Note: This is a reference cited in *AP 42, Compilation of Air Pollutant Emission Factors, Volume I Stationary Point and Area Sources.* AP42 is located on the EPA web site at www.epa.gov/ttn/chief/ap42/

The file name refers to the reference number, the AP42 chapter and section. The file name "ref02_c01s02.pdf" would mean the reference is from AP42 chapter 1 section 2. The reference may be from a previous version of the section and no longer cited. The primary source should always be checked.

AP42 Section:	11.3
Reference:	15
Title:	Source Emission Test At Belden Brick, Inc., Sugarcreek, OH, No. 1 Kiln, Plant 3, CSA Company, Alliance, OH, July 21, 1989.

AP-42 Section 11.3
Reference 15

CSA COMPANY

(Custom Stack Analysis)

ENGINEERING REPORT

SOURCE EMISSION TESTS
AT
BELDEN BRICK INC.
SUGARCREEK, OHIO
JULY 21, 1989
NO. 1 KILN PLANT3

TECHNICAL SERVICES FOR POLLUTION CONTROL
SOURCE TESTING - LAB SERVICE - BOILER CONSULTING

CONTENTS

BRIEF OF TESTS	1
RESULTS	1
TEST METHODS	1
PARTICULATE TEST APPARATUS	2
PARTICULATE TEST PROCEEDURES	3
SULFUR DIOXIDE PROCEEDURES	4
NITROGEN OXIDES TEST APPARATUS AND PROCEEDURES	4
NITROGEN OXIDE LAB ANALYSIS	5
COMPILED DATA	7
LOCATION OF SAMPLE PORTS AND POINTS	8
SCEMATIC OF METHOD 5 APPARATUS	9
SCEMATIC OF INTEGRATED SAMPLER	10
SCEMATIC OF NO_x APPARATUS	11
APPENDIX I	
COMPUTER NOMENCLATURE	12
CALCULATION FORMULA	13
RAW DATA AND CALCULATONS FOR M-5 AND SO_2	
TEST 1	14 - 16
TEST 2	17 - 19
TEST 3	20 - 22
APPENDIX II	
NO_X RAW DATA AND CALCULATIONS	23 - 28
APPENDIX III	
INTENT TO TEST NOTIFICATION	29 - 41

C. S. A. Co.
24385 Center Road
P. O. Box 3750
ALLIANCE, OH 44601

SOURCE EMISSION TESTS

AT

BELDEN BRICK INC.

SUGARCREEK, OHIO

JULY 21, 1989

Brief of Tests

Particulate emission tests were performed on the stack of the brick kiln as per EPA Federal Register methods 1 through 5 and method 7 as set forth in the Appendix to Part 60, "Standards of Performance for stationary sources", Subchapter C, Chapter 1, Title 40, Volume 42, No. 160, Thursday, August 18, 1977 as amended from the original Federal Register, Volume 36, No. 247, December 23, 1971. The number of traverse points used for method 1 was as per Federal Register Volume 48, No. 191, Friday, September 30, 1983. Sulfur dioxide tests were a part of the method 5 tests as approved by the administrator.

The tunnel kiln is a continuos operation where the green product is loaded on cars that travel through the various heat zones and discharge as a finished product at the other end. The kiln is heated with natural gas with the proudcts of combustion and the emissions from the curring process discharging to a stack via induced draft fan.

Results

A) The particulate emission rate was 3.03 pounds per hour.

B) The sulfur dioxide emission rate was 3.71 pounds per hour.

C) The nitrogen oxides emission rate was 2.85 pounds per hour.

D) The process weight rate was 21,533 pounds per hour.

Test Methods

A twelve point traverse was selected for the ~~thirty five~~ FORTY-FOUR inch square brick stack as per method 1. Each point was sampled for five minutes for a total test time of 60 minutes. (See figure 1) The CO_2 and O_2 analysis were conducted by an orsat flue gas analyzer from an integrated sample taken at the test ports to provide data for method 3.

Method 5 was used to determine the particulate quantity, moisture determination by method 4 and gas velocity by method 2 using a Research Appliance Corp. "Stacksamplr". The impinger catch was used for the sulfur dioxide determination by replacing the distilled water with the same hydrogen peroxide solution as is used in the method 8 SO_x proceedure.

The nitrogen oxides were determined by EPA method 7.

Particulate Test Apparatus

A schematic of the apparatus is shown in figure 2.

The dust laden gases were passed through a pyrex lined probe and heated glass cyclone separator bypass followed by a four inch filter holder containing Gelman Type A-E fiberglass filter media. The gases leaving the filter were cooled in a series of three impingers packed in ice. The first and third impinger were the modified Greenburg-Smith type and the second one was a standard Greenburg-Smith. The First and second impingers were filled with 100 ml of hydrogen peroxide with the third one used as a dry trap. After leaving the dry trap, the gases passed through a "Drierite" column containing about 500 grams of calcium sulfate (CaS04) desicant to remove the remaining water vapor. The dry gas passed through the hose portion of the umbilical cord to a Research Appliance Corp. model 2343 "Stacksamplr" module. In the module the gas was moved through the system by a leakless air pump to a rockwill 175-S dry test meter. The dry test meter exhausted to a calibrated orifice to measure the flow rate of the gases passing through the sampling apparatus. A type "S" pitot tube was attached to the sheath of the heated probe to measure the velocity head of the flue gases near the tip of the probe nozzle. The orifice pressure taps and the pitot tube were connected to a Dwyer dual 10 inch combination inclined well type manometer. One half of the manometer measured the orifice differential (ΔH) and the other half measured the flue gas velocity head (ΔP).

The temperature of the flue gas was measured by a type "K" thermocouple connected to a PyroMation digital temperature indicator.

The CO_2 and 0_2 were measured with a Burrell "Industro" Model

B orsat from an integrated sample taken by withdrawing a constant flow rate of gas from the stack and injecting it into a Tedlar bag. This was done by drawing the gas through an in-stack filter via neoprene tubing to a condenser and condensate collector ahead of a leakless diaphragm vacuum-pressure pump. The pump discharged to the rotometer and the Tedlar bag. The apparatus is equipped with valves to by-pass the rotometer and bag when clearing the sample line as shown in figure 3.

Particulate Test Procedures

The probe, filter and glassware was assembled and leak tested in our lab before transporting to the job site. Three sets of equipment were used. At the job site a preliminary pitot traverse was performed to select the proper nozzle size. The nozzles were measured with an inside vernier caliper and micrometer calibrated with a one inch micrometer standard.

The first and second impingers were filled with 100 ml of 3% hydrogen peroxide and the "Drierite" columns were connected just prior to elevating the probe into position.

After leak testing the apparatus at 10 inches of mercury the probe was inserted at the first sample point to start the test.

The isokinetic sampling rates were determined using a portable desk top computer programmed to calculate the proper ΔH setting at the flue gas temperature, pressure, density and the assumed moisture along with the temperature, ΔP and an assumed ΔH of the test module.

The sampling rate (ΔH) can be determined in less than 5 seconds using this technique.

The apparatus was leak tested after the test was completed at a vacuum exceeding that encountered during the test.

The moisture content was determined from the amount of condensate collected in the impingers and the difference of the tare and gross weight of the "Drierite" desicant column. The desicant column was weighed on an Ohaus 5 Kg industrial lab balance to the nearest half gram.

The filter media was dried in a desicator at room temperature to dryness before tare and gross weighing on a Stanton CL4D analytical

balance.

The probe liner, nozzle, cyclone bypass and front half of the filter holder were washed with acetone and brush after testing and evaporated to dryness at room temperature in 500 ml beakers. The beakers were dried and tare weighed prior to sample evaporation and gross weighed after allowing the samples to desicate to dryness. These weights were accomplished with the Stanton Balance.

The contents of the impingers were measured in a 500 ml graduate and poured into a 1000 ml volumetric flask. The impingers, connecting glassware and beaker were washed with distilled water and placed into the flask. Ten ml aloquots were used for the sulfur dioxide titrations.

The integrated gas sampler was started at the beginning of the method 5 test with about two cubic foot of gas collected in the tedlar bag at the end of the test. The sampling rate was maintained constant during the test by maintaining a constant reading on the rotometer.

The orsat analysis was performed on the gases contained in the bag shortly after the test was completed.

The raw data and calculations are shown in Appendix I.

Sulfur dioxide test proceedures

The samples were titrated as per EPA Federal Register methods using barium perclorate titrant and thorin indicator. The barium perclorate was standardized against a purchased .01 normal sulfuric acid standard. The dry gas volumetric flow rate (Q-CFH) from method 5 was used to calculate the pounds per hour of sulfur dioxide emission.

The calculations are shown in Appendix I.

NOx Apparatus & Procedure

The NOx sampling apparatus is shown in figure 4. Prior to testing the absorbing solution was made by adding 2-8 ml of concentrated H_2SO_4 to 1 liter of deionized, distilled water. After mixing, 6 ml of 3 per cent H_2O_2 was added. This solution was made just prior to testing and was stored in a dark glass bottle away from sunlight. 25 ml of this solution was used for each test. Four tests were performed during each of the three method 5 tests. The raw data and calculations are shown in Appendix II.

Before taking a sample the system was leak checked by evacuating the flask to the maximum vacuum and closing the valve to the pump with the three way stopcock left in the evacuate position and the one way stopcock open. The system was considered leak-free if the vacuum remained the same for a period of one minute. The reading indicated on the manometer was recorded along with the temperature of the flask.

The contents in the flask were shaken for at least five minutes after collecting the sample. The samples were contained in the flask for at least sixteen hours before transferring to plastic bottles. The flasks were rinsed twice with about five ml portions of distilled water that was added to the plastic bottle. The pH of the contents of the plastic bottle was adjusted to about ten with one normal sodium hydroxide. The bottles were marked and sealed for transport. The barometric pressures were obtained from the local airport and corrected for elevation.

NOx Lab Analysis

1) Spectrophotometer Calibration

The spectrophotometer was turned on and allowed to warm up for about one hour prior to calibrating with a didymium calibrating standard along with the procedures of standard practice for the Perkin-Elmer model 44 linear absorbance spectrophotometer.

A KNO_3 standard solution was made by dissolving 2.198 grams of dries KNO_3 in one liter of distilled deionized water in a 1,000 ml volumetric flask. Ten ml of this solution was dilluted to 100 ml in a 100 ml volumetric flask to use as a working standard were one ml is equal to 100 m-grams NO_2.

The spectrophotometer calibration factor was made by adding 0, 1,2,3 & 4 ml of the standard working solution to a series of five porcelain evaporating dishes along with 25 ml of the absorbing solution and 10 ml of distilled water. The pH of this solution was adjusted to about 10 by adding NaOH (1N) before evaporating to dryness on a steam bath. After drying and cooling 2 ml of phenoldisulfonic acid was added to the residue. 1 ml of distilled water and four drops of concentrated sulfuric acid was added and titrated throughly with a polyethylene policeman. This solution was stirred while being heated for about 3 minutes on the

steam bath. After cooling, 20 ml of distilled water was added and mixed well. Concentrated NH_4OH was added dropwise with constant stirring until the pH was 10 by pH paper. This solution was added to 100 ml volumetric flasks and dilluted to the mark with distilled water. The contents were mixed throughly before transferring a portion to the 25 x 105 mm round spectrophotometer cuvettes. The absorbance of each of the solutions was measured and recorded at 410 nm wave length using the 0 ml sample as the blank. The blank sample showed the same absorbance as the distilled water. The absorbance for each standard is shown on the data sheetin Appendix II.

2) Sample Analysis

All samples were returned with none of the liquid lost in transit. The contents of the plastic bottles were transfered to 50 ml volumetric flasks and rinsed twice with 5 mlportions of distilled water, then dilluted to the mark with distilled water and mixed throughly. A 25 ml aliquot was piped into the 250 ml porcelain evaporating dish and evaporated to dryness on the steam bath. Since there were no solids in the solution the remaining procedures were performed the same as the calibration standards.

All equipment and reagents used in this test are in compliance with the Federal Register, Volume 42, No.160, Thursday, August 18, 1977.

The volume of the 2 liter sample flask was determined by filling the flask to the one way stopcock bore and emptying it into a graduated cyclinder for measurement. This was done with water at room temperature.

The"Intent To Test Notification"is shown in Appendix III

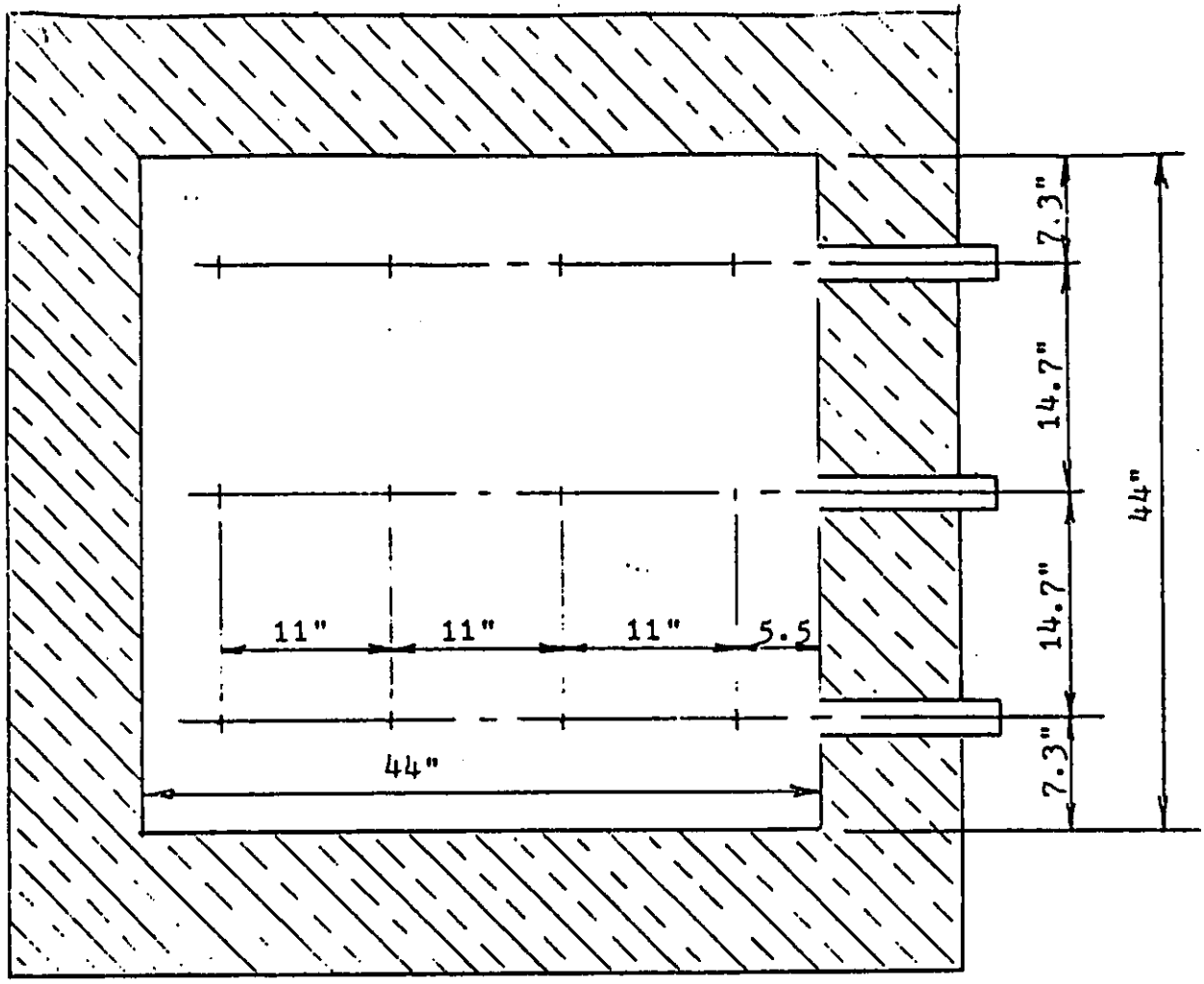
Submitted by

Ernest L.Kolm

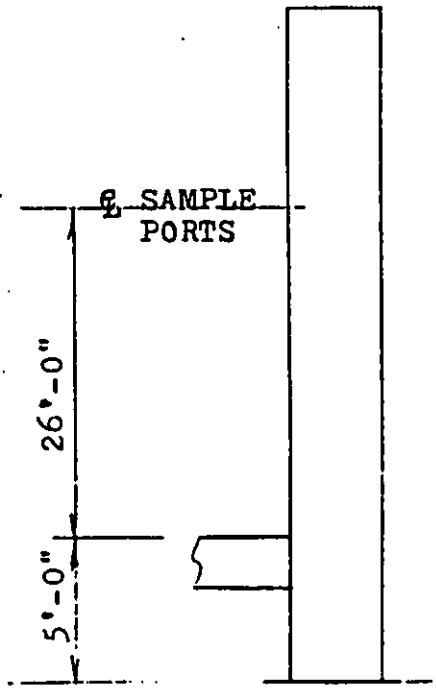
Test	1	2	3	Avg.
Date	7/21/89	7/21/89	7/21/89	
Time	10:00/11:03	11:17/12:20	12:30/13:32	
PARTICULATE QUANTITY				
Grains/f3 Dry STP	0.0202	0.0203	0.0275	0.0227
Pounds/Hr.	2.6463	2.7491	3.6883	3.0279
GASEOUS EMISSIONS				
SO2 Pounds/Hr	3.76	4	3.37	3.71
SO2 Parts/Million	25	26	21.7	24.2333
NOx Pounds/Hr	2.38	2.9	3.26	2.84667
STACK GAS CONDITIONS				
Temperature -dg. F	462	463	471	465.333
Static Pressure-in H2O	0	0	0	0
CO2 - %	2.2	2.5	1.8	2.16667
O2 - %	18.2	17.5	18.8	18.1667
H2O - %	9.67614	9.12614	8.08589	8.96272
Velocity - FPS	37.3275	38.268	37.8661	37.8205
Stack Area - sqr. ft.	13.4	13.4	13.4	13.4
Gas Flow - ACFM	30011	30767	30444	30408
Gas Flow (DSTP) CFH	916504	944292	936951	932582
SAMPLE TRAIN CONDITIONS				
Pitot Delta P in H2O	.241	.254	.247	
Orifice Delta P in H2O	1.42	1.67	1.68	
Temp. Meter - dg. F	85	101	104	
Gas Volume - CF Dry STP	36.5034	38.7029	39.6023	
Barometer - in Hg	29.33	29.33	29.33	
Probe Tip Dia. - in.	.313	.313	.313	
Isokinetic Var. - %	100.319	103.234	106.46	

BELDEN BRICK INC.
SUGARCREEK OH
NO 1 KILN PLANT 3
COMPILED DATA

Table 1

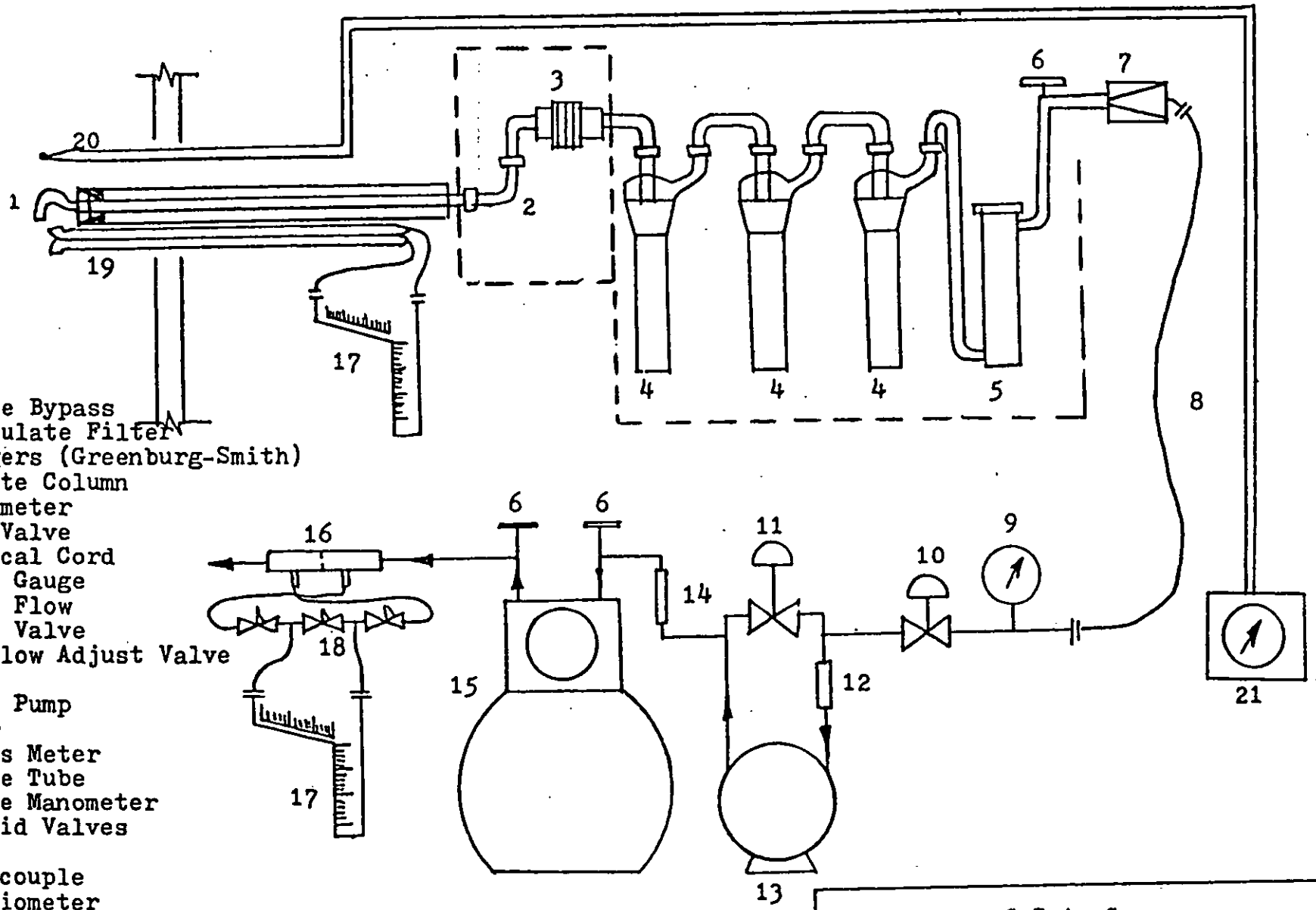


AREA = 13.4 f^2
EQUIVALENT DIA. = 44"
EQUIV. DIA. UPSTREAM = 7.1
EQUIV. DIA. DOWNSTREAM = 2+



BELDEN BRICK

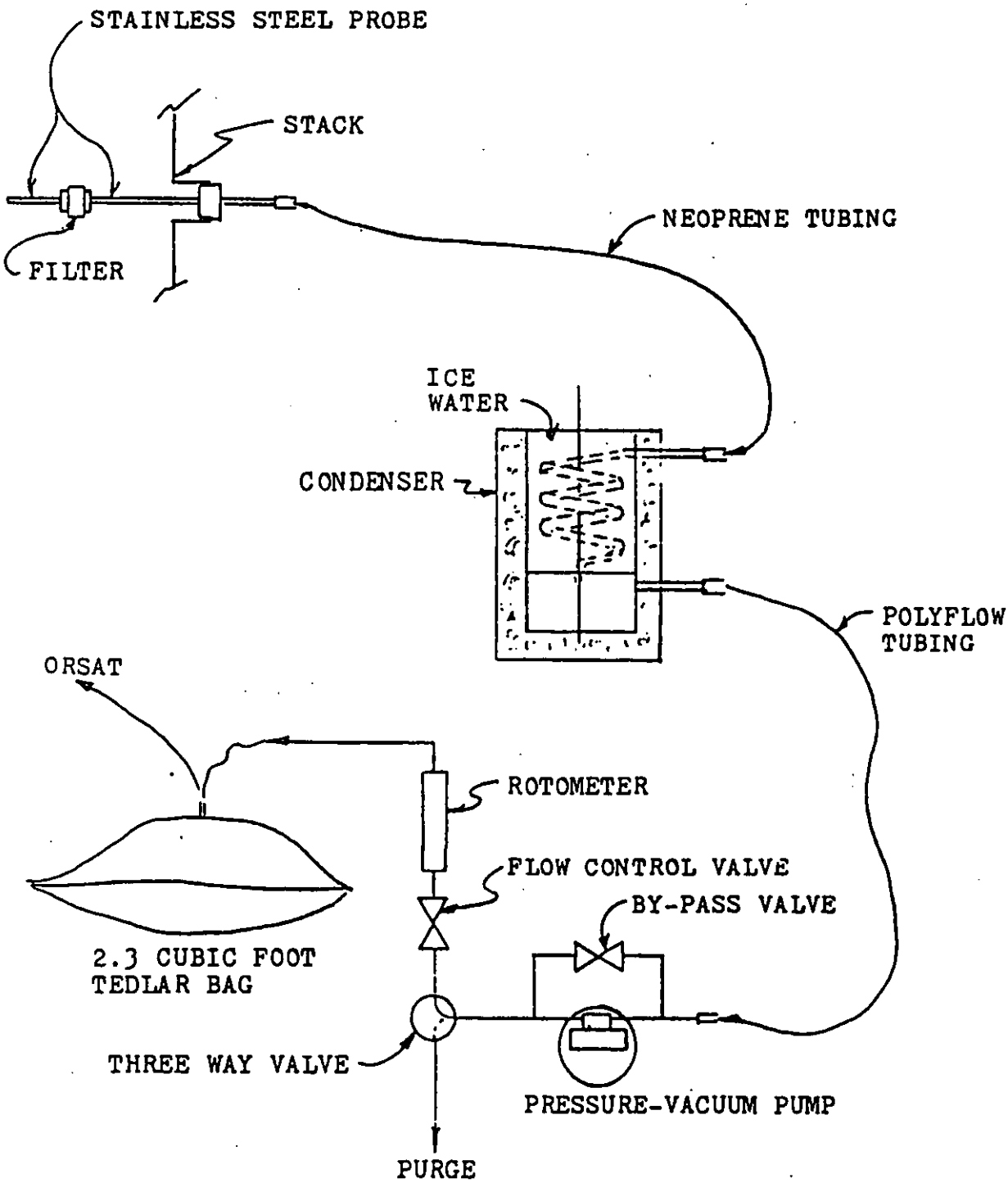
FIGURE 1



1) Probe
2) Cyclone Bypass
3) Particulate Filter
4) Impingers (Greenburg-Smith)
5) Drierite Column
6) Thermometer
7) Check Valve
8) Umbilical Cord
9) Vacuum Gauge
10) Course Flow Adjust Valve
11) Fine Flow Adjust Valve
12) Oiler
13) Vacuum Pump
14) Filter
15) Dry Gas Meter
16) Orifice Tube
17) Incline Manometer
18) Solenoid Valves
19) Pitot
20) Thermocouple
21) Potentiometer

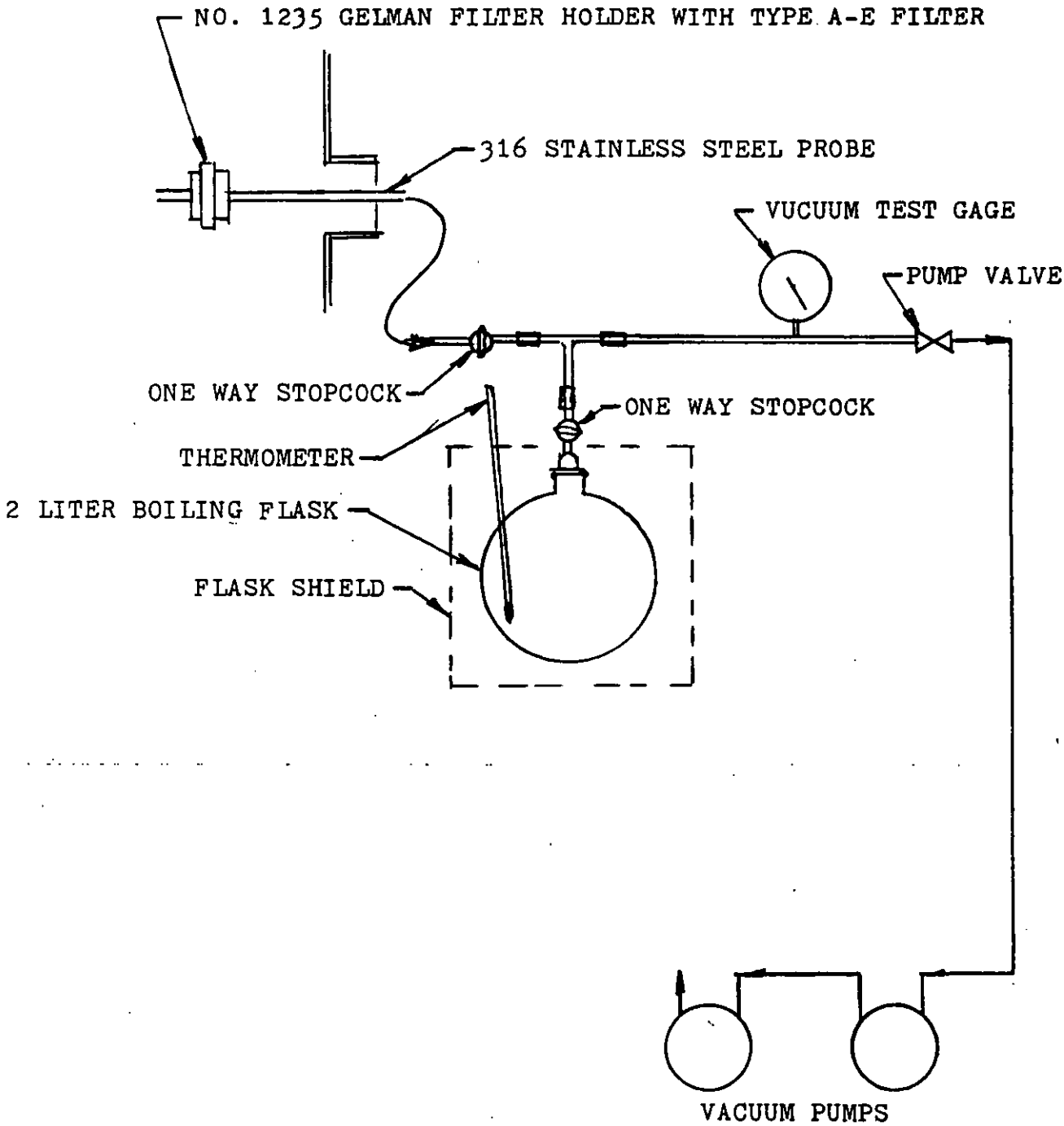
C.S.A. Co.
MODIFICATION OF R.A.C. SAMPLE TRA
USING DRIERITE COLUMN IN PLACE OF
IMPINGER DESICANT

Figure 2



INTEGRATED SAMPLER

FIGURE 3



METHOD 7 NO_X SAMPLE APPARATUS

FIGURE 4

APPENDIX I

COMPUTER NOMENCLATURE

SYMBOL	DESCRIPTION	UNITS
VM, FT^3	METER VOLUME	CUBIC FEET
Pb, IN.H2O	BAROMETER	INCHES MERCURY
ΔH, IN H2O	ORIFICE DIFFERENTIAL	INCHES WATER
PMA, IN Hg	ABSOLUTE METER PRESSURE	INCHES MERCURY
TM, °F	METER TEMPERATURE	DEGREES FARENHEIT
TS, F	STACK TEMPERATURE	DEGREES FARENHEIT
PG, IN H2O	STACK STATIC PRESSURE	INCHES WATER
PSA, IN Hg	ABSOLUTE STACK PRESSURE	INCHES MERCURY
CP,	PITOT COEFFICIENT	DIMENTIONLESS
$\sqrt{\Delta P}$, IN H2O	AVERAGE SQUARE ROOT OF ΔP	INCHES $WATER^{\frac{1}{2}}$
%CO2	CARBON DIOXIDE	PERCENT
%O2	OXYGEN	PERCENT
%CO	CARBON NONOXIDE	PERCENT
%N2	NITROGEN	PERCENT
MD	MOLECULAR WEIGHT DRY	DIMENTIONLESS
VLC,ML	VOLUME OF CONDENSATE	MILLILITERS
AS, FT2	STACK AREA	SQUARE FEET
MN, MG	TOTAL PARTICULATE CATCH WEIGHT	MILLIGRAMS
O, MIN	TEST TIME	MINUTES
DN, IN	NOZZLE DIAMETER	INCHES
AN, FT2	NOZZLE AREA	SQUARE FEET
L, #/HR	EMISSION RATE	POUNDS PER HOUR
I, %	ISOKINETIC VARIATION	PERCENT
VMSTP, FT3	METER VOLUME @ STANDARD TEMP. & PRESS. (DRY)	CUBIC FEET
VWSTP	METER VOLUME @ STANDARD TEMP. & PRESS. (WET)	CUBIC FEET
BWO%	MOISTURE	PERCENT
MS	MOLECULAR WEIGHT @ STACK CONDITIONS	DIMENTIONLESS
VS, FT/SEC	STACK VELOCITY	FEET PER SECOND
QS, FT3/HR	STACK GAS FLOW	CUBIC FEET PER HOUR
CS, #/SCF	EMISSION RATE	LB./DRY F3 @ STP
C"S,GR/SCF	EMISSION RATE	GRAINS/DRY F3 @ STP
C"S12	EMISSION RATE CORRECTED TO 12% CO2	GRAINS/DRY F3 @ STP

CALCULATIONS

Dry Molecular Weight lb/lb-mole

$$Md = 0.44\ (\%CO_2) + 0.32\ (\%O_2) + 0.28\ (\%N_2 + \%\ CO)$$

Dry Gas Volume (standard conditions), ft^3

$$Vmstd = \left(17.71\ \frac{^oR}{in.\ Hg}\right) Vm\left(\frac{Pbar + \frac{\Delta H}{13.6}}{Tm + 460}\right)$$

Volume of Water (standard conditions) ft^3

$$Vwstd = \left(0.0474\ \frac{ft^3}{ml}\right) Vlc$$

Moisture Content (proportion by volume)

$$Bwo = \frac{Vwstd}{Vmstd + Vwstd}$$

Molecular Weight of Stack Gas (wet basis) lb/lb-mole

$$Ms = Md\ (1-Bwo) + 18\ Bwo$$

Stack Gas Velocity, ft/sec

$$Vs = 85.48Cp\sqrt{\Delta P}\sqrt{\frac{Tsa}{Psa\ Ms}}$$

Stack Gas Volumetric Flow Rate dry basis, standard conditions, ft^3/hr

$$Qs = 3600\ (1-Bwo)\ VsAs\ \left(\frac{530}{Tsa}\right)\ \left(\frac{Psa}{29.92}\right)$$

Concentration (particulate matter in stack gas), lb/s.c.f. dry basis

$$Cs = 2.205 \times 10^{-6}\ \frac{Mn}{Vmstd}$$

Load (particulate matter in stack gas), lb/hour

$$L = (Qs)\ (Cs)$$

Isokinetic Variation, %

$$I = \frac{Tsa\ \left(1.667\ \frac{Min}{Sec}\right)\ \left[\left(0.00267\ \frac{in\ Hg\ ft^3}{ml\ ^oR}\right)\ Vlc + \frac{VmPoa}{Tma}\right]}{\Theta\ Vs\ Psa\ An}$$

Concentration (particulate matter in stack gas), gr/s.c.f., dry basis

$$C''s = \left(0.0154\ \frac{gr}{mg}\right)\ \left(\frac{Mn}{Vmstd}\right)$$

Concentration (particulate matter in stack gas), gr/S.C.F., dry basis corrected to 12% CO_2

$$C_{12} = \frac{12\ C''s}{\%CO_2}$$

C.S.A. CO. (EPA METHOD 5) DATA SHEET

TEST NO. 1 PLANT BELDEN BRICK DATE 7/21/89

LOCATION KILN NO 1 STACK, PLANT 3 BY [illegible]

BAROMETER 29.33 AMBIENT TEMP ASSUMED MOISTURE

MODULE NO. 2031 PROBE NO. 4-1 FILTER NO. HEATER NO. 3 NOZZLE DIA. 5/16

TEST POINT	METER VOLUME (Vm)	METER TEMP(Tm) IN	METER TEMP(Tm) OUT	COND TEMP °F	FILTER HEATER TEMP °F	STACK TEMP °F(Ts)	STACK PRESS. (Ps)	VACUUM IN. Hg	ORIFICE (ΔH)(Pm) IN.H_2O	VEL HEAD (ΔP)	TIME
1	42.3	70	70	66	250	449	0	6-	.87	.15	10:00
1	44.8	74	70	58	250	451	0	6-	.87	.15	05
2	47.6	78	72	54	250	454	0	6	1.0	.18	10
3	50.4	82	72	54	250	456	0	6+	.99	.17	15
4	53.0	85	76	52	250	457	0	6+	.93	.16	20
1	53.0	84	78	52	250	458	0	7+	1.5	.20	22
1	56.1	90	79	58	250	461	0	7+	1.5	.25	27
2	59.4	92	80	58	250	463	0	7+	1.5	.25	32
3	61.9	95	82	58	250	464	0	7+	1.5	.25	37
4	65.9	96	84	58	250	465	0	8-	1.6	.27	42
1	65.9	94	84	60	250	465	0	8-	1.6	.25	43
1	69.3	100	86	60	250	469	0	8+	1.7	.30	48
2	73.1	102	88	60	250	471	0	9	1.9	.32	53
3	76.9	104	90	60	250	473	0	9	1.9	.32	58
4	80.6	104	90	60	250	474	0	9	1.9	.32	11:03
TOTAL	38.3	90	80.1								
AVERAGE		85		~	~	462	0	MAX 9	1.42	.241	60 MIN

ORSAT DATA						AVG
TIME	NT			INTEGRATED		
CO2						2.2
O2						18.2
CO						

N_2= 79.6

CONDESATE COLLECTED	FINAL	INITIAL	TOTAL
DRIERITE	960	950.5	9.5
IMPINGER	273	200	73
GRAND TOTAL (Vlw)			82.5

FILTER WEIGHT	PROBE WASH WT	IMPINGER WASH WT	LEAK RATE @ 12 "Hg = <.01
GROSS .6738	185.2361		
TARE .6472	185.2149		AVERAGE $\sqrt{\Delta P}$ = .4907
NET .0266	.0212		

TOTAL PARTICULATE WEIGHT (Mn) 47.8 mg | STACK AREA(As) 13.41 FT2

21,533 LB/HR PROCESS WT

Ohio EPA - Riso

E.P.A. Method 5

DATA INPUT

Pb,In Hg	Barometer	29.33
VM,ft3	Meter Volume	38.3
ΔH,In H2O	Orifice Differential	1.42
PG,In H2O	Stack Static Pressure	0
Tm,F	Meter Temperature	85
Ts,F	Stack Temperature	462
CP	Pitot Coefficient	.84
$\sqrt{\Delta P}$,In H2O	Average Square Root Of Delta P	.4907
% CO2	Carbon Dioxide	2.2
% O2	Oxygen	18.2
% N	Nitrogen	79.6
VCL,Ml	Volume Of Condensate	82.5
AS,ft2	Stack Area	13.4
MN,Mg	Total Particulate Catch Weight	47.8
Ø,Min	Test Time	60
DN,In	Diameter Of Nozzle	.313

RESULTS

Pma,In Hg	Absolute Meter Pressure	29.43
PSA,In Hg	Absolute Stack Pressure	29.33
MD	Molecular Weight Dry Gas	29.08
MS	Molecular Weight @ Stack Conditions	28.01
VMSTP,ft3	VM Standard Temp.& Press. Dry	36.50
VWSTP,ft3	VM Standard Temp.& Press. Wet	3.91
BWO,%	Moisture	9.68
I,%	Isokinetic Variation	100.32
VS,ft/Sec	Stack Velocity	37.33
QA,ASCFM	Stack Gas Flow (Actual)	30011
QS,ft3/Hr	Stack Gas Flow (Dry STP)	916504
L,#/Hr	Emission Rate	2.64629
CS,#/SCF	Particulate Emission	2.88738E-06
C''S,Grn/SCF	Particulate Emission	.0201658
C12,GR/SCF	C''S Corrected to 12% CO_2	.109995

BELDEN BRICK INC
SUGARCREEK OH
KILN NO 1 PLANT 3
7/21/89
TEST 1

COMBINED METHOD 5 & 8

N= NORMALITY OF BARIUM PERCHLORATE TITRANT
VT= VOLUME OF TITRANT, ML
VTB= VOLUME OF TITRANT FOR BLANK, ML
VA= VOLUME OF ALOQUOT SAMPLE, ML
VM= VOLUME OF GAS SAMPLE FROM METHOD 5, VM(DSCF)
VSOLN= TOTAL VOLUME OF SAMPLE SOLUTION, ML
QS= DSCF/HOUR FROM METHOD 5 CALCULATION
DSCF= DRY STANDARD CUBIC FOOT

VM= 36.5

QS= 916504

SULFUR DIOXIDE CONCENTRATION = SO_2 LB/DSCF = S2

N=	.0101
VT=	2.2
VTB=	.1
VA=	10
VM=	36.5
VSOLN=	1000
QS=	916504

S2= (.00007061 x N x (VT-VTB) x VSOLN)/(VM x VA)= 4.10312E-06 LB SO_2/DSCF

SO_2 PPM= 6.037 x MM x S2 = 24.7705

SO_2 LB/HR = QS x S2 = 3.76052

BELDEN BRICK INC
SUGARCREEK OH
KILN NO 1 PLANT 3
7/21/89
TEST 1

C.S.A. CO. (EPA METHOD 5) DATA SHEET

TEST NO. 2 PLANT BELDEN BRICK DATE 7/21/89

LOCATION KILN W/ STACK, PLANT 3 BY [illegible]

BAROMETER 29.33 AMBIENT TEMP ASSUMED MOISTURE

MODULE NO. 2031 PROBE NO. 2-4 FILTER NO. HEATER NO. 4 NOZZLE DIA. 3/8

TEST POINT	METER VOLUME (Vm)	METER TEMP(Tm) IN	METER TEMP(Tm) OUT	COND TEMP °F	FILTER HEATER TEMP °F	STACK TEMP °F(Ts)	STACK PRESS (Ps)	VACUUM IN. Hg	ORIFICE (ΔH)(Pm) IN.H_2O	VEL HEAD (ΔP)	TIME
1	80.9	95	92	70	258	489	0	6-	.80	.18	11:17
1	83.7	98	92	60	250	490		6-	.80	.15	22
2	86.6	100	92	60	250	491		6+	1.2	.19	27
3	89.8	102	94	58	250	498		6+	1.1	.17	32
4	91.7	102	94	58	250	498		5-	.44	.07	37
1	91.7	100	94	58	250	449		7	1.9	.30	38
1	95.0	104	96	58	250	449		7	1.9	.30	43
2	97.3	105	96	58	250	448		7	1.9	.30	48
3	102.6	108	97	60	250	447		7	1.9	.30	53
4	106.1	108	98	60	250	446		7-	1.6	.25	58
1	106.1	106	98	64	250	446		9	2.2	.34	12:00
1	110.3	108	98	60	250	447		9	2.2	.34	05
2	114.2	110	98	60	250	452		9	2.2	.34	10
3	118.6	112	100	60	250	454		10-	2.4	.37	15
4	122.7	114	100	62	250	455		10	2.5	.39	20
TOTAL	41.8	104.8	95.9								
AVERAGE		101		~	~	463	0	MAX 9	1.67	.254	60 MIN

ORSAT DATA	N_2= 80.0					AVG
TIME	①			INTEGRATED		
CO2						2.5
O2						17.5
CO						

CONDESATE COLLECTED	FINAL	INITIAL	TOTAL
DRIERITE	943.0	936.0	7
IMPINGER	275	200	75
GRAND TOTAL (Vlw)			82

FILTER WEIGHT	PROBE WASH WT	IMPINGER WASH WT	LEAK RATE @12 "Hg =<.01
GROSS .6775	193.9030		
TARE .6531	193.8763		AVERAGE $\sqrt{\Delta P}$ = .5035
NET .0244	.0267		

TOTAL PARTICULATE WEIGHT (Mn) 51.1 mg | STACK AREA(As) 13.4 FT^2

* CHANGE

Ohio EPA - Lisa

E.P.A. Method 5

DATA INPUT

Pb,In Hg	Barometer	29.33
VM,ft3	Meter Volume	41.8
ΔH,In H2O	Orifice Differential	1.67
PG,In H2O	Stack Static Pressure	0
Tm,F	Meter Temperature	101
Ts,F	Stack Temperature	463
CP	Pitot Coefficient	.84
$\sqrt{\Delta P}$,In H2O	Average Square Root Of Delta P	.5035
% CO2	Carbon Dioxide	2.5
% O2	Oxygen	17.5
% N	Nitrogen	80
VCL,Ml	Volume Of Condensate	82
AS,ft2	Stack Area	13.4
MN,Mg	Total Particulate Catch Weight	51.1
Ø,Min	Test Time	60
DN,In	Diameter Of Nozzle	.313

RESULTS

Pma,In Hg	Absolute Meter Pressure	29.45
PSA,In Hg	Absolute Stack Pressure	29.33
MD	Molecular Weight Dry Gas	29.10
MS	Molecular Weight @ Stack Conditions	28.09
VMSTP,ft3	VM Standard Temp.& Press. Dry	38.70
VWSTP,ft3	VM Standard Temp.& Press. Wet	3.89
BWO,%	Moisture	9.13
I,%	Isokinetic Variation	103.23
VS,ft/Sec	Stack Velocity	38.27
QA,ASCFM	Stack Gas Flow (Actual)	30767
QS,ft3/Hr	Stack Gas Flow (Dry STP)	944292
L,#/Hr	Emission Rate	2.74911
CS,#/SCF	Particulate Emission	2.91129E-06
C''S,Grn/SCF	Particulate Emission	.0203328
C12,GR/SCF	C''S Corrected to 12% CO_2	.0975975

BELDEN BRICK INC
SUGARCREEK OH
KILN NO 1 PLANT 3
7/21/89
TEST 2

COMBINED METHOD 5 & 8

N= NORMALITY OF BARIUM PERCHLORATE TITRANT
VT= VOLUME OF TITRANT, ML
VTB= VOLUME OF TITRANT FOR BLANK, ML
VA= VOLUME OF ALOQUOT SAMPLE, ML
VM= VOLUME OF GAS SAMPLE FROM METHOD 5, VM(DSCF)
VSOLN= TOTAL VOLUME OF SAMPLE SOLUTION, ML
QS= DSCF/HOUR FROM METHOD 5 CALCULATION
DSCF= DRY STANDARD CUBIC FOOT

VM= 38.7

QS= 944292

SULFUR DIOXIDE CONCENTRATION = SO_2 LB/DSCF = S2

N=	.0101
VT=	2.4
VTB=	.1
VA=	10
VM=	38.7
VSOLN=	1000
QS=	944292

S2= (.00007061 x N x (VT-VTB) x VSOLN)/(VM x VA)= 4.23843E-06 LB SO_2/DSCF

SO_2 PPM= 6.037 x MM x S2 = 25.5874

SO_2 LB/HR = QS x S2 = 4.00231

BELDEN BRICK INC
SUGARCREEK OH
KILN NO 1 PLANT 3
7/21/89
TEST 2

C.S.A. CO. (EPA METHOD 5) DATA SHEET

TEST NO. 3 PLANT Belden Brick DATE 7/21/89

LOCATION Kiln #1 Stack Plant 3 BY [illegible]

BAROMETER 29.33 AMBIENT TEMP ASSUMED MOISTURE

MODULE NO. 2031 PROBE NO. 3-4 FILTER NO. HEATER NO. 5 NOZZLE DIA. 3/8

TEST POINT	METER VOLUME (Vm)	METER TEMP(Tm) IN	METER TEMP(Tm) OUT	COND TEMP °F	FILTER HEATER TEMP °F	STACK TEMP °F(Ts)	STACK PRESS (Ps)	VACUUM IN. Hg	ORIFICE (ΔH)(Pm) IN.H_2O	VEL HEAD (ΔP)	TIME
1	123.0	100	100	72	250	460	0	6-	1.0	.18	12:30
1	125.7	104	100	66	250	460		6-	1.0	.15	35
2	128.6	104	100	60	250	461		6+	1.3	.20	40
3	131.5	105	100	60	250	464		6-	1.0	.15	45
4	134.8	106	100	60	250	466		7	1.4	.20	50
1	134.8	104	100	62	250	467		8	1.9	.28	51
1	138.7	108	100	62	250	470		8	1.9	.28	56
2	142.5	108	100	62	250	472		8-	1.8	.26	1:01
3	146.3	110	100	64	250	473		8-	1.8	.26	06
4	149.8	110	100	64	250	474		5-	1.8	.26	01
1	149.8	109	100	66	250	474		8	1.9	.28	12
1	153.8	110	100	55	250	475		8	1.9	.28	17
2	157.7	110	100	55	250	480		8+	2.0	.31	22
3	161.8	111	100	55	250	483		9-	2.2	.34	27
4	166.0	112	100	55	250	486		9-	2.3	.35	32
TOTAL	43.0	107.4	100								
AVERAGE		104		~	~	471	0	MAX 9	1.68	.247	60 MIN

ORSAT DATA	N_2= 79.4					AVG
TIME				INTEGRATED		
CO2						1.8
O2						18.8
CO						

CONDESATE COLLECTED	FINAL	INITIAL	TOTAL
DRIERITE	927	919.5	7.5
IMPINGER	266	200	66
GRAND TOTAL (Vlw)			73.5

FILTER WEIGHT	PROBE WASH WT	IMPINGER WASH WT	LEAK RATE @ "Hg =
GROSS .6865	191.4809		
TARE .6538	191.4429		AVERAGE $\sqrt{\Delta P}$ = .4966
NET .0327	.0380		

TOTAL PARTICULATE WEIGHT (Mn) 70.7 mg STACK AREA(As) 13.4 FT^2

E.P.A. Method 5

DATA INPUT

Pb,In Hg	Barometer	29.33
VM,ft3	Meter Volume	43
ΔH,In H2O	Orifice Differential	1.68
PG,In H2O	Stack Static Pressure	0
Tm,F	Meter Temperature	104
Ts,F	Stack Temperature	471
CP	Pitot Coefficient	.84
$\sqrt{\Delta P}$,In H2O	Average Square Root Of Delta P	.4966
% CO2	Carbon Dioxide	1.8
% O2	Oxygen	18.8
% N	Nitrogen	79.4
VCL,Ml	Volume Of Condensate	73.5
AS,ft2	Stack Area	13.4
MN,Mg	Total Particulate Catch Weight	70.7
Ø,Min	Test Time	60
DN,In	Diameter Of Nozzle	.313

RESULTS

Pma,In Hg	Absolute Meter Pressure	29.45
PSA,In Hg	Absolute Stack Pressure	29.33
MD	Molecular Weight Dry Gas	29.04
MS	Molecular Weight @ Stack Conditions	28.15
VMSTP,ft3	VM Standard Temp.& Press. Dry	39.60
VWSTP,ft3	VM Standard Temp.& Press. Wet	3.48
BWO,%	Moisture	8.09
I,%	Isokinetic Variation	106.46
VS,ft/Sec	Stack Velocity	37.87
QA,ASCFM	Stack Gas Flow (Actual)	30444
QS,ft3/Hr	Stack Gas Flow (Dry STP)	936951
L,#/Hr	Emission Rate	3.68829
CS,#/SCF	Particulate Emission	3.93648E-06
C''S,Grn/SCF	Particulate Emission	.0274929
C12,GR/SCF	C''S Corrected to 12% CO_2	.183286

BELDEN BRICK INC
SUGARCREEK OH
KILN NO 1 PLANT 3
7/21/89
TEST 3

COMBINED METHOD 5 & 8

N= NORMALITY OF BARIUM PERCHLORATE TITRANT
VT= VOLUME OF TITRANT, ML
VTB= VOLUME OF TITRANT FOR BLANK, ML
VA= VOLUME OF ALOQUOT SAMPLE, ML
VM= VOLUME OF GAS SAMPLE FROM METHOD 5, VM(DSCF)
VSOLN= TOTAL VOLUME OF SAMPLE SOLUTION, ML
QS= DSCF/HOUR FROM METHOD 5 CALCULATION
DSCF= DRY STANDARD CUBIC FOOT

VM= 39.6

QS= 936951

SULFUR DIOXIDE CONCENTRATION = SO_2 LB/DSCF = S2

N=	.0101
VT=	2.1
VTB=	.1
VA=	10
VM=	39.6
VSOLN=	1000
QS=	936951

S2= (.00007061 x N x (VT-VTB) x VSOLN)/(VM x VA)= 3.60182E-06 LB SO_2/DSCF

SO_2 PPM= 6.037 x MM x S2 = 21.7442

SO_2 LB/HR = QS x S2 = 3.37473

BELDEN BRICK INC
SUGARCREEK OH
KILN NO 1 PLANT 3
7/21/89
TEST 3

APPENDIX II

CSA CO. NOx RAW DATA SHEET

For BELDEN BRICK By [illegible] 7/21/89

Test	Date	Time	Barometer (30.32)	Flask vacuum initial	Flask vacuum final	Flask temp initial	Flask temp final	Flask volume
1	7/21/89	10:55	29.32	26.3	.3	70	68	2079
2		11:10	29.32	26.4	.6	74	68	1975
3		12:25	29.32	26.4	.3	79	68	1942
4		13:35	29.32	26.4	.5	81	68	2097

NO1 KILN PLANT 3

NO_x LAB DATA

100 µg SPO	$A_1 = .10$	PB FINAL 29.06
200 " "	$A_2 = .20$	
300 " "	$A_3 = .295$	
400 " "	$A_4 = .390$	

SAMPLE	A	Q_s	M-5 TEST
1	.036	916,504	1
2	.041	916,504	1
3	.045	944,292	2
4	.044	936,951	3

FOR BELDEN BRICK 7/21/89 dlk

NO 1 KILN PLANT 3

EPA METHOD 7
(NOx)

Barometer, Initial =	29.32	Inches Hg	(Pbi)
Flask Vacuum Initial =	26.40	Inches Hg	(Pfi)
Flask Temp. Initial =	79.0	Degrees F	(Tfi)
Barometer, Final =	29.06	Inches Hg	(Pbf)
Flask Vacuum Final =	0.30	Inches Hg	(Pbf)
Flask Temp. Final =	68.00	Degrees F	(Tff)
Flask Volume =	1942	Ml.	(Vf)

Pi = Pbi - Pfi = 2.92 Inches Hg Absolute
Ti = 460 + Tfi = 539 Temp. Absolute Degrees R
Pf = Pbf - Pff = 28.76 Inches Hg Absolute
Tf = 460 + Tff = 528 Temp. Absolute Degrees R

Vsc = 17.64 (Vf - 25ml.) ((Pf / Tf) - (Pi / Ti)) = ml. STP = 1658.7

Spectrophotometer Calibration Factor = Kc

A_1 = Absorbance of 100 ug Standard = .1
A_2 = Absorbance of 200 ug Standard = .2
A_3 = Absorbance of 300 ug Standard = .295
A_4 = Absorbance of 400 ug Standard = .39

$Kc = 100((A_1 + 2A_2 + 3A_3 + 4A_4) / (A_1^2 + A_2^2 + A_3^2 + A_4^2)) = 1018.6$

A = Absorbance Of Sample = 0.045 , F= Dilution Factor = 1.000
M = Total ug NO_2 Per Sample = 2 x Kc x A x F = 91.673

C = Sample Concentration = $6.243 \times 10^{-5} \times M / Vsc = 3.4502 \times 10^{-4}$

QS From Method 5 Or Gas Volume Calculation = 944292

C x QS = 3.258 LB/HR

BELDEN BRICK INC
SUGARCREEK OH
KILN NO 1 PLANT 3
7/21/89
TEST ~~3~~ 2

EPA METHOD 7
(NOx)

Barometer, Initial = 29.32	Inches Hg	(Pbi)
Flask Vacuum Initial = 26.40	Inches Hg	(Pfi)
Flask Temp. Initial = 81.0	Degrees F	(Tfi)
Barometer, Final = 29.06	Inches Hg	(Pbf)
Flask Vacuum Final = 0.50	Inches Hg	(Pbf)
Flask Temp. Final = 68.00	Degrees F	(Tff)
Flask Volume = 2097	Ml.	(Vf)

Pi = Pbi - Pfi = 2.92 Inches Hg Absolute
Ti = 460 + Tfi = 541 Temp. Absolute Degrees R
Pf = Pbf - Pff = 28.56 Inches Hg Absolute
Tf = 460 + Tff = 528 Temp. Absolute Degrees R

Vsc = 17.64 (Vf - 25ml.) ((Pf / Tf) - (Pi / Ti)) = ml. STP = 1779.8

Spectrophotometer Calibration Factor = Kc

A_1 = Absorbance of 100 ug Standard = .1
A_2 = Absorbance of 200 ug Standard = .2
A_3 = Absorbance of 300 ug Standard = .295
A_4 = Absorbance of 400 ug Standard = .39

$Kc = 100((A_1 + 2A_2 + 3A_3 + 4A_4) / (A_1^2 + A_2^2 + A_3^2 + A_4^2)) = 1018.6$

A = Absorbance Of Sample = 0.044 , F= Dilution Factor = 1.000
M = Total ug NO_2 Per Sample = 2 x Kc x A x F = 89.636

C = Sample Concentration = $6.243 \times 10^{-5} \times M / Vsc = 3.1442 \times 10^{-4}$

QS From Method 5 Or Gas Volume Calculation = 936951

C x QS = 2.946 LB/HR

BELDEN BRICK INC
SUGARCREEK OH
KILN NO 1 PLANT 3
7/21/89
TEST # 3

EPA METHOD 7
(NOx)

Barometer, Initial = 29.32	Inches Hg	(Pbi)
Flask Vacuum Initial = 26.30	Inches Hg	(Pfi)
Flask Temp. Initial = 70.0	Degrees F	(Tfi)
Barometer, Final = 29.06	Inches Hg	(Pbf)
Flask Vacuum Final = 0.30	Inches Hg	(Pbf)
Flask Temp. Final = 68.00	Degrees F	(Tff)
Flask Volume = 2079	Ml.	(Vf)

Pi = Pbi - Pfi = 3.02 Inches Hg Absolute
Ti = 460 + Tfi = 530 Temp. Absolute Degrees R
Pf = Pbf - Pff = 28.76 Inches Hg Absolute
Tf = 460 + Tff = 528 Temp. Absolute Degrees R

Vsc = 17.64 (Vf - 25ml.) ((Pf / Tf) - (Pi / Ti)) = ml. STP = 1767.1

Spectrophotometer Calibration Factor = Kc

A_1 = Absorbance of 100 ug Standard = .1
A_2 = Absorbance of 200 ug Standard = .2
A_3 = Absorbance of 300 ug Standard = .295
A_4 = Absorbance of 400 ug Standard = .39

$Kc = 100((A_1 + 2A_2 + 3A_3 + 4A_4) / (A_1^2 + A_2^2 + A_3^2 + A_4^2)) = 1018.6$

A = Absorbance Of Sample = 0.036 , F= Dilution Factor = 1.000
M = Total ug NO_2 Per Sample = 2 x Kc x A x F = 73.339

C = Sample Concentration = $6.243 \times 10^{-5} \times M / Vsc = 2.5909 \times 10^{-4}$

QS From Method 5 Or Gas Volume Calculation = 916504

C x QS = 2.375 LB/HR

BELDEN BRICK INC
SUGARCREEK OH
KILN NO 1 PLANT 3
7/21/89
TEST 1

EPA METHOD 7
(NOx)

Barometer, Initial = 29.32	Inches Hg	(Pbi)
Flask Vacuum Initial = 26.40	Inches Hg	(Pfi)
Flask Temp. Initial = 74.0	Degrees F	(Tfi)
Barometer, Final = 29.06	Inches Hg	(Pbf)
Flask Vacuum Final = 0.60	Inches Hg	(Pbf)
Flask Temp. Final = 68.00	Degrees F	(Tff)
Flask Volume = 1975	Ml.	(Vf)

Pi = Pbi - Pfi = 2.92 Inches Hg Absolute
Ti = 460 + Tfi = 534 Temp. Absolute Degrees R
Pf = Pbf - Pff = 28.46 Inches Hg Absolute
Tf = 460 + Tff = 528 Temp. Absolute Degrees R

Vsc = 17.64 (Vf - 25ml.) ((Pf / Tf) - (Pi / Ti)) = ml. STP = 1666.0

Spectrophotometer Calibration Factor = Kc

A_1 = Absorbance of 100 ug Standard = .1
A_2 = Absorbance of 200 ug Standard = .2
A_3 = Absorbance of 300 ug Standard = .295
A_4 = Absorbance of 400 ug Standard = .39

$Kc = 100((A_1 + 2A_2 + 3A_3 + 4A_4) / (A_1^2 + A_2^2 + A_3^2 + A_4^2)) =$ 1018.6

A = Absorbance Of Sample = 0.041 , F= Dilution Factor = 1.000
M = Total ug NO_2 Per Sample = 2 x Kc x A x F = 83.524

C = Sample Concentration = $6.243 \times 10^{-5} \times M / Vsc = 3.1298 \times 10^{-4}$

QS From Method 5 Or Gas Volume Calculation = 916504

C x QS = 2.869 LB/HR

BELDEN BRICK INC
SUGARCREEK OH
KILN NO 1 PLANT 3
7/21/89
TEST ~~2~~ (1)

APPENDIX III

Agency Use Only
Date Received _____
No. Assigned _____
Premise No. _____

INTENT TO TEST NOTIFICATION

Proposed Test Date JULY 21, 1989
Pre-Test Meeting Desired? Yes / / No / /

A. Facility Information

Name BELDEN BRICK

Address PLANT 3 SUGARCREEK OH 44681

Contact Person _____

Telephone Number _____

B. Testing Firm Information

Name CSA CO. (CUSTOM STACK ANALYSIS)

Address 24385 CENTER ROAD, ALLIANCE, OH 44601

Contact Person ERNIE KOLM

Telephone Number (216) 525-5119

C. Source Sampling Information: Identify all sources and pollutants to be sampled.

Source	Control Equipment	Monitoring Equipment	Pollutant to be Tested	EPA Test Method	Filter Box Temperature	Number of Sampling Points	Total Time for Test Run	Number of Sampling Runs
BRICK KILN	—	—	PARTICULATE	5	250	12	60	3
			SO_2	6	—	2	20/RUN	6
			NO_x	7	—	2	GRAB	4

Any modifications to USEPA Reference Method(s)? Yes / / No / / ; If yes explain _____

Sampling Location(s): Inlet / / Outlet /✓/ Simultaneous / / Will cyclonic flow check(s) be conducted? Yes / / No /✓/

Fuel Sampling: Coal - Proximate / / Ultimate / / Other (specify) _____

Emission Rate to be calculated using: F-Factor /✓/ ~~Ultimate Coal Analysis~~ / / Other (specify) _____

Are concurrent Method 9 readings to be performed? Yes / / No / /

D. Sample Train Calibration: All affected measuring and metering equipment should be calibrated within 60 days of the scheduled testing.

AIR POLLUTION SOURCE TESTING PHONE -216- 525-5119

CSA COMPANY

CUSTOM STACK ANALYSIS
24661 CENTER ROAD
P.O. BOX 3750
ROUTE 5
ALLIANCE, OHIO 44601

GENERAL

Source emission tests will be performed at BELDEN BRICK PLANT #3 on JULY 21, 198 with testing to commence at about 9:00 O'clock — AM PM as per INTENT TO TEST NOTIFICATION.

The sample train is a Research Appliance Corp modle 2043 using a PYREX lined probe heated to 250 °F. The filter media is A/E FIBERGLASS enclosed in pyrex holders heated to 250 °F. The contents of the impingers will be used for (a) — moisture determination only, (b) ___ moisture determination and particulate weight. The gas drying agent after the impingers is calcium sulfate contained in a "Drierite" desicant column. The probe and glassware will be washed using ACETONE & BRUSH. If impinger contents are used as part of the particulate weight, they will be dried by ___ at ___ °C. The test and analytical procedures used are as per latest FEDERAL EPA REGULATIONS AS WRITTEN IN THE FEDERAL REGISTER.

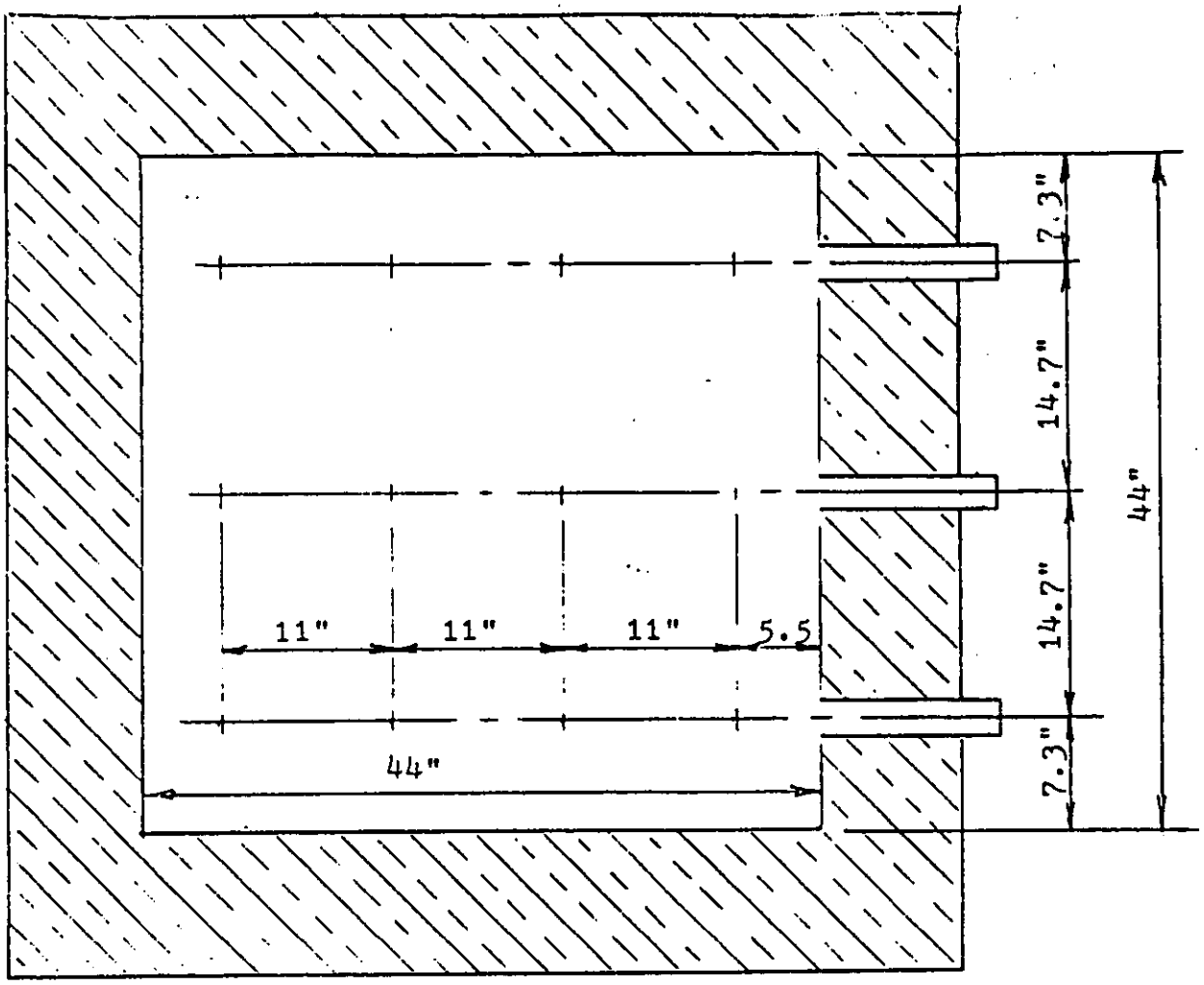
___ An equivalent emissions opacity test is requested

DESCRIPTION OF PLANT OPERATION

CONTINUOUS BRICK KILN

STACK AND VENT DESCRIPTION

SEE SKETCHES

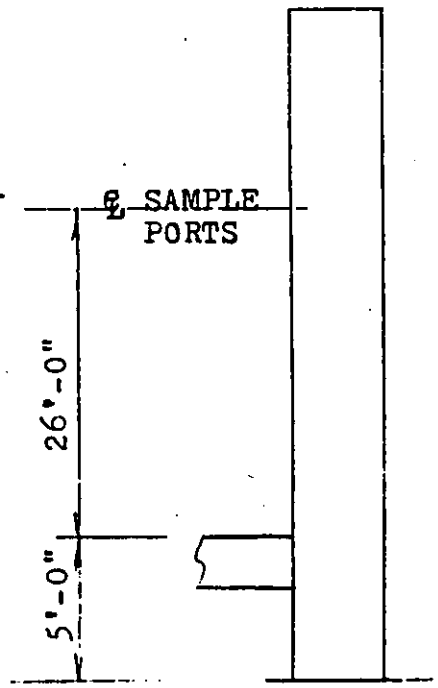


AREA = 13.4 f^2

EQUIVALENT DIA. = 44"

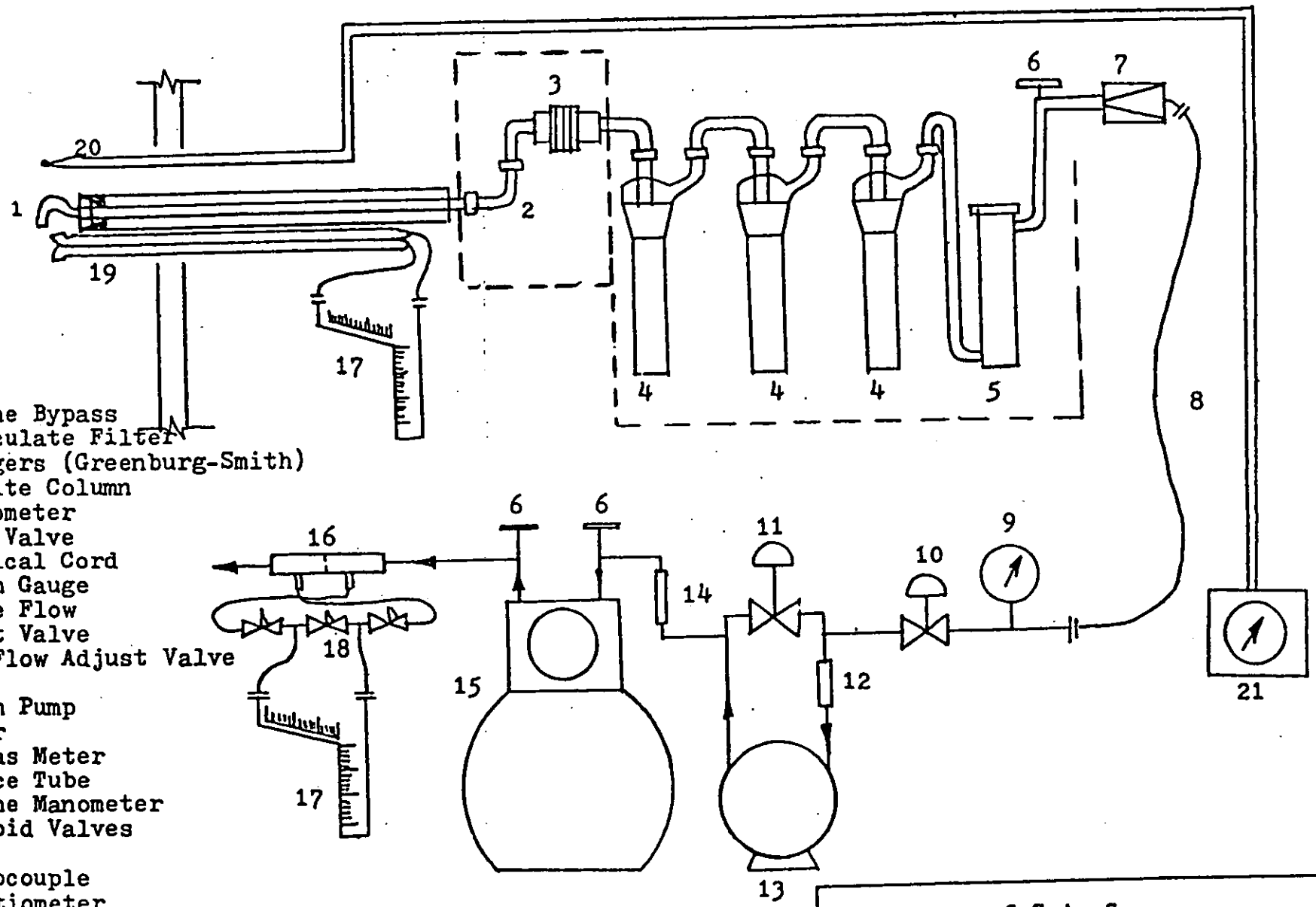
EQUIV. DIA. UPSTREAM = 7.1

EQUIV. DIA. DOWNSTREAM = 2+



BELDEN BRICK

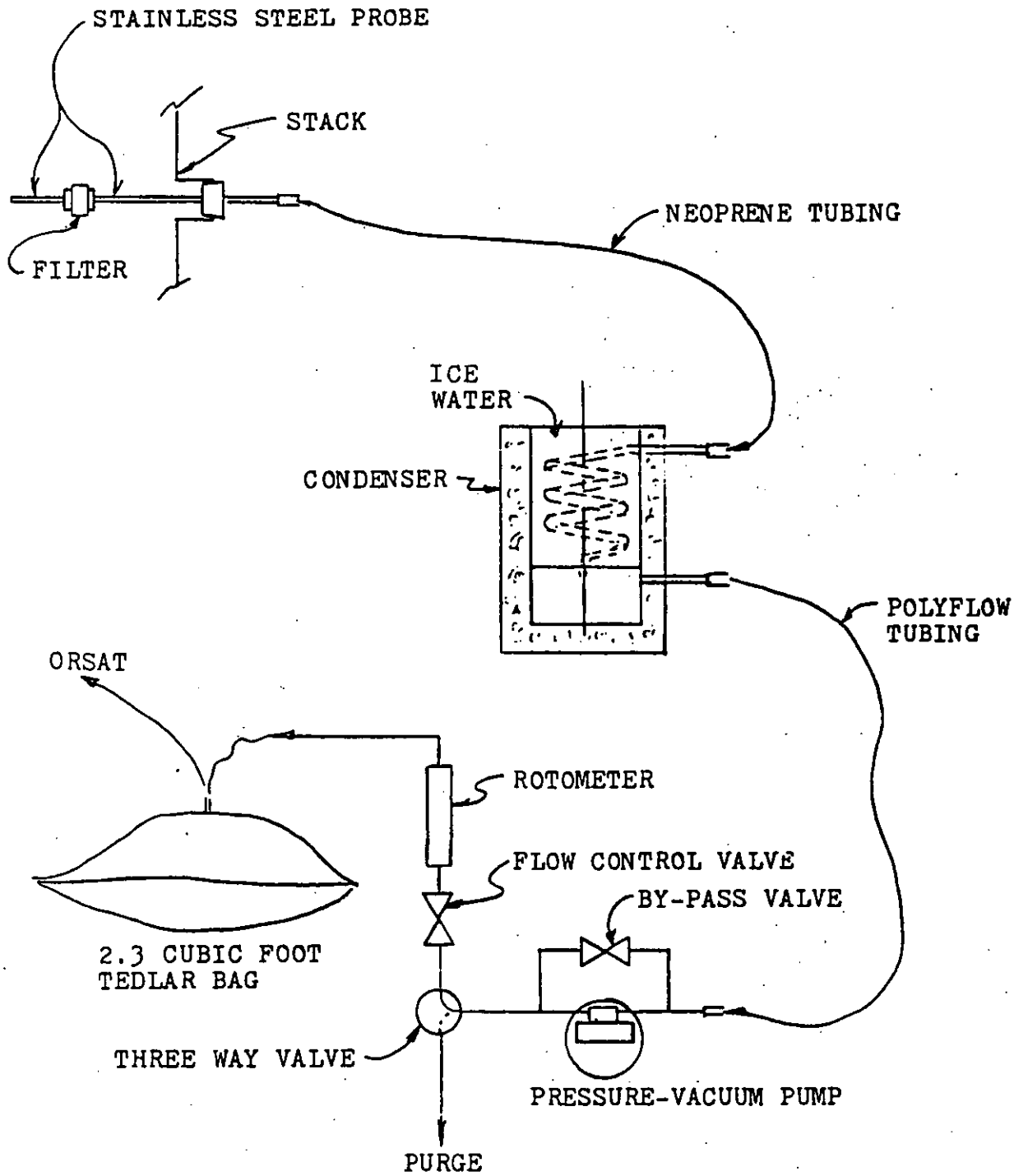
FIGURE 1



1) Probe
2) Cyclone Bypass
3) Particulate Filter
4) Impingers (Greenburg-Smith)
5) Drierite Column
6) Thermometer
7) Check Valve
8) Umbilical Cord
9) Vacuum Gauge
10) Course Flow Adjust Valve
11) Fine Flow Adjust Valve
12) Oiler
13) Vacuum Pump
14) Filter
15) Dry Gas Meter
16) Orifice Tube
17) Incline Manometer
18) Solenoid Valves
19) Pitot
20) Thermocouple
21) Potentiometer

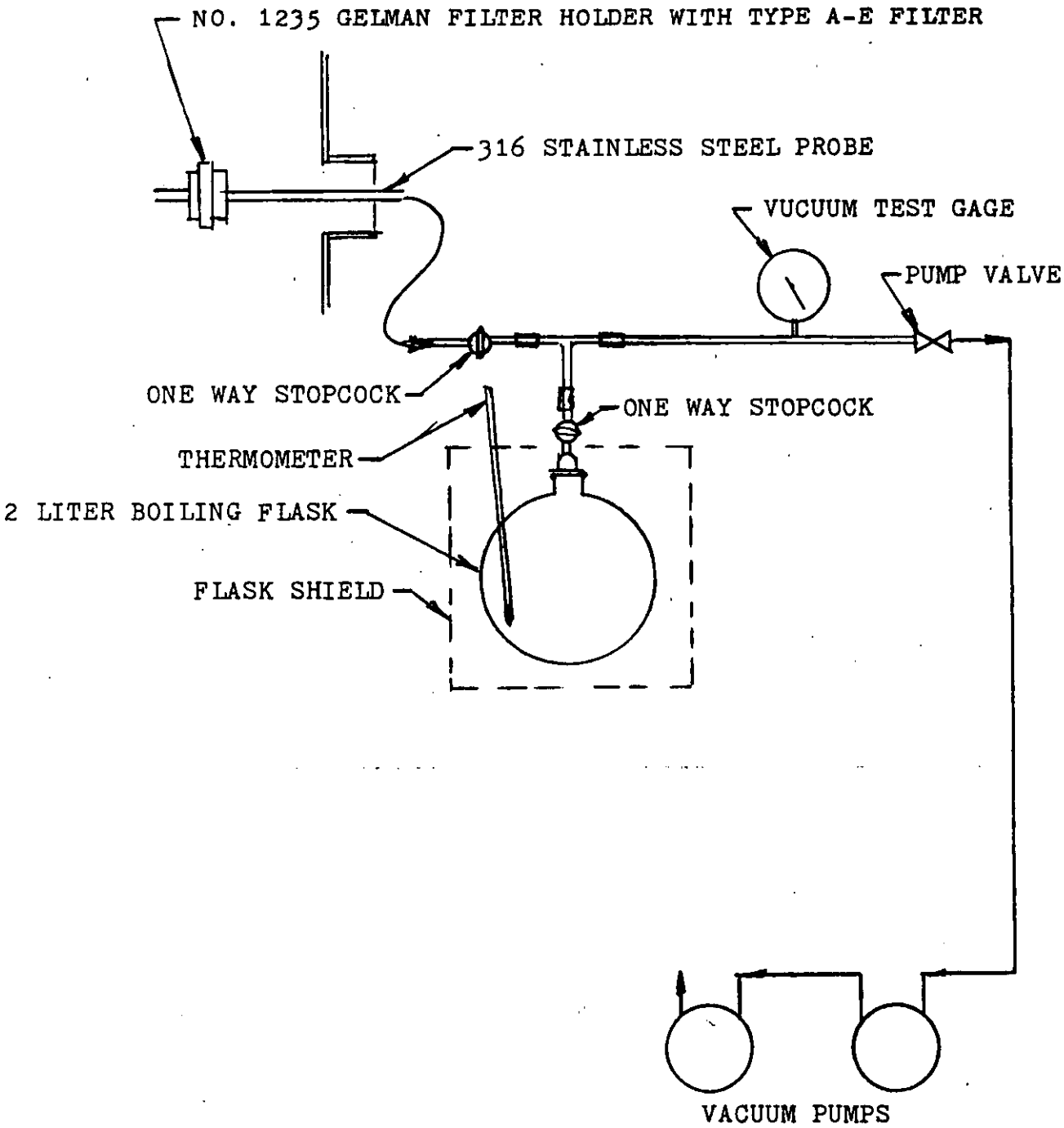
C.S.A. Co.
MODIFICATION OF R.A.C. SAMPLE TRA
USING DRIERITE COLUMN IN PLACE OF
IMPINGER DESICANT

Figure 2



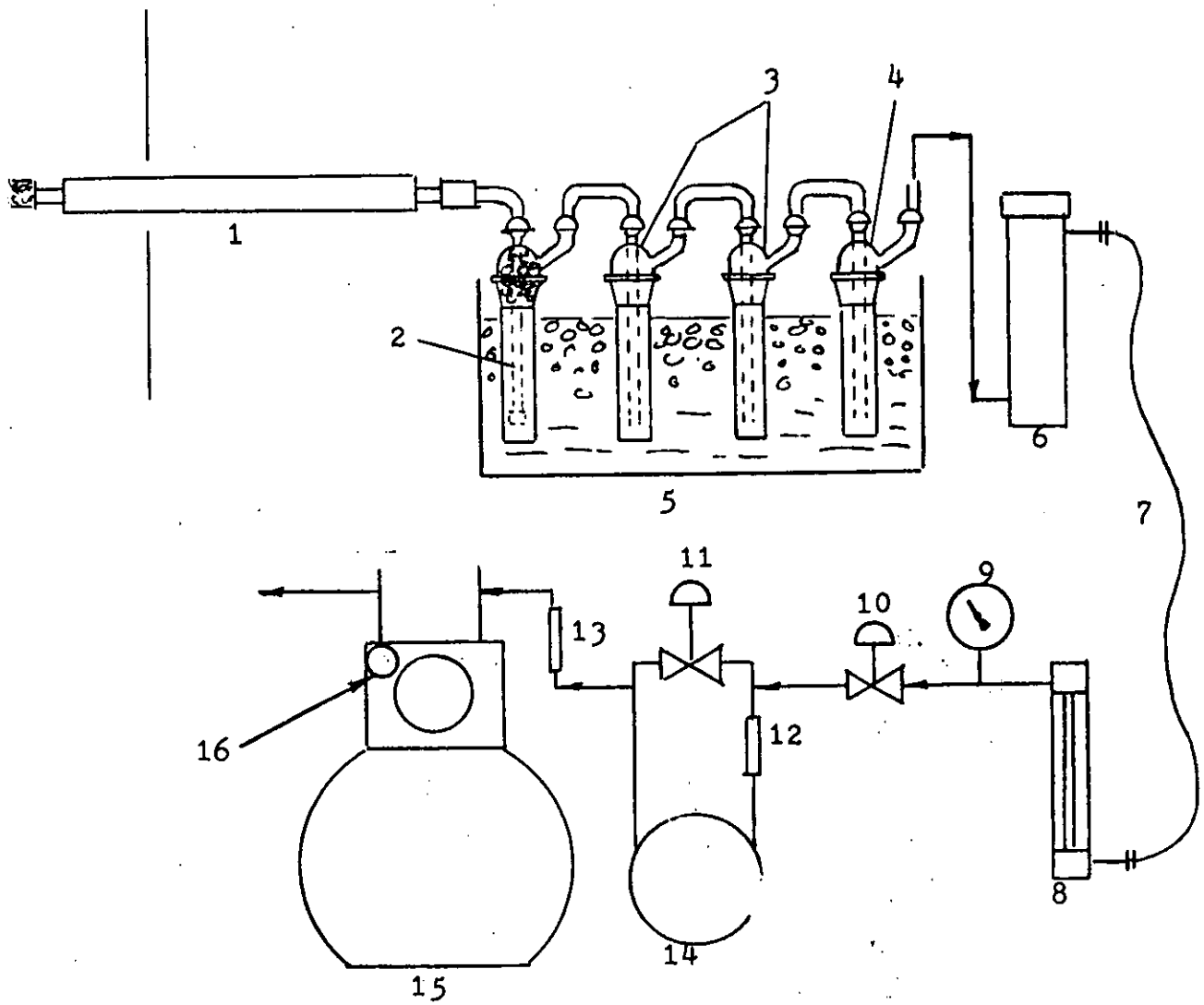
INTEGRATED SAMPLER

FIGURE 3



METHOD 7 NO_X SAMPLE APPARATUS

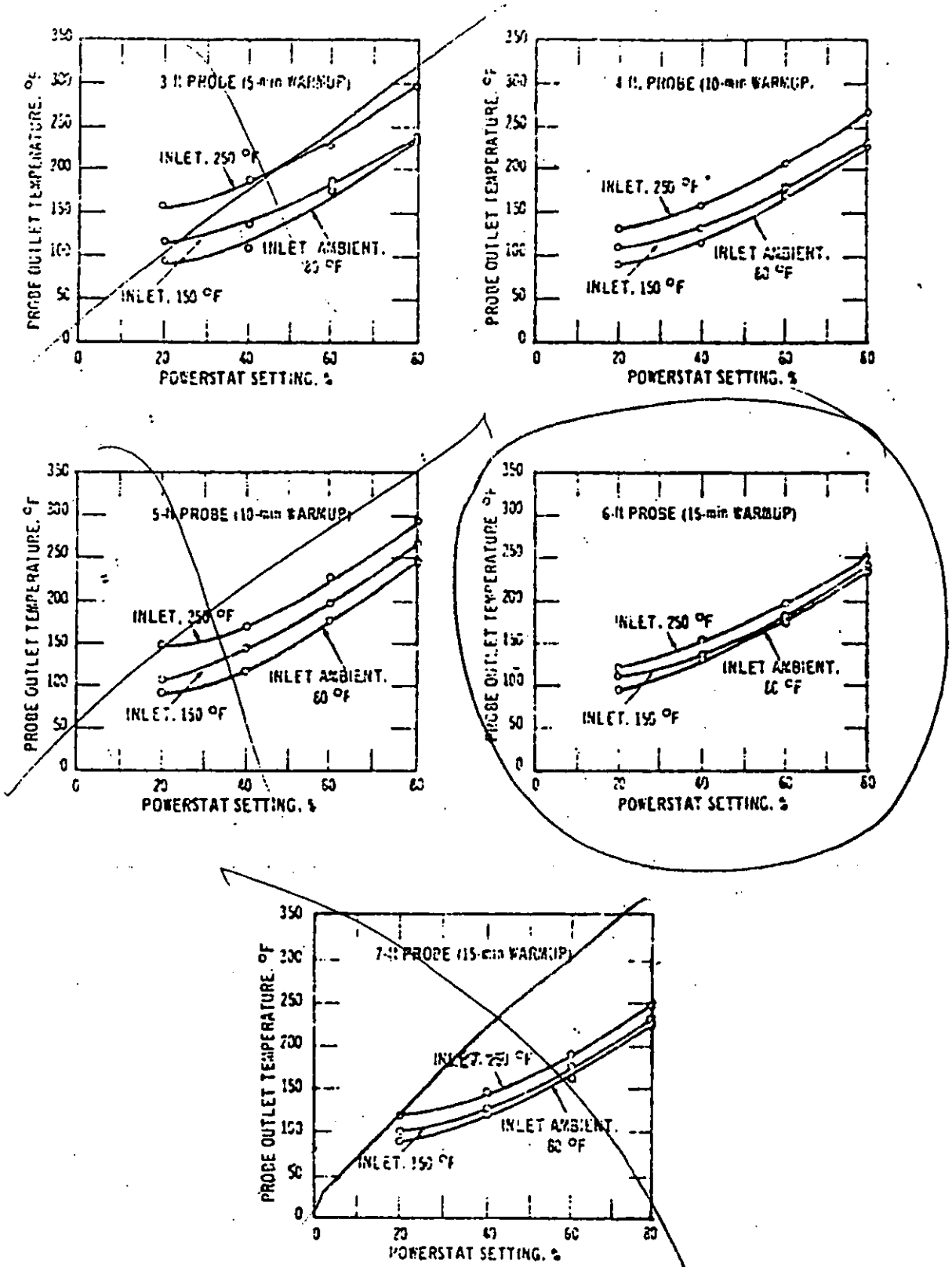
FIGURE 4



1) HEATED PYREX LINED PROBE. END PACKED WITH QUARTZ WOOL
2) MIDGET BUBBLER. TOP PAKED WITH GLASS WOOL
3) MIDGET IMPINGERS. EACH FILLED WITH 15 ml OF H_2O_2 (3%)
4) MIDGET IMPINGER. DRY TRAP
5) ICE BATH
6) DRIERITE COLUMN. FILLED WITH CALCIUM SULFATE DESICANT
7) UMBILICAL CORD
8) ROTAMETER
9) VACUUM GAGE
10) VALVE FOR COARSE FLOW ADJUSTMENT
11) VALVE FOR FINE FLOW ADJUSTMENT
12) OILER
13) OIL FILTER
14) VACUUM PUMP
15) DRY GAS TEST METER
16) THERMOMETER

E.P.A. METHOD 6 SO_2 SAMPLING TRAIN

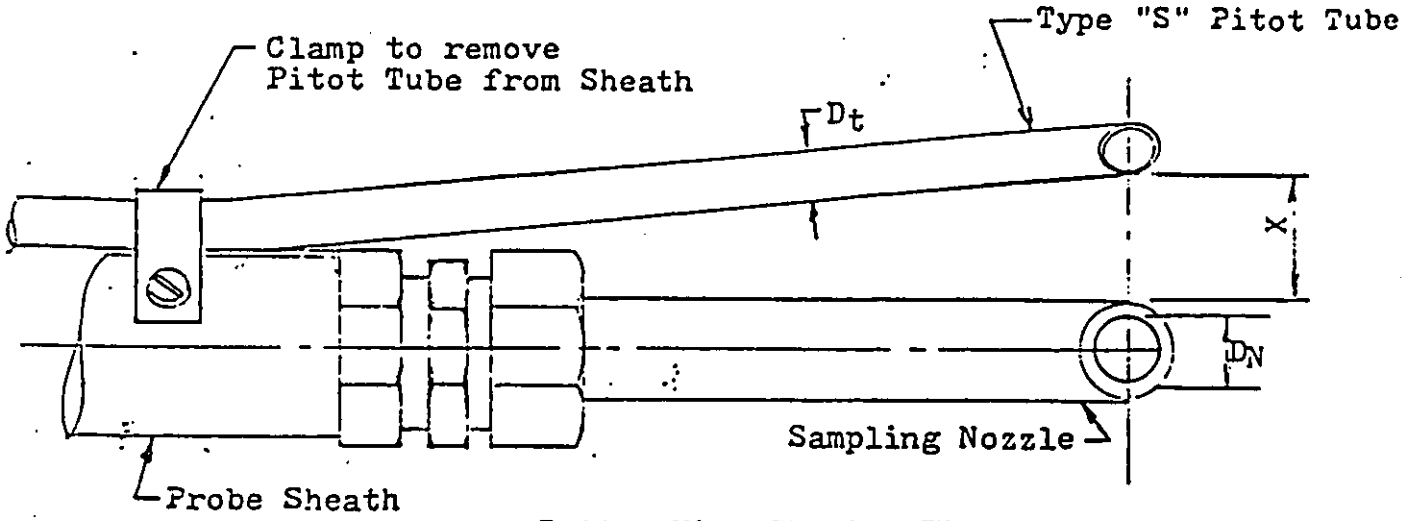
FIGURE 1



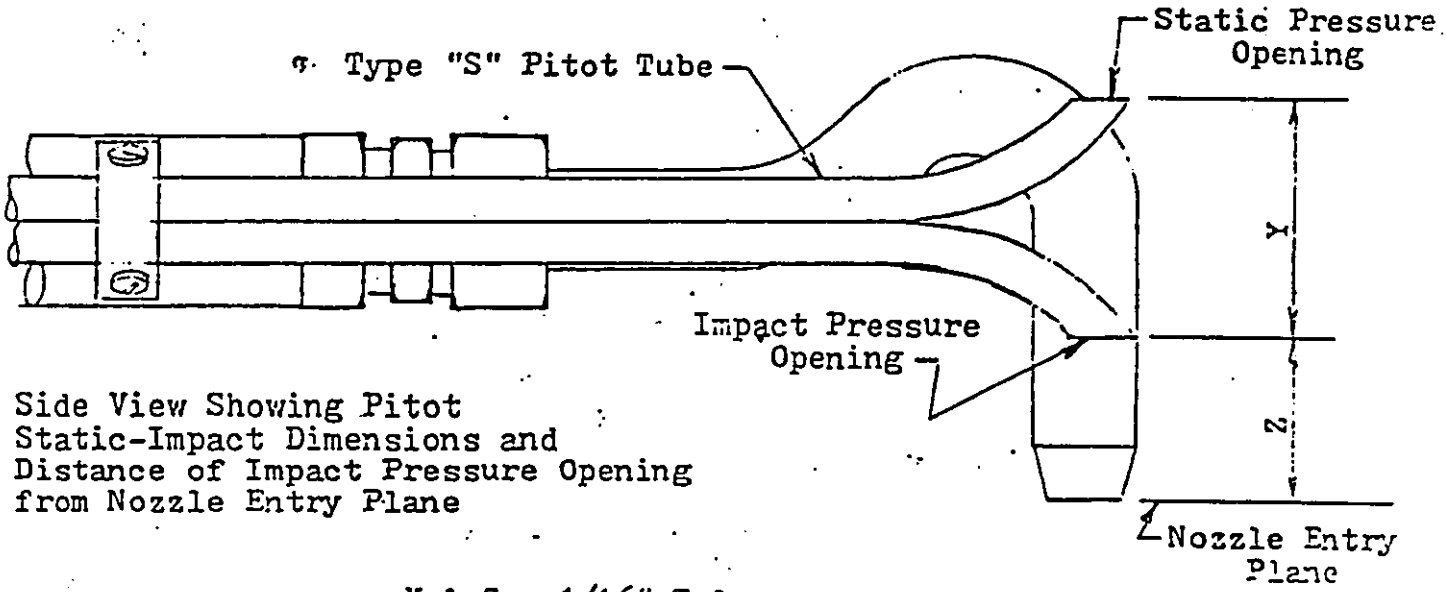
NOTE: Flow rate held constant at 0.75; 50% change in flow rate has little effect on probe temperature.

Figure 16

Probe Temperatures



Bottom View Showing Pitot-Nozzle Separation



Side View Showing Pitot
Static-Impact Dimensions and
Distance of Impact Pressure Opening
from Nozzle Entry Plane

X & Z 1/16" Tolerance

D_N - Inches (Nominal)	X	Y	Z	D_t
3/16	1	1 7/16	5/16	3/8
1/4	15/16	1 7/16	5/16	3/8
5/16	7/8	1 7/16	5/16	3/8
3/8	3/4	1 7/16	5/16	3/8
1/2	5/8	1 7/16	1/2	3/8

PITOT TUBE INTERFERENCE DIMENSIONS

C.S.A. CO. (EPA METHOD 5) DATA SHEET

TEST NO.	PLANT		DATE
LOCATION			BY
BAROMETER	AMBIENT TEMP	ASSUMED MOISTURE	
MODULE NO.	PROBE NO.	FILTER NO.	HEATER NO.
NOZZLE DIA.			

TEST POINT	METER VOLUME (Vm)	METER TEMP(Tm) IN	OUT	COND TEMP °F	FILTER HEATER TEMP°F	STACK TEMP °F(Ts)	STACK PRESS (Ps)	VACUUM IN. Hg	ORIFICE (ΔH)(Pm) IN.H_2O	VEL HEAD (ΔP)	TIME
TOTAL											
AVERAGE											

ORSAT DATA	N_2=			AVG
TIME			INTEGRATED	
CO2				
O2				
CO				

CONDESATE COLLECTED	FINAL	INITIAL	TOTAL
DRIERITE			
IMPINGER			
GRAND TOTAL (Vlw)			

FILTER WEIGHT	PROBE WASH WT	IMPINGER WASH WT
GROSS		
TARE		
NET		

LEAK RATE @ "Hg =

AVERAGE $\sqrt{\Delta P}$ =

TOTAL PARTICULATE WEIGHT (Mn) mg | STACK AREA(As) FT^2

CSA CO

EPA METHOD 6 (SULFUR DIOXIDE)

DATA AND CALCULATION SHEET

TEST NO._____ PLANT_____ DATE_____

LOCATION_____ BY_____

Pbar_____

Vm	Tmi	Tmo	ROTOMETER	TIME
Vm	Tm			

$$Vmstd = K_1 Y \frac{Vm\ Pb}{Tm}$$

$$Vmstd = 17.64 (\quad) \frac{(\quad)(\quad)}{(460 + \quad)} = \_\_\_\_\_$$

	1st TITRATION	2nd TITRATION	3rd TITRATION	AVERAGE	Vb TITRATION
Vt					

$$Cso_2 = K_2 \frac{(Vt - Vb)(N)\left(\frac{Vsoln}{Va}\right)}{Vmstd}$$

$$= .00007061 \frac{(\quad - \quad)(\quad)(\_\_\_\_\_)}{(\quad)} = \_\_\_\_\_ Lb/f^3DSTP$$

SO_2 (PPM) $= (Cso_2)(6.037)(10^6) =$ _____

Lb SO_2/Hr = (f^3/HrDSTP)(Lb/f^3DSTP) = _____

Lb/MBTU =_____ Lb/Hr - _____ MBTU = _____

Cso_2 = Concentration of sulfur dioxide - lb/dry standard cubic foot
N = Normality of barium perclorate titrant
Pbar = Barometric pressure - inches Hg
Tmi = Temperature at meter inlet - °F
Tmo = Temperature at meter outlet - °F
Tm = Average meter temperature -°F
Va = Volume of sample aliquot titrated - ml
Vm = Dry gas volume as measured at meter - dcf
Vm(std) = Vm corrected to standard conditions - dscf
Vsoln = Total volume of sample solution - ml
Vt = Average volume of titrant used for sample aliquot - ml
Vb = Volume of titrant used for blank - ml
Y = Dry gas meter calibration factor
K_1 = 17.64 $K_2 = 7.061 \times 10^{-5}$

TEST	DATE	TIME	BAROMETER INITIAL	FLASK VACUUM INITIAL	FLASK TEMP INITIAL	BAROMETER FINAL	FLASK VACUUM FINAL	FLASK TEMP FINAL	FLASK VOLUME	(A) ABSORBANCE

Ao = 0 (ABSORBANCE OF BLANK)
A1 = _____ (" " 100 μg STANDARD)
A2 = _____ (" " 200 μg ")
A3 = _____ (" " 300 μg ")
A4 = _____ (" " 400 μg ")
A = ABORBANCE OF SAMPLE

FOR_____ LOCATION_____ BY_____

CSA CO. NOx DATA SHEET

C.S.A. Co.
STACKSAMPLR CALIBRATION SHEET

Customer _____ Order No. _____
Date 6/17/89 Serial No. 2031 RAC Order No. _____

Pump OK Pump Oil OK Clean Quick Disconnects YES
Manometers OK Dry Test Meter OK Thermometers OK
Lights OK Electrical Check OK Variac OK
Vacuum Gauge OK Leak Check @ 27''Hg Vacuum OK
Remarks PRESSURE TEST AT 10" H2O

Barometer (Pb) 29.03

K	N	DH	CFw	CFd	Tw	ITd	OTd	TD	t	H	Y
.0158	.0368	0.5	5	5.03	70	74	71	72	12.68	1.852	0.997
.0317	.0737	1.0	5	5.05	70	76	70	73	8.95	1.854	0.993
.0634	.1470	2.0	10	10.10	70	84	72	78	12.68	1.854	1.000
.1268	.2490	4.0	10	10.11	70	85	75	80	8.96	1.841	0.999
.1902	.4310	6.0	10	10.11	70	86	76	81	7.34	1.850	0.995
.2536	.5880	8.0	10	10.09	70	88	76	82	6.33	1.834	0.993

Tolerances H=1.6-1.84-2.1 , Y=0.99-1.00-1.01

$H=(K/(Pb(OTd+460)))*(((Tw+460)t)/CFw)^2$

Y=(CFw Pb (Td avg.+460))/(CFd (Pb+N) (Tw+460))

DH= Orifice pressure drop - in. H_2O
CFw= Volume wet test meter - f^3
CFd= Volume dry test meter - f^3
Tw= Temp. wet test meter
ITd= Inlet temperature dry test meter
OTd= Outlet temperature dry test meter
Td avg.= Average temperature dry test meter
t= Time - minutes
Pb=Barometer press.