, .248 avg POSTTEST .248, .248, .248, .248 avg

STACK DIA. (IN.) 32 PROBE LENGTH/TYPE 3'/SS PROBE ID NO. 3-1 PITOT TUBE ID NO. P21 Cp .84

SAMPLING TYPE M5 FILTER NO. C21304 CONDENSATE 230.4 mL

AMBIENT TEMP (°F) 70 BAROMETRIC PRES. (IN.HG) 30.10 STATIC (IN.H_2O) +.38

SAMPLE TRAIN: PITOT TUBE LEAK CHECK:

PRETEST LEAK RATE (Ft^3/MIN) 0.010 @ (IN.HG) 12 PRETEST CHECK ok

POSTTEST LEAK RATE (Ft^3/MIN) 0.005 @ (IN.HG) 6 POSTTEST CHECK OK

METHOD OF COLLECTION Grab Sample

ANALYTICAL METHOD Fyrite

	RUN 1	RUN 2	RUN 3	AVG.	AMBIENT
% CO_2	3.0	3.0	3.0	3.0	0.0
% O_2	16.0	16.0	16.0	16.0	20.8

Port/ Point No.	Elapsed Test Time (Min)	Clock Time (24Hr)	DGM Reading V_M(Ft^3)	ΔP (In.H_2O)	ΔH (In.H_2O)	Stack Temp (°F)	Probe Temp (°F)	Hot Box Temp (°F)	Dryer Temp (°F)	DGM Temp (°F)	Sample Train Vac (In.Hg)
1/1	0	14:47	105.600	.39	.99	144	255	234	60	95	2
2	3		107.420	.40	1.02	149	254	242	55	96	2
3	6		109.140	.37	.94	148	252	238	54	97	2
4	9		110.790	.36	.92	149	254	244	56	97	2
5	12		112.400	.35	.89	148	255	240	57	98	2
6	15		114.080	.50	1.27	148	254	244	57	99	2
7	18		115.730	.54	1.38	147	254	240	57	99	2
8	21		117.700	.53	1.35	146	254	247	57	100	2
9	24		119.600	.47	1.20	146	255	238	58	100	2
10	27		121.190	.38	.97	141	255	246	57	100	2
2/1	30		122.780	.34	.87	145	254	246	59	98	2
2	33		124.200	.35	.89	150	254	240	52	99	2
3	36		125.700	.33	.84	150	254	246	52	99	2
4	39		127.220	.33	.84	150	253	238	52	99	2
5	42		128.760	.32	.82	149	255	246	52	99	2
6	45		130.350	.48	1.22	149	254	236	52	100	2
7	48		132.170	.50	1.28	150	254	244	53	100	2
8	51		134.000	.50	1.28	150	253	240	53	100	2
9	54		135.890	.45	1.15	148	254	246	54	100	2
10	57		137.690	.38	.97	144	254	240	55	100	2
Final	60	15:51	139.340								

NET SAMPLE TIME	DGM ΔREADING	AVG$\sqrt{\Delta P}$	AVGΔH	AVG STACK TEMP (°F)	AVG DGM TEMP (°F)
60	33.74	.6406	1.0545	147.6	98.75

K= 2.55

Page ____ of ____

$$\Delta H = \Delta P[(893.94)(C_p)^2(FDA)^2(\Delta H@)(Dn)^4\left(\frac{T_m}{T_s}\right)]$$

Limit 3.59 lbs/hr

SAMPLE RECOVERY AND INTEGRITY

CLIENT CHI-VIT WORK ORDER NUMBER 6423-01-01

SOURCE FRIT UNIT NO. 2 - SCRUBBER NO. 2 IMPINGER BOX NUMBER

SAMPLE DATE 4/11/91 SAMPLE PERSONNEL Smith

RECOVERY DATE 4/11/91 RECOVERY PERSONNEL Newman

MOISTURE DATA

	RUN # ONE	RUN # TWO	RUN # Three
Final Volume in Impingers (mL)	399	404	423
Initial Volume in Impingers (mL)	200	200	200
Net Volume Increase (mL)	199	204	223
Silica Gel Number	One	Two	Three
Final Silica Gel Wt (g)	204.0	238.0	227.2
Initial Silica Gel Wt (g)	198.0	231.7	219.8
Δ Wt (g)	6.0	6.3	7.4
Total Moisture (mL)	205.0	210.3	230.4

IMPINGER NUMBER

		1	2	3	4	5
Run # ONE	Final Wt	255	142	2	204.0	
	Initial Wt	100	100	0	198.0	
	Δ Wt	155	42	2	6.0	
Run # TWO	Final Wt	301	102	1	238.0	
	Initial Wt	100	100	0	231.7	
	Δ Wt	201	2	1	6.3	
Run # Three	Final Wt	305	118	0	227.2	
	Initial Wt	100	100	0	219.8	
	Δ Wt	205	18	0	7.4	

SAMPLE RECOVERY

	RUN # ONE	RUN # TWO	RUN # THREE
Filter Number	C21302	C21303	C21304
Filter Container No./Wash Container No.	C21302	C21303	C21304
Filter Container Sealed (Y/N)	Y	Y	Y
Probe Wash Level Mark? (Y/N)	Y	Y	Y
Solvent Blank Container No.	C21305		

NOTES:

Tim J. Smith
TEST TEAM LEADER

Page ____ of ____

WESTON MANAGERS DESIGNERS/CONSULTANTS

PRELIMINARY VELOCITY DATA

CLIENT: CAI- VIT
SOURCE: Frit Unit No. 2 - Scrubber No. 2
WORK ORDER NO. 6423-01-01
DATE: 4/10/91

DUCT DATA

Dist. from far wall to outside of port: 53.5 in.
Nipple length: 1.5 in.
Depth of duct: 32 in.
Width of duct (rec): ____ in.
Area of duct: 5.58 ft²

Equivalent diameter = 2 x depth x width / depth + width
2( ) ( ) / ( ) + ( )

Dist. from nearest disturbance to ports

	"A" up-stream	"B" down-stream
ft	22	18
dia	8.25	6.75

LOCATION OF TRAVERSE POINTS

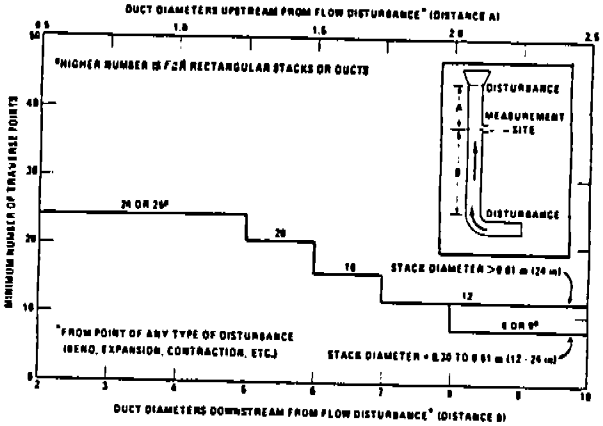

Figure 1-1. Minimum number of traverse points for particulate traverses.

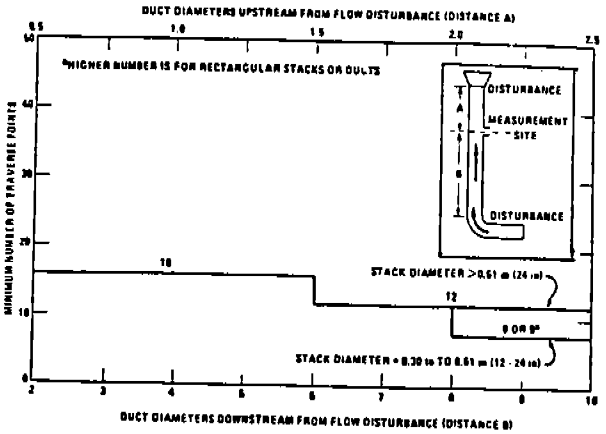

Figure 1-2. Minimum number of traverse points for velocity (nonparticulate) traverses.

MEASUREMENTS

Traverse Point	% of Diameter	Distance from inside wall	Distance from outside of port
1	2.6	0.83	2.33
2	8.2	2.62	4.12
3	14.6	4.67	6.17
4	22.6	7.23	8.73
5	34.2	10.94	12.44
6	65.8	21.06	22.56
7	77.4	24.77	26.27
8	85.4	27.33	28.83
9	91.8	29.38	30.88
10	97.4	31.17	32.67
11			
12			

RECTANGULAR DUCTS

	3	4	5	6	7	8	9	10	11	12
1	16.7	12.5	10.0	8.3	7.1	6.3	5.6	5.0	4.5	4.2
2	50.0	37.5	30.0	25.0	21.4	18.8	16.7	15.0	13.6	12.5
3	83.3	62.5	50.0	41.7	35.7	31.3	27.8	25.0	22.7	20.8
4		87.5	70.0	58.3	50.0	43.8	38.9	35.0	31.8	29.2
5			90.0	75.0	64.3	56.3	50.0	45.0	40.9	37.5
6				91.7	78.6	68.8	61.1	55.0	50.0	45.8
7					92.9	81.3	72.2	65.0	59.1	54.2
8						93.8	83.3	75.0	68.2	62.5
9							94.4	85.0	77.3	70.8
10								95.0	86.4	79.2
11									95.5	87.5
12										95.8

CIRCULAR DUCTS

Traverse point number on a diameter	(Percent of stack diameter from inside wall to traverse point) 2	4	6	8	10	12
1	14.6	6.7	4.4	3.2	2.6	2.1
2	85.4	25.0	14.6	10.5	8.2	6.7
3		75.0	29.6	19.4	14.6	11.8
4		93.3	70.4	32.3	22.6	17.7
5			85.4	67.7	34.2	25.0
6			95.6	80.6	65.8	35.6
7				89.5	77.4	64.4
8				96.8	85.4	75.0
9					91.8	82.3
10					97.4	88.2
11						93.3
12						97.9

Table 1-1. Cross-Section Layout for Rectangular Stacks

Number of traverse points	Matrix layout
9	3x3
12	4x3
16	4x4
20	5x4
25	5x5
30	6x5
36	6x6
42	7x6
49	7x7

Page ______ of ______

APPENDIX C. LABORATORY DATA

Inter-Office Memorandum

WESTON MANAGERS DESIGNERS/CONSULTANTS

TO: Auburn Operations
Joe Oven

FROM: Catherine Lloyd CL

DATE: 18 April 1991

PROJECT: CHI-VIT

W.O. NO.: 6423-01-01

SUBJECT: Laboratory Results

ACTION:

RESULTS AND DISCUSSION:

Attached are the results for samples submitted to the laboratory for analysis on 12 April 1991.

ANALYTICAL METHODOLOGY:

The analysis is performed following EPA Method 5. Acetone / deionized water is used to rinse the sample bottles where applicable.

QUALITY ASSURANCE / QUALITY CONTROL:

All glassware is thoroughly cleaned before use. The blank wash and filter are analyzed at the same time and under the same conditions as the samples. The analytical balance used was calibrated prior to use and NBS Class S weights are weighed and recorded every tenth weighing.

cl

M:\1502\.MEM

RFW 04-08-004/A-5/85

METHOD 5
LABORATORY DATA

Client: CHI-VIT CORPORATION
Date Received: 12 April 1991
Date Transmitted: 17 April 1991

WESTON W.O.: 6423-01-01
Lab W.O.: 0033-70-04-0010

Laboratory #	CZ1302	CZ1303	CZ1304	CZ1305
Beaker #	29-3	30-3	31-3	32-3
Liquid Volume(ml)	90	102	96	70
Field Run #	ONE	TWO	THREE	BLANK
Filter #	CZ1302	CZ1303	CZ1304	CZ1305
Initial Beaker Weights(g)				
Weight #1	102.3237	106.1020	104.6367	108.9868
Weight #2	102.3242	106.1015	104.6368	108.9870
Weight #3				
Weight #4				
Average Initial Weight	102.3240	106.1018	104.6368	108.9869
Final Beaker Weights(g)				
Weight #1	102.3568	106.1207	104.6494	108.9908
Weight #2	102.3566	106.1203	104.6494	108.9905
Weight #3				
Weight #4				
Average Final Weight	102.3567	106.1205	104.6494	108.9907
Final-Initial Beaker Wts.	0.0327	0.0187	0.0126	0.0038
Liquid Blank	0.0049	0.0055	0.0052	
Liquid Particulate Weight	0.0278	0.0132	0.0074	0.0038
Final Filter Weights(g)				
Weight #1	3.3528	3.7247	3.6836	3.3688
Weight #2				
Weight #3				
Weight #4				
Average Final Weight	3.3528	3.7247	3.6836	3.3688
Final Filter Weight	3.3528	3.7247	3.6836	3.3688
Filter Tare Weight	3.2926	3.6656	3.6179	3.3684
Filter Blank	0.0004	0.0004	0.0004	0.0004
Filter Particulate Weight	0.0598	0.0587	0.0653	
Liquid Particulate Weight	0.0278	0.0132	0.0074	
Net Particulate Weight(g)	0.0876	0.0719	0.0727	

CHAIN-OF-CUSTODY FORM

CLIENT Chi-Vit Corp. WORK ORDER NO. 6423-01-01

FACILITY Leesburg, AL. DATE 4/12/91

DESCRIPTION OF SAMPLES Particulate Filters, Probe Washes, & Blanks

NAME OF INDIVIDUAL COLLECTING SAMPLES [redacted], Mitch Newman

	RECEIVED BY	RECEIVED FROM	DATE	TIME	NO. SAMPLES
1.	C. Lloyd	Mitch Newman	4/12/91	1055	3+1 blk
2.					
3.					
4.					

SAMPLES COLLECTED

SAMPLE ID	LAB NO	SAMPLE ID	LAB NO
C21302			
C21303			
C21304			
C21305			

Sample Description On Back? YES

Mitch Newman
Signed Date

CONDITION OF SAMPLES ON ARRIVAL

Shipping Box Damaged? —

Security Tape Intact? NO

Any Sample Containers Open? NO

Any Sample Containers Damaged? —

Comments Hand Delivered

Samples Stored Chem Lab

Form Complete ✓

C. Lloyd 4/12/91
Signed Date

TAS-09-5/89

WESTON

SAMPLE ID	DESCRIPTION
CZ 1302	PARTICULATE FILTER RUN # 1
CZ 1302	PROBE WASH RUN # 1
CZ 1303	PARTICULATE FILTER RUN # 2
CZ 1303	PROBE WASH RUN # 2
CZ 1304	PARTICULATE FILTER RUN # 3
CZ 1304	PROBE WASH RUN # 3
CZ 1305	PARTICULATE FILTER BLANK
CZ 1305	PROBE WASH BLANK

APPENDIX D. SAMPLE CALCULATIONS

SAMPLE CALCULATIONS

Frit Unit No. 2
Scrubber No. 2
Run No. 1

I. Meter Pressure (Pm), in. Hg

Pm = Pb + (Delta H)/(13.6 in. H20/in. Hg)

where, Pb = barometric pressure, in. Hg
Delta H = pressure differential of orifice, in. H20

$$Pm = 30.10 \text{ in. Hg} + \frac{1.214 \text{ in.H20}}{13.6 \text{ in. H20/in. Hg}} = 30.19 \text{ in. Hg}$$

II. Standard Meter Volume (Vmstd), ft^3

$$Vmstd = \frac{17.64\ °R/\text{in. Hg} \times Y \times Vm \times Pm}{Tm}$$

where, Y = meter correction factor
Vm = meter volume, ft^3
Pm = meter pressure, in. Hg
Tm = meter temperature, °R

$$Vmstd = \frac{17.64\ °R/\text{in. Hg} \times 1.010 \times 36.875\ \text{ft}^3 \times 30.19\ \text{in. Hg}}{548\ °R} = 36.173\ \text{ft}^3$$

III. Standard Wet Volume (Vwstd), ft^3

Vwstd = 0.04707 ft^3/mL x Vlc

where, Vlc = volume of water collected, mL

Vwstd = 0.04707 ft^3/mL x 205.0 mL = 9.649 ft^3

IV. Moisture Fraction (Measured) (Bws)

$$Bws = \frac{Vwstd}{(Vwstd + Vmstd)} = \frac{9.649\ \text{ft}^3}{9.649\ \text{ft}^3 + 36.173\ \text{ft}^3} = 0.211$$

V. Molecular Weight (Ms), lb/lb-mole

Ms = [0.44 %CO2 + 0.32 %O2 + 0.28 (100 - %CO2 - %O2)] (1 - Bws) + 18 Bws

Ms = [(0.44 x 2.0)+(0.32 x 17.0) + (0.28 x (100 - 2.0 - 17.0))]

x (1 - 0.211) + 18(0.211) = 26.7 lb/lb-mole

VI. Average Velocity (Vs), ft/sec

```
         ft      (lb/lb-mole)(in. Hg)                                                  Ts
Vs= 85.49 ---  [ -------------------- ]^½   x  Cp  x  ((Delta P)^½)avg x (-----------)^½
         sec        (°R) (in. H2O)                                                  Ps x Ms
```

where, Cp = pitot tube coefficient
Delta P = velocity head of stack gas, in. H2O
Ts = absolute stack temperature, °R
Ps = absolute stack gas pressure, in. Hg
Ms = molecular weight of stack gas

```
         ft      (lb/lb-mole)(in. Hg)
Vs= 85.49 ---  [ -------------------- ]^½ x   0.84 x        0.6428 (in. H2O)^½
         sec        (°R) (in. H2O)

                             608 °R
       x  [-----------------------------------------]^½ =   40.1 ft/sec
             30.13 in. Hg x     26.7 lb/lb-mole
```

VII. Average Stack Gas Flow at Stack Conditions (Qa), ft^3/min

Qa = 60 sec/min x Vs x As   where, Vs = stack gas velocity, ft/sec
As = cross-sectional area of stack, ft^2

Qa = 60 sec/min x 40.1 ft/sec x 5.59 ft^2

Qa = 1.34E+04 ft^3/min

SAMPLE CALCULATIONS (continued)

VIII. Average Stack Gas Flow at Standard Conditions (Qs), ft^3/min

$$Qs = 17.64 \frac{°R}{in.\ Hg} \times Qa \times (1 - Bws) \times \frac{Ps}{Ts}$$

where, Qa = average stack gas flow at stack conditions, ft^3/min
Bws = moisture content
Ps = absolute stack gas pressure, in. Hg
Ts = absolute stack temperature, °R

$$Qs = 17.64 \frac{°R}{in.\ Hg} \times 1.34E{+}04 \frac{ft^3}{min} \times (1 - 0.211) \times \frac{30.13\ in.\ Hg}{608\ °R}$$

Qs = 9.29E+03 ft^3/min

IX. Percent Isokinetic Sampling Rate (% I)

$$\%\ I = \frac{0.0945\ (in.\ Hg)(min)/(°R)(sec) \times Ts \times Vmstd}{Ps \times Vs \times An \times \theta \times (1 - Bws)}$$

where, Ts = average stack temperature, °R
Vmstd = standard meter volume, ft^3
Ps = stack gas pressure, in. Hg
Vs = stack gas velocity, ft/sec
An = cross-sectional area of nozzle, ft^2
θ = total sampling time, min
Bws = moisture content

$$\%\ I = \frac{0.0945\ (in.\ Hg)(min)/(°R)(sec) \times 608\ °R \times 36.173\ ft^3}{30.13\ in.\ Hg \times 40.1\ ft/sec \times 3.35E{-}04\ ft^2 \times 60\ min \times (1 - 0.211)}$$

% I = 108

SAMPLE CALCULATIONS (continued)

X. Particulate Concentration at Standard Conditions (Cs), gr/ft^3

$$Cs = 15.43 \frac{gr}{g} \times \frac{Mn}{Vmstd}$$

where, Mn = particulate matter collected, g
Vmstd = standard meter volume, ft^3

$$Cs = 15.43 \frac{gr}{g} \times \frac{0.0876\ g}{36.173\ ft^3} = 0.037\ gr/ft^3$$

XI. Particulate Emission Rate (PMR), lb/hr

$$PMR = 0.00857 \frac{(lb)(min)}{(gr)(hr)} \times Cs \times Qs$$

where, Cs = particulate concentration at standard conditions, gr/ft^3
Qs = average stack gas flow at standard conditions, ft^3/min

$$PMR = 0.00857 \frac{(lb)(min)}{(gr)(hr)} \times 0.037 \frac{gr}{ft^3} \times 9.29E+03 \frac{ft^3}{min}$$

PMR = 3.0 lb/hr

XII. Permit Limit, lb/hr

From ADEM Rules and Regulations Section 4.4.1 for processes producing less than 30 ton/day:

Emission Limit, lb/hr = 3.59 X Production Rate^0.62

Production Rate = 1 ton/hr

Emission Limit, lb/hr = (3.59)(1)^0.62 = 3.59

APPENDIX E. PROCESS OPERATING DATA

CHI-VIT CORPORATION LEESBURG, AL

OPERATOR: BOBBY GRIMES

NORTH STACK #2

UNIT: #2 FRIT UNIT

ALA PERMIT: 3-03-0001-Z003

PRODUCT: A-1578

PORCELAIN ENAMEL FRIT

DATE	TIME	FEED RATE	CFH GAS USEAGE	VENTURI PRES. DROP	TOTAL GAS AND AIR CFH
4-11-91	8 AM	1 T/H	12100	40	133,100
	9 AM	1 T/H	12100	40	133,100
	10 AM	1 T/H	12100	39	133,100
	11 AM	1 T/H	12100	39	133,100
	12 PM	1 T/H	11600	38	127,600
	1 PM	1 T/H	11600	38	127,600
	2 PM	1 T/H	11600	38	127,600
	3 PM	1 T/H	11600	38	127,600
	4 PM	1 T/H	11600	38	127,600

APPENDIX F. CERTIFICATIONS, CALIBRATIONS, AND REPRESENTATIONS

METHOD 5 METER BOX CALIBRATION

CLIENT Initial 3 Point PROJECT NUMBER ______ $\overline{\Delta H}$ 0.75, 2.0, 6.0 HIGHEST VACUUM 0

DATE 12-21-90 CONSOLE # A07 METER # 5m-1 P_B 30.24 γ_{STD} 0.9918 CALIBRATED BY L.O.7

			STANDARD METER						DRY TEST METER				
ΔH	Θ	VAC	V_{SF}	V_{SI}	V_S	T_{SI} / T_{SF}	T_S	P_S	V_{DF}	V_{DI}	V_D	T_{DI} / T_{DF}	T_D
2.0	7.0	0	43.972	38.630	5.342	67 / 68	67.5	-0.2	747.038	741.804	5.234	68 / 70	69
0.75	16.0	0	95.190	87.565	7.625	68 / 68	68	0.0	797.658	789.951	7.707	81 / 82	81.5
6.0	9.0	0	128.770	116.916	11.854	68 / 68	68	-6.5	831.002	819.210	11.792	85 / 87	86

$$\gamma_i = \frac{V_S (P_B + P_S/13.6)(T_D + 460)\,\gamma_{STD}}{V_D (P_B + \Delta H/13.6)(T_S + 460)}$$

$$\Delta H@ = \frac{0.0319\,\Delta H}{P_B (T_D + 460)}\left[\frac{(T_S + 460)\Theta}{V_S\,\gamma_{STD}}\right]^2$$

ΔH	γ_i CALCULATION	γ_i	ΔH@ CALCULATION	ΔH@
	(+ /13.6) (+ 460) / (+ /13.6) (+ 460)	1.010	0.0319 ( ) / (+ 460) [(+ 460) / ( )( )]	1.937
		1.005		1.823
		1.015		1.894
		1.010 ✓		1.885 ✓

Are Individual Values for ΔH@ ±0.02 from $\overline{\Delta H@}$ Y

ARE INDIVIDUAL VALUES FOR γ_i ±0.02 FROM $\overline{\gamma}$? Y

DATA CHECKED BY /DATE: 1/8/91 [signature]

QC REQUIREMENTS

1) LEAK CHECK STANDARD METER UP TO COARSE ADJUST VALVE UNDER POSITIVE PRESSURE – 0.5 INCHES H_2O.
2) ALLOW 15 MINUTE WARM-UP BEFORE BEGINNING CALIBRATION AND RE-VERIFY $\overline{\Delta H}$ AND VACUUM.
3) MAINTAIN CONSTANT ΔH.

C:MARKET\AIR\CALIBRAT TAR-19 1/90

WESTON MANAGERS DESIGNERS CONSULTANTS

METHOD 5 METER BOX CALIBRATION

CLIENT CHI-VIT Corp. PROJECT NUMBER 6423-01-01 $\overline{\Delta H}$ 1.2 HIGHEST VACUUM 4

DATE 4/15/91 CONSOLE # A07 METER # SM-1 P_B 30.08 γ_{STD} .9918 CALIBRATED BY 28

ΔH	Θ	VAC	STANDARD METER V_{SF}	V_{SI}	V_S	T_{SI} / T_{SF}	T_S	P_S	DRY TEST METER V_{DF}	V_{DI}	V_D	T_{DI} / T_{DF}	T_D
1.2	9.0	5	785.423	779.729	5.694	78 / 79	78.5	-0.015	178.924	173.197	5.727	86 / 89	87.5
1.2	9.0	5	791.080	785.423	5.657	79 / 79	79	-0.01	184.622	178.924	5.698	88 / 89	88.5
1.2	9.0	5	796.470	791.080	5.390	79 / 79	79	-0.01	190.050	184.622	5.428	89 / 90	89.5

$$\gamma_i = \frac{V_S (P_B + P_S/13.6)(T_D + 460)\,\gamma_{STD}}{V_D (P_B + \Delta H/13.6)(T_S + 460)}$$

$$\Delta H@ = \frac{0.0319\,\Delta H}{P_B (T_D + 460)}\left[\frac{(T_S + 460)\Theta}{V_S\,\gamma_{STD}}\right]^2$$

ΔH	γ_i CALCULATION	γ_i	$\Delta H@$ CALCULATION	$\Delta H@$
	(+ /13.6) (+ 460) / (+ /13.6) (+ 460)	.9996	0.0319 ( ) / (+ 460) [(+ 460) / ( )( )]	1.7119
		.9991		1.7344
		1.0011		1.9071
		.9999		1.7845

$\bar{\gamma}$ FROM LAST FULL CALIBRATION: 1.010

IS THIS $\bar{\gamma}$ WITHIN 5%? Y

ARE INDIVIDUAL VALUES FOR γ_i ± .2% FROM $\bar{\gamma}$? Y

DATA CHECKED BY /DATE: M. Owen / 4/19/91

QC REQUIREMENTS

1) LEAK CHECK STANDARD METER UP TO COARSE ADJUST VALVE UNDER POSITIVE PRESSURE ~ 0.5 INCHES H_2O.

2) ALLOW 15 MINUTE WARM-UP BEFORE BEGINNING CALIBRATION AND RE-VERIFY $\overline{\Delta H}$ AND VACUUM.

3) MAINTAIN CONSTANT ΔH.

C:\MARKET AIR\CALIBRAT TAR-19 1/90

WESTON

DRY GAS METER TEMPERATURE SENSOR CALIBRATION DATA FORM
Reference: Digital Thermometer - Wahl Model C-65 NIST

Thermocouple Number: A07
Date: 10 January 1991
Ambient Temperature, °F: 66
Calibrator: Jeff Hollingworth

Reference Point Number		Reference Temperature, °F	Thermocouple Potentiometer Temperature, °F	Temperature Difference, °F
1	A	144.5	148.0	3.5
	B	144.1	148.0	3.9
	C	144.0	148.2	4.2
2	A	69.1	70.0	0.9
	B	69.4	70.2	0.8
	C	69.5	70.3	0.8

Are all temperature differences less than 5.4°F ? Yes

****

POSTTEST DRY GAS METER TEMPERATURE SENSOR CALIBRATION DATA

Client: ____________
Work Order Number: ____________
Date: ____________
Calibrator: ____________

Reference Point	Reference Temperature, °F	Thermocouple Potentiometer Temperature, °F	Temperature Difference, °F
Ambient	76.3	79.9	3.6

Was a pretest temperature correction used? ____Yes ✓ No

Is temperature difference within 10.8 °F ? (Yes)

If no, is meter thermocouple temperature higher? __________

If no, temperature correction: ____________ (Within 5.4 °F over range)

i:\a503\initcal\ao7.wk1

STACK TEMPERATURE SENSOR CALIBRATION DATA FORM
Reference: Digital Thermometer - Wahl Model C-65 NIST

Thermocouple Number: PR 3-1
Date: 17 January 1991
Calibrator: Wayne Prather

Reference Point Number		Reference Temperature, °F	Thermocouple Potentiometer Temperature, °F	Temperature Difference, %
1	A	32.5	32.9	0.08
	B	32.5	32.7	0.04
	C	32.3	32.7	0.08
2	A	214.0	213.0	0.15
	B	214.2	213.1	0.16
	C	214.1	213.1	0.15
3	A	448.2	443.3	0.54
	B	449.9	442.9	0.77
	C	449.5	445.0	0.49

$$\text{Temp Diff (\%)} = \left| \frac{(\text{Ref Temp, °F} + 460) - (\text{Therm Pot Temp, °F} + 460)}{\text{Ref Temp, °F} + 460} \right| \times 100$$

Are all temperature differences less than 1.5 % ? Yes

****

POSTTEST STACK TEMPERATURE SENSOR CALIBRATION DATA

Client: CHI-VIT
Work Order Number: 6423-01-01
Date: 4/15/91
Calibrator: Smith

Avg Stack Temp, °F	Reference Temperature, °F	Thermocouple Temperature, °F	Temperature Difference, %
146	74.8	75.5	0.13

Was a pretest temperature correction used? ____Yes ✓ No

Is temperature difference within 1.5 % ? (Yes)

If no, calculations done once with recorded values and once with corrected values. ____________

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PITOT TUBE CALIBRATION

DATE 3/29/91

PITOT TUBE ID NO. P-21

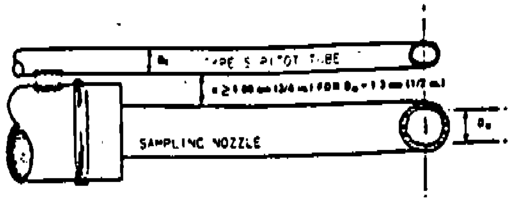
PROBE ID NO. N/A

PITOT TUBE ASSEMBLY LEVEL? ✓ yes ____ no

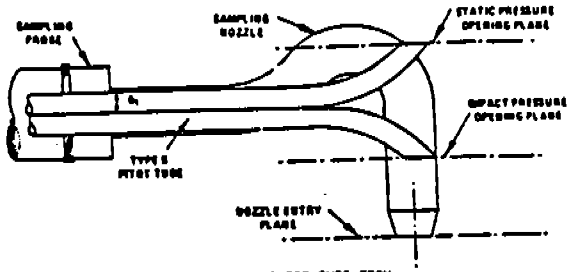
PITOT TUBE OPENINGS DAMAGED? ____ yes ✓ no

PITOT TUBE COEFFICIENT 0.84? ✓ yes ____ no

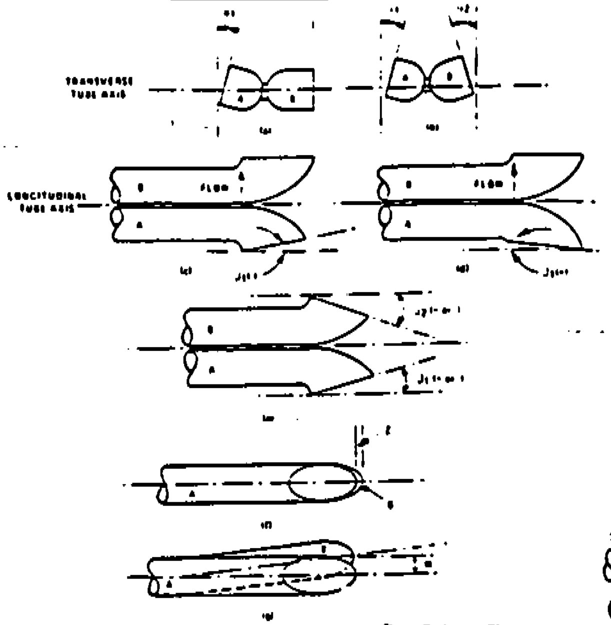
CHECKED BY MC

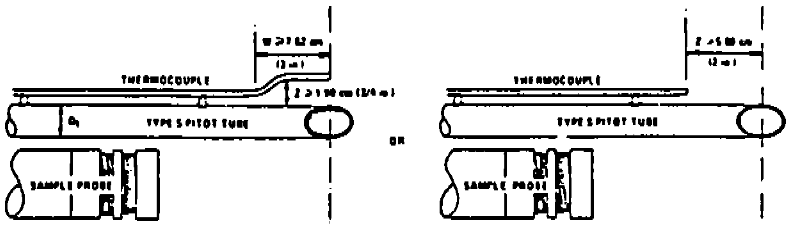


A. BOTTOM VIEW: SHOWING MINIMUM PITOT-NOZZLE SEPARATION.



B. SIDE VIEW: TO PREVENT PITOT TUBE FROM INTERFERING WITH GAS FLOW STREAMLINES APPROACHING THE NOZZLE, THE IMPACT PRESSURE OPENING PLANE OF THE PITOT TUBE SHALL BE EVEN WITH OR ABOVE THE NOZZLE ENTRY PLANE.





Proper thermocouple placement to prevent interference. D_t between 0.48 and 0.95 cm (3/16 and 3/8 in.)

α_1 = 0 ° (<10°), α_2 = 0 ° (<10°),

β_1 = 1.5 ° (<5°), β_2 = 0.5 ° (<5°)

γ = 1.0 °, Θ = 0.5 °, A = 0.925 (in.)

Z = A sin γ = 0.0161 (in.); <0.125

w = A sin Θ = 0.0081 (in.); <0.031

P_A 0.471 (in.) P_B 0.454 (in.)

D_t = 0.365 (in.)

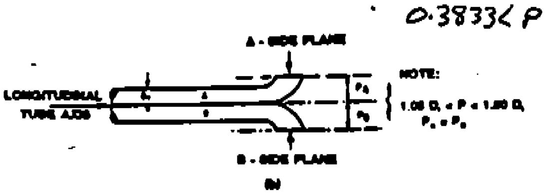
$1.05 D_T < P < 1.50 D_T$

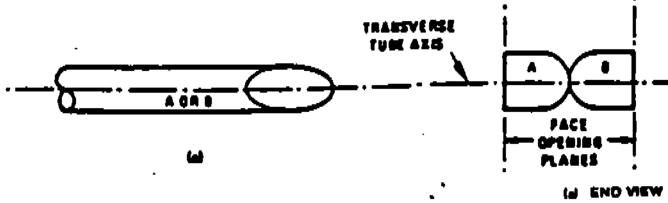
$0.3833 < P < .5475$

X = ________ (in.); ≥0.750

Z = ________ (in.); ≥2.0

Y = ________ (in.); ≥3.0





POSTTEST CHECK

Client CHI-VIT Corp.

Work Order No. 6423-01-01

Date 4/18/91

Damage Found? ____ yes ✓ no

Checked by [signature]

Comments ________

Page ____ of ____

5.1-M:\ADMIN\FORMS\TAR-20.FRM TAR-20 3/91

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