

ABMA

American
Boiler Manufacturers
Association

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Arlington VA 22209

DoE

United States
Department
of Energy

Division of Power Systems
Energy Technology Branch
Washington DC 20545

EPA

United States
Environmental Protection
Agency

Industrial Environmental Research
Laboratory
Research Triangle Park NC 27711

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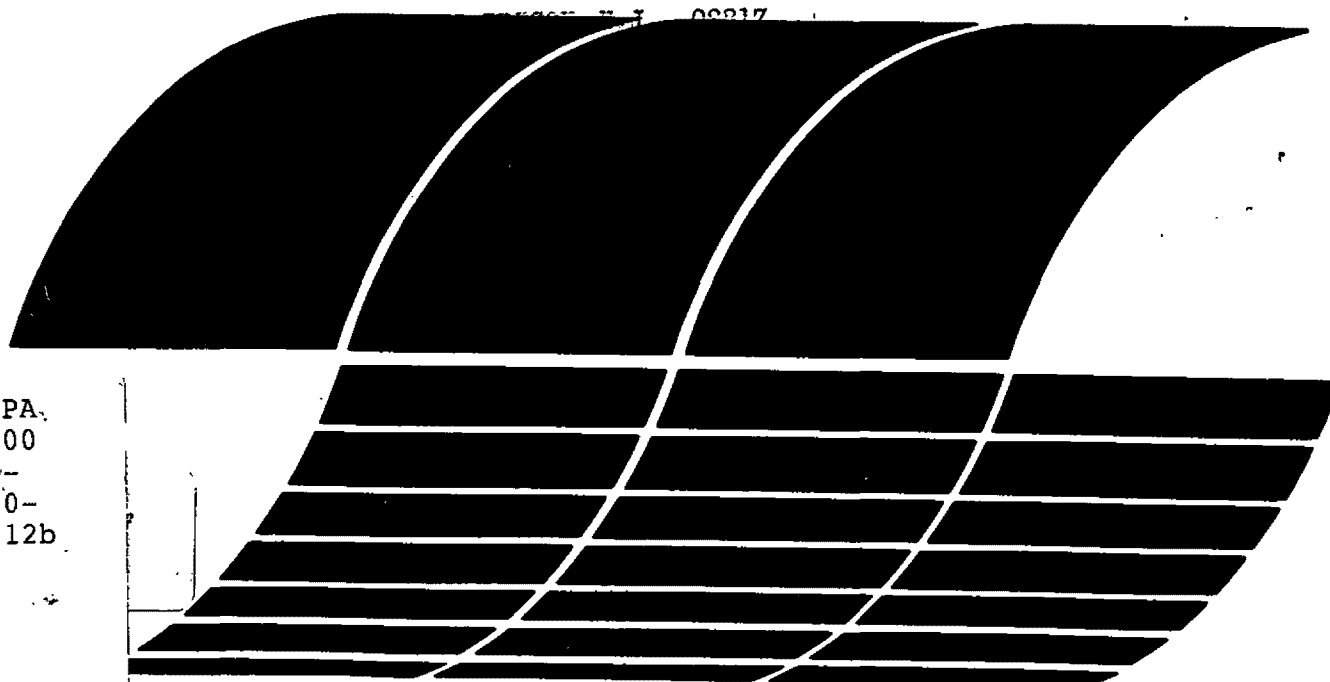
Field Tests of Industrial Stoker Coal-fired Boilers for Emissions Control and Efficiency Improvement — Site H (Data Supplement)

Interagency Energy/Environment R&D Program Report

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Field Tests of Industrial Stoker Coal-fired Boilers for Emissions Control and Efficiency Improvement — Site H (Data Supplement)

by

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ABSTRACT

The Data Supplement is a compilation of test data presented in greater detail than was practical in the Final Technical Report. It is intended to provide the necessary details to other researchers who are interested in performing their own analysis. Readers are referred to the contract final report for information as to objectives, description of facility tested and coals fired, test equipment and procedures, interpretations and conclusions. The Final Technical Report also contains data summaries not found in this volume. The Supplement contains panel board data for each test, detailed particulate, O₂, CO₂, CO, NO, NO₂, SO₂ and SO₃ data, particle size distribution data, chemical analysis of the coal, coal size consistency data, and combustible analysis data.

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FOREWORD

The purpose of this Data Supplement Volume is to document data in greater detail than was practical in the Final Technical Report.¹ It is intended to provide the necessary details to other researchers who are interested in performing their own analysis. Readers are referred to the contract final report for information as to objectives, description of facility tested and coals fired, test equipment and procedures, interpretations and conclusions. The Final Technical Report also contains data summaries not found in this volume.

The data in this volume are arranged by type (i.e., Panel Board Data, Particulate Data, etc.) and within each type by test number. Data summaries where they exist are at the front of each section. The boiler tested is referred to as Boiler H; as it is the eighth boiler tested under the program entitled, "A Testing Program to Update Equipment Specifications and Design Criteria for Stoker Fired Boilers."

¹ Langsjoen, P. L., et al., "Field Tests of Industrial Stoker Coal-Fired Boilers for Emissions Control and Efficiency Improvement - Site H."

CONVERSION FACTORS

ENGLISH AND METRIC UNITS TO SI UNITS

<u>To Convert From</u>	<u>To</u>	<u>Multiply By</u>
in	cm	2.540
in ²	cm ²	6.452
ft	m	0.3048
ft ²	m ²	0.09290
ft ³	m ³	0.02832
lb	Kg	0.4536
lb/hr	Mg/s	0.1260
lb/10 ⁶ BTU	ng/J	430
g/Mcal	ng/J	239
BTU	J	1054
BTU/lb	J/kg	2324
BTU/hr	W	0.2929
J/sec	W	1.000
J/hr	W	3600
BTU/ft/hr	W/m	0.9609
BTU/ft/hr	J/hr/m	3459
BTU/ft ² /hr	W/m ²	3.152
BTU/ft ² /hr	J/hr/m ²	11349
BTU/ft ³ /hr	W/m ³	10.34
BTU/ft ³ /hr	J/hr/m ³	37234
psia	Pa	6895
"H ₂ O	Pa	249.1
Rankine	Celsius	C = 5/9R-273
Fahrenheit	Celsius	C = 5/9(F-32)
Celsius	Kelvin	K = C+273
Rankine	Kelvin	K = 5/9R

FOR TYPICAL COAL FUEL

ppm @ 3% O ₂ (SO ₂)	ng/J (lb/10 ⁶ Btu)	0.851 (1.98x10 ⁻³)
ppm @ 3% O ₂ (SO ₃)	ng/J (lb/10 ⁶ Btu)	1.063 (2.47x10 ⁻³)
ppm @ 3% O ₂ (NO)*	ng/J (lb/10 ⁶ Btu)	0.399 (9.28x10 ⁻⁴)
ppm @ 3% O ₂ (NO ₂)	ng/J (lb/10 ⁶ Btu)	0.611 (1.42x10 ⁻³)
ppm @ 3% O ₂ (CO)	ng/J (lb/10 ⁶ Btu)	0.372 (8.65x10 ⁻⁴)
ppm @ 3% O ₂ (CH ₄)	ng/J (lb/10 ⁶ Btu)	0.213 (4.95x10 ⁻⁴)

g/kg of fuel**

*Federal environmental regulations express NO_x in terms of NO₂;

thus NO units should be converted using the NO₂ conversion factor.

**Based on higher heating value of 10,000 Btu/lb. For a heating value other than 10,000 Btu/lb, multiply the conversion factor by 10,000/(Btu/lb).

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CONVERSION FACTORS

SI UNITS TO ENGLISH AND METRIC UNITS

<u>To Convert From</u>	<u>To</u>	<u>Multiply By</u>
cm	in	0.3937
cm ²	in ²	0.1550
m	ft	3.281
m ²	ft ²	10.764
m ³	ft ³	35.315
Kg	lb	2.205
Mg/s	lb/hr	7.937
ng/J	lb/10 ⁶ BTU	0.00233
ng/J	g/Mcal	0.00418
J	BTU	0.000948
J/kg	BTU/lb	0.000430
J/hr/m	BTU/ft/hr	0.000289
J/hr/m ²	BTU/ft ² /hr	0.0000881
J/hr/m ³	BTU/ft ³ /hr	0.0000269
W	BTU/hr	3.414
W	J/hr	0.000278
W/m	BTU/ft/hr	1.041
W/m ²	BTU/ft ² /hr	0.317
W/m ³	BTU/ft ³ /hr	0.0967
Pa	psia	0.000145
Pa	"H ₂ O	0.004014
Kelvin	Fahrenheit	F = 1.8K-460
Celsius	Fahrenheit	F = 1.8C+32
Fahrenheit	Rankine	R = F+460
Kelvin	Rankine	R = 1.8K

FOR TYPICAL COAL FUEL

ng/J	ppm @ 3% O ₂ (SO ₂)	1.18
ng/J	ppm @ 3% O ₂ (SO ₃)	0.941
ng/J	ppm @ 3% O ₂ (NO)	2.51
ng/J	ppm @ 3% O ₂ (NO ₂)	1.64
ng/J	ppm @ 3% O ₂ (CO)	2.69
ng/J	ppm @ 3% O ₂ (CH ₄)	4.69
ng/J	g/kg of fuel	0.000233

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SI PREFIXES

<u>Multiplication Factor</u>	<u>Prefix</u>	<u>SI Symbol</u>
10^{18}	exa	E
10^{15}	peta	P
10^{12}	tera	T
10^9	giga	G
10^6	mega	M
10^3	kilo	k
10^2	hecto*	h
10^1	deka*	da
10^{-1}	deci*	d
10^{-2}	centi*	c
10^{-3}	milli	m
10^{-6}	micro	μ
10^{-9}	nano	n
10^{-12}	pico	p
10^{-15}	femto	f
10^{-18}	atto	a

*Not recommended but occasionally used

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**EMISSION UNITS CONVERSION FACTORS
FOR TYPICAL COAL FUEL (HV= 13,320 BTU/LB)**

Multiply To Obtain	By	% Weight in Fuel		lbs/10 ⁶ Btu		grams/10 ⁶ Cal		PPM (Dry @ 3% O ₂)		Grains/SCF. (Dry @ 12% CO ₂)	
		S	N	SO ₂	NO ₂	SO ₂	NO ₂	SOx	NOx	SO ₂	NO ₂
% Weight In Fuel	S	1		0.666	/	0.370	/	13.2x10 ⁻⁴	/	1.48	/
	N			/	0.405	/	0.225	/	5.76x10 ⁻⁴	/	.903
lbs/10 ⁶ Btu	SO ₂	1.50	/	1		(.556)	/	19.8x10 ⁻⁴	/	(2.23)	/
	NO ₂	/	2.47			/	(.556)	/	14.2x10 ⁻⁴	/	(2.23)
grams/10 ⁶ Cal	SO ₂	2.70	/	(1.8)	/	1		35.6x10 ⁻⁴	/	(4.01)	/
	NO ₂	/	4.44	/	(1.8)			25.6x10 ⁻⁴	/	(4.01)	/
PPM (Dry @ 3% O ₂)	SOx	758	/	505	/	281	/	1		1127	/
	NOx	/	1736	/	704	/	391			/	1566
Grains/SCF (Dry @ 12% CO ₂)	SO ₂	.676	/	(.448)	/	(.249)	/	8.87x10 ⁻⁴	/	1	
	NO ₂	/	1.11	/	(.448)	/	(.249)	/	6.39x10 ⁻⁴		

NOTE: 1. Values in parenthesis can be used for all flue gas constituents such as oxides of carbon, oxides of nitrogen, oxides of sulfur, hydrocarbons, particulates, etc.
2. Standard reference temperature of 530°R was used.

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SECTION 1.0
PANEL BOARD DATA SHEETS

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1.1 CONTROL ROOM DATA SHEETS	2

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PANEL BOARD DATA
ABMA TEST SITE H

Boiler #4

(Integrator)

Steam Flow, lb/hr 69310

Coal Flow, lb/hr _____

Lb/Steam/Lb Coal _____

TEST NO.	1	1			
TEST DATE	MAR 14 1979	3-19-79			
TEST COAL	SANDS HILL	SANDS HILL			
TEST CONDITIONS:	BASLINE (H ₂ O)	BASLINE (H ₂ O)			
	NORM OFA	NORM OFA			
<u>COAL SCALE</u>					
Start & stop time	-	-			
Pounds Coal Added	-	-			
<u>STEAM INTEGRATOR</u>					
Reading (x 1000 = #/hr)	583991	584192			
Time of Reading	10:46	13:40			
<u>CHART RECORDER</u>					
Steam Flow, lb/hr	40000	39000			
Air Flow, Relative					
<u>DRAFT GAUGES</u>					
Furnace Draft, "H ₂ O	-0.7	-0.7			
Boiler Outlet Draft, "H ₂ O	-1.7	-1.7			
Compartment #1 Draft, "H ₂ O	0.0	0.0			
#2 Draft, "H ₂ O	+0.6	+2.6			
#3 Draft, "H ₂ O	+0.7	+2.5			
#4 Draft, "H ₂ O	+0.3	0.0			

3

TEST CITY N

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NOTES

TEST NO: 1
Coal slugging up during test. Large clinkers forming.
TEST NO:
TEST NO:
TEST NO:

KVB

PANEL BOARD DATA
ABMA TEST SITE H

Steam Flow, lb/hr $\sim 43,200$
Coal Flow, lb/hr $\frac{3-20}{4774} / \frac{2-21}{4573}$
Avg. = $4673.5 \frac{\text{lb}}{\text{hr}}$
Lb/Steam/Lb Coal 9.2

TEST NO.	2a	2b	2b	2c	2d
TEST DATE	3-20-79	3-21-79			
TEST COAL	SANDS HILL				
TEST CONDITIONS:	O ₂ VARIATIONS				
	NORM O ₂ A				
	MIN. O ₂	BASELINE		MAX O ₂	Mel. H ₂ O ₂
<u>COAL SCALE</u>					
Start & stop time	1055/1205	0930/10:20			
Pounds Coal Added	5570	9385			
<u>STEAM INTEGRATOR</u>					
Reading	09:25	08:34	09:01	09:56	11:21
Time of Reading	584712	585422	585457	585528	585634
<u>CHART RECORDER</u>					
Steam Flow, lb/hr	44000	44000	46000	42000	42000
Air Flow, Relative	31.5	33.5	33.5	38.5	34.0
<u>DRAFT GAUGES</u>					
Furnace Draft, "H ₂ O	-0.2	-0.2	-0.2	-0.2	-0.2
Boiler Outlet Draft, "H ₂ O	-1.0	-1.0	-1.0	-1.2	-1.0
Compartment #1 Draft, "H ₂ O	+0.4	+0.2	+0.2	+0.7	+0.8
#2 Draft, "H ₂ O	+1.0	+0.9	+0.9	+1.6	+1.5
#3 Draft, "H ₂ O	+1.0	+0.9	+0.9	+1.5	+1.2
#4 Draft, "H ₂ O	0.0	0.0	0.0	0.0	0.0
STEAM PRESS. PSI	-	140	142	138	138

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PANEL BOARD DATA
ABMA TEST SITE H

Steam Flow, lb/hr _____

Coal Flow, lb/hr _____

Lb/Steam/Lb Coal _____

TEST NO.	2e	2f			
TEST DATE	3-21-79	3-21-79			
TEST COAL	SANDS HILL	—————→			
TEST CONDITIONS:	O ₂ VARIATIONS	—————→			
	NORM OFA	—————→			
	REPEAT BASELINE	MIN O ₂			
<u>COAL SCALE</u>					
Start & stop time					
Pounds Coal Added					
<u>STEAM INTEGRATOR</u>					
Reading	585791	585843			
Time of Reading	13:23	14:04			
<u>CHART RECORDER</u>					
Steam Flow, lb/hr	41500	43,000			
Air Flow, Relative	32.8	30.8			
<u>DRAFT GAUGES</u>					
Furnace Draft, "H ₂ O	-0.2	-0.2			
Boiler Outlet Draft, "H ₂ O	-0.9	-0.8			
Compartment #1 Draft, "H ₂ O	+0.5	+0.3			
#2 Draft, "H ₂ O	+1.0	+0.8			
#3 Draft, "H ₂ O	+0.9	+0.7			
#4 Draft, "H ₂ O	+0.7	+0.5			
STEAM PRESS, PSI	140	140			

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NOTES

TEST NO: 10a COAL BURNING MUCH BETTER THAN IN TEST #1. LONGER FLAME
OVER A SHORTER PORTION OF BED. LESS AIR REQ'D.
TROUBLE WITH ASH HANDLING SYSTEM $\Rightarrow$ LARGE FLUCTUATIONS
IN BLR LOAD + EXCESS O_2 . HAD TO ABORT REST OF TEST
CLINKER BEGAN FORMING AT LOW O_2 COND. AFTER AWHILE

TEST NO: 2b BOILER RUNNING FAIRLY STEADILY IN EARLY A.M. FIRE A
LITTLE SHORTER.

TEST NO: 2f Clinker formation - not an operable boiler setting.
Will use their baseline air for our "low O_2 "
port tests.

TEST NO:

TEST NO:

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PANEL BOARD DATA
ABMA TEST SITE H

Steam Flow, lb/hr ~45,700

Coal Flow, lb/hr 5277

Lb/Steam/Lb Coal 8.7

TEST NO.	3	3	3		
TEST DATE	3-22-79	3-22-79	3-22-79		
TEST COAL	SANDS HILL				
TEST CONDITIONS:	MIN. O ₂				
	NORM (LOW) O ₂				
	PARTICULATES				
<u>COAL SCALE</u>					
Start & stop time	10:03				
Pounds Coal Added					
<u>STEAM INTEGRATOR</u>					
Reading	586328	586519	586612		
Time of Reading	10:16	12:46	13:55		
<u>CHART RECORDER</u>					
Steam Flow, lb/hr	45600	46,000	45,500		
Air Flow, Relative	32.8	31.0	32.5		
<u>DRAFT GAUGES</u>					
Furnace Draft, "H ₂ O	-0.2	-0.2	-0.2		
Boiler Outlet Draft, "H ₂ O	-1.0	-1.0	-0.9		
Compartment #1 Draft, "H ₂ O	+0.1	+0.8	+0.9		
#2 Draft, "H ₂ O	+0.8	+1.2	+1.4		
#3 Draft, "H ₂ O	+0.8	+1.0	+1.2		
#4 Draft, "H ₂ O	0.0	0.0	0.0		
STEAM PRESS, PSI	140	145	152		

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TEST SITE N

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NOTES

TEST NO: SOME CLIPPER FORMATION AT 12:45.
TEST NO:
TEST NO:
TEST NO:

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PANEL BOARD DATA
ABMA TEST SITE H

Steam Flow, lb/hr 22,433

Coal Flow, lb/hr _____

Lb/Steam/Lb Coal _____

TEST NO.	4a	4b	4c		
TEST DATE	3-23-79				
TEST COAL	SANDS HILL				
TEST CONDITIONS:	50% LOAD				
COAL SCALE					
Start & stop time	—	—	—		
Pounds Coal Added	—	—	—		
STEAM INTEGRATOR					
Reading	586996	587048	587066		
Time of Reading	09:56	11:17	11:46		
CHART RECORDER					
Steam Flow, lb/hr	22000	22000	22300		
Air Flow, Relative	16.0	16.0	18.5		
DRAFT GAUGES					
Furnace Draft, "H ₂ O	-0.2	-0.2	-0.2		
Boiler Outlet Draft, "H ₂ O	-0.5	-0.4	-0.5		
Compartment #1 Draft, "H ₂ O	0.0	0.0	0.0		
#2 Draft, "H ₂ O	+0.1	+0.1	+0.1		
#3 Draft, "H ₂ O	0.0	0.0	0.0		
#4 Draft, "H ₂ O	0.0	0.0	0.0		
STEAM PRESS, PSI	140	140	143		

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PANEL BOARD DATA
ABMA TEST SITE H

Steam Flow, lb/hr 44,533
Coal Flow, lb/hr 7460 LB/HR
Lb/Steam/Lb Coal 6.0

TEST NO.	5	5	5		
TEST DATE	3-26-79	3-26-79	3-26-79		
TEST COAL	SANDS HILL				
TEST CONDITIONS:	LOW O ₂				
	HIGH OFA				
	BRINK F				
	PARTIC.				
<u>COAL SCALE</u>					
Start & stop time	9:38/10:38				
Pounds Coal Added	7460 LB				
<u>STEAM INTEGRATOR</u>					
Reading	588566	588725	588910		
Time of Reading	08:59	11:09	13:36		
<u>CHART RECORDER</u>					
Steam Flow, lb/hr	47000	43000	43,600		
Air Flow, Relative	37.4	36.0	37.0		
<u>DRAFT GAUGES</u>					
Furnace Draft, "H ₂ O	-0.2	-0.2	-0.2		
Boiler Outlet Draft, "H ₂ O	-1.1	-1.1	-1.1		
Compartment #1 Draft, "H ₂ O	+0.2	+0.5	+0.4		
#2 Draft, "H ₂ O	+0.9	+1.0	+0.8		
#3 Draft, "H ₂ O	+1.0	+0.9	+0.7		
#4 Draft, "H ₂ O	0.0	0.0	+0.7		
STEAM PRESS., PSI	137	135	144		

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NOTES

TEST NO: 5)	Coal seems to have more ash than in previous tests.
	Trouble maintaining steam load w/ same stoker and F.D. - I.D.
	FAW settings. Much larger coal flow rate. Emptied one coal storage
	bin + started another. Flame length much shorter than previously.
TEST NO:	
TEST NO:	
TEST NO:	
TEST NO:	

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PANEL BOARD DATA
ABMA TEST SITE H

Steam Flow, lb/hr 43,800

Coal Flow, lb/hr 48970

Lb/Steam/Lb Coal 8.9

TEST NO.	6	6	6		
TEST DATE	3-27-79	3-27-79	3-27-79		
TEST COAL	SANDS HILL				
TEST CONDITIONS:	HIGH O ₂				
	HIGH OFA				
	PARTIC.				
<u>COAL SCALE</u>					
Start & stop time	7:45	11.00			
Pounds Coal Added	0	15,915			
<u>STEAM INTEGRATOR</u>					
Reading	589696	589790	589878		
Time of Reading	08:43	09:54	11:06		
<u>CHART RECORDER</u>					
Steam Flow, lb/hr	46,500	43,700	41,200		
Air Flow, Relative	39.0	39.0	39.0		
<u>DRAFT GAUGES</u>					
Furnace Draft, "H ₂ O	0.0	0.0	0.0		
Boiler Outlet Draft, "H ₂ O	-1.0	-1.0	-1.0		
Compartment #1 Draft, "H ₂ O	+0.7	+0.7	+0.8		
#2 Draft, "H ₂ O	+1.4	+1.3	+1.4		
#3 Draft, "H ₂ O	+1.4	+1.4	+1.5		
#4 Draft, "H ₂ O	+1.1	+1.1	+1.2		
STM PRESS., PSI	122	135	140		

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Test City N

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PANEL BOARD DATA
ABMA TEST SITE H

Steam Flow, lb/hr 33,975
Coal Flow, lb/hr 3687
Lb/Steam/Lb Coal 9.2

TEST NO.	7a	7a	7a	7a	7a
TEST DATE	3-28-79	3-28-79	3-28-79	3-28-79	3-28-79
TEST COAL	SANDS HILL				
TEST CONDITIONS:	75% LOAD				
	VARY O ₂				
	BASELINE	BASELINE	BASELINE	BASELINE	BASELINE
COAL SCALE					
Start & stop time	08:40/11:40				
Pounds Coal Added	11060				
STEAM INTEGRATOR					
Reading	590629	590672	590704	590732	590771
Time of Reading	08:34	09:19	09:53	10:28	11:03
CHART RECORDER					
Steam Flow, lb/hr	36000	34000	32000	35000	33000
Air Flow, Relative	22.0	21.4	21.3	21.6	22.4
DRAFT GAUGES					
Furnace Draft, "H ₂ O	-0.2	-0.2	-0.2	-0.2	-0.2
Boiler Outlet Draft, "H ₂ O	-0.6	-0.6	-0.6	-0.6	-0.6
Compartment #1 Draft, "H ₂ O	+0.1	+0.1	+0.1	+0.1	+0.1
#2 Draft, "H ₂ O	+0.3	+0.3	+0.3	+0.3	+0.3
#3 Draft, "H ₂ O	0.0	0.0	0.0	0.0	0.0
#4 Draft, "H ₂ O	0.0	0.0	0.0	0.0	0.0
5.014 4.55, 1.51	146	130	135	140	130

21

TEST SITE N

KVB

NOTES

TEST NO: 7a Fairly long flame but over a small portion of bed -
basically only 2 zones. No clinker at ~820.

TEST NO:

TEST NO:

TEST NO:

TEST NO:

KVB

PANEL BOARD DATA
ABMA TEST SITE H

Steam Flow, lb/hr _____

Coal Flow, lb/hr 3687

Lb/Steam/Lb Coal _____

TEST NO.	7b	7c	7d		
TEST DATE	3-28-79	3-28-79	3-28-79		
TEST COAL	SANDS HILL	SANDS HILL	SANDS HILL		
TEST CONDITIONS:	VARY O ₂	—————→	—————→		
	75% LOAD	—————→	—————→		
	H: O ₂	Med.-H: O ₂	Lo O ₂		
<u>COAL SCALE</u>					
Start & stop time	08:40/11:40				
Pounds Coal Added	11060				
<u>STEAM INTEGRATOR</u>					
Reading	590813	590842	590942		
Time of Reading	11:49	12:19	14:06		
<u>CHART RECORDER</u>					
Steam Flow, lb/hr	32000	34800	35000		
Air Flow, Relative	32.4	29.5	19.8		
<u>DRAFT GAUGES</u>					
Furnace Draft, "H ₂ O	-0.2	-0.2	-0.2		
Boiler Outlet Draft, "H ₂ O	-0.9	-0.8	-0.5		
Compartment #1 Draft, "H ₂ O	+0.9	+0.7	0.0		
#2 Draft, "H ₂ O	+1.6	+1.2	+0.2		
#3 Draft, "H ₂ O	+0.5	+0.3	+0.2		
#4 Draft, "H ₂ O	0.0	0.0	0.0		
STM. PRESS., PSI	115	140	140		

KVB

[illegible]

KVB

NOTES

TEST NO: 7d (oc) bed uneven. Large chunk in center of bed.
TEST NO:
TEST NO:
TEST NO:

KVB

PANEL BOARD DATA
ABMA TEST SITE H

Steam Flow, lb/hr 33,666

Coal Flow, lb/hr 2400

Lb/Steam/Lb Coal 13.9

TEST NO.	8	8	8		
TEST DATE	3-29-79	3-29-79	3-29-79		
TEST COAL	SANDS HILL				
TEST CONDITIONS:	75% LOAD				
	NORM O ₂				
	NORM OFA				
	PARTIC.				
<u>COAL SCALE</u>					
Start & stop time	08:30/10:30				
Pounds Coal Added	4840				
<u>STEAM INTEGRATOR</u>					
Reading	591466	591507	591577		
Time of Reading	09:40	09:24	10:42		
<u>CHART RECORDER</u>					
Steam Flow, lb/hr	34000	33000	34000		
Air Flow, Relative	21.0	21.0	20.9		
<u>DRAFT GAUGES</u>					
Furnace Draft, "H ₂ O	-0.2	-0.2	-0.2		
Boiler Outlet Draft, "H ₂ O	-0.6	-0.6	-0.6		
Compartment #1 Draft, "H ₂ O	0.0	0.0	0.0		
#2 Draft, "H ₂ O	+0.3	+0.3	+0.3		
#3 Draft, "H ₂ O	+0.1	+0.1	+0.1		
#4 Draft, "H ₂ O	0.0	0.0	0.0		
STM. PRESS, PSI	135	132	140		

KVB[illegible]

KVB

PANEL BOARD DATA
ABMA TEST SITE H

Steam Flow, lb/hr 23,333

Coal Flow, lb/hr 2704

Lb/Steam/Lb Coal 8.6

TEST NO.	9	9	9		
TEST DATE	3-30-79	3-30-79	3-30-79		
TEST COAL	SANDS HILL				
TEST CONDITIONS:	COAL				
	50% LOAD				
	NORM O ₂				
	NORM OFA				
	PARTIC.				
COAL SCALE					
Start & stop time	08:03/10:39				
Pounds Coal Added	6895				
STEAM INTEGRATOR					
Reading	592013	592070	592120		
Time of Reading	08:12	09:43	11:02		
CHART RECORDER					
Steam Flow, lb/hr	24000	23000	23,000		
Air Flow, Relative	21.2	19.1	19.0		
DRAFT GAUGES					
Furnace Draft, "H ₂ O	-0.2	-0.2	-0.2		
Boiler Outlet Draft, "H ₂ O	-0.6	-0.6	-0.6		
Compartment #1 Draft, "H ₂ O	+0.1	0.0	+0.05		
#2 Draft, "H ₂ O	+0.3	+0.3	+0.3		
#3 Draft, "H ₂ O	+0.2	+0.3	+0.2		
#4 Draft, "H ₂ O	0.0	0.0	0.0		
STM. PRESS. PSI	120	117	138		

KVB

[illegible]

KVB

PANEL BOARD DATA
ABMA TEST SITE H

Steam Flow, lb/hr 22,875

Coal Flow, lb/hr 2381

Lb/Steam/Lb Coal 9.6

TEST NO.	10A9b	10c	10d	10e	
TEST DATE	3-30-79	3-30-79	3-30-79	3-30-79	
TEST COAL	SANDS HILL				
TEST CONDITIONS:	NORM OFA				
	50% LOAD				
	VARY O ₂				
	BASELINE MED -H ₂ O ₂	LO O ₂	MED-LO O ₂	Hi O ₂	
COAL SCALE					
Start & stop time	11:15 / 13:36				
Pounds Coal Added	5595				
STEAM INTEGRATOR					
Reading	592134	592179	592187	592224	
Time of Reading	11:26	12:37	12:51	13:45	
CHART RECORDER					
Steam Flow, lb/hr	22,500	25,000	23,000	21,000	
Air Flow, Relative	19.0	17.5	17.5	20.6	
DRAFT GAUGES					
Furnace Draft, "H ₂ O	-0.2	-0.2	-0.2	-0.2	
Boiler Outlet Draft, "H ₂ O	-0.6	-0.5	-0.5	-0.7	
Compartment #1 Draft, "H ₂ O	0.0	+0.3	+0.3	+1.0	
#2 Draft, "H ₂ O	+0.3	+0.5	+0.4	+1.1	
#3 Draft, "H ₂ O	+0.3	0.0	0.0	0.0	
#4 Draft, "H ₂ O	+0.0	0.0	0.0	0.0	
STM PRESS. PSI	131	138	139	135	

KVB

[illegible]

KVB

PANEL BOARD DATA
ABMA TEST SITE H

Steam Flow, lb/hr 45000
Coal Flow, lb/hr 5050/5548
Avg. = 5299
Lb/Steam/Lb Coal 8.5

TEST NO.	11	11	11	11
TEST DATE	4-4-79	4-4-79	4-4-79	4-4-79
TEST COAL	SANDS HILL			
TEST CONDITIONS:	MIN O ₂			
	NORM OFA			
	SASS F			
	GOKSOYR-ROSS			
COAL SCALE				
Start & stop time	10:00/11:00	11:10/12:33		
Pounds Coal Added	5050	7675		
STEAM INTEGRATOR				
Reading	593743	593931	594099	594250
Time of Reading	09:05	11:29	13:35	15:29
CHART RECORDER				
Steam Flow, lb/hr	43000	46000	45000	46000
Air Flow, Relative	36.0	36.0	36.2	36.5
DRAFT GAUGES				
Furnace Draft, "H ₂ O	-0.2	-0.2	-0.2	-0.2
Boiler Outlet Draft, "H ₂ O	-1.1	-1.1	-1.1	-1.1
Compartment #1 Draft, "H ₂ O	+0.7	+0.7	+0.65	+0.6
#2 Draft, "H ₂ O	+1.2	+1.1	+1.1	+1.1
#3 Draft, "H ₂ O	+1.0	+1.0	+1.0	+1.0
#4 Draft, "H ₂ O	0.0	0.0	0.0	0.0
SIM PRESS, PSI	132	134	127	140

KVB

[illegible]

SECTION 2.0
PARTICULATE DATA

2.1	PARTICULATE DATA SUMMARY	<u>PAGE</u> 35
2.2	PARTICULATE DATA SHEETS	37
2.3	PARTICULATE LAB WORKSHEET	42

STACK AREA = 19,635 ft²

PARTICULATE DATA SUMMARY

PART I

LOCATION: ABMA TEST SITE #

[illegible]

#15900 rev.

Location ABMA TEST SITE H:

#15900 Rev.

PARTICULATE

DATA

Leak Check Rate

ISO KINETICS = 985.

TEST NUMBER

3

DATE

3-22-74

OPERATOR

FUEL

S.H.

SITE

H

PROBE LOCATION

Stack

Sampling Time Per Point, Min
4

Before
AfterVac
in. Hg ft³/min

Sample Point	Time	METER CONDITIONS			TEMPERATURES, °F						O ₂ , %	Vac.
		ΔP _s	ΔH	Meter Reading	Stack	Probe	Oven	Impingers		Meter		
								In	Out			
1	4 min	.08	.53	414.35	510	300	270	165	60	65		2.5
2		.09	.60	416.46	509	310	275	165	60	70		3.0
3		.095	.63	418.59	508	350	343	170	62	70		3.0
4		.095	.63	420.80	509	350	343	180	62	70		3.0
5		.075	.50	422.50	509			175	62	72		2.5
6		.085	.57	424.185	509			175	62	73		2.7
7		.13	.87	426.77	509			155	63	74		3.3
8		.165	1.05	429.57	509			155	63	74		4.0
9		.19	1.22	432.55	509			170	64	74		4.2
10		.145	1.24	436.30	509			175	64	74		4.2
11		.145	1.24	439.35	509			180	62	76		
12		.14	.8	441.915	509			195	62	76		
13		.16	1.02	444.79	509	350	343	145	66	73		4.5
14		.165	1.05	447.612	511			170	66	75		4.5
15		.17	1.09	450.58	518			170	66	75		5.0
16		.18	1.15	453.50	520			175	66	78		5.2
17		.175	1.12	456.41	522			165	70	78		5.2
18		.16	1.02	459.20	520			165	70	78		5.0
19		.175	1.12	462.16	522			165	70	78		5.2
20		.175	1.12	465.03	520			185	68	78		5.2
21		.155	.97	467.72	520			190	68	78		4.8
22		.15	.96	470.50	520			185	70	78		
23		.135	.87	473.04	520			185	70	78		
24	V	.10	.64	475.325	520			185	70	78		
25	46											
Average		0.143	0.92		504.2 466.2					75°F		

METER VOL. END 475.35
START 411.05
SAMPLE VOL. 63.30 ft³

C _{pitot}	Stack Press. In. Hg-Gauge	Barometric Pressure
	-.2415	29.36

Percent O₂ = 8.0

Nomenclature Setup

P_{meter} = C
P_{stack} = T_{stack}
T_{meter} = ΔP
ΔH_g = Noz (Ideal) =
ΔH₂O = 6.23 Noz (Actual) =

Imp.	Vol. (End)	Vol. (Start)	ΔVol. (ml)
#1	165	100	65
#2	109	100	9
#3	1	0	1
Total			75

#4	q (End)	q (Start)	Δgrams
Silica	1634	150.0	136
Gel			
Total Vol. H ₂ O			88.6 ml

PARTICULATE

DATA

Leak Check Rate

ISOKINETICS = 105.2%

TEST NUMBER 5

Vac
in. Hg ft³/min

DATE 3-26-74

Sampling Time
Per Point, Min
3Before
After

OPERATOR

FUEL Sandia H₂

SITE H

PROBE LOCATION Stack

Sample Point	Time	METER CONDITIONS			TEMPERATURES, °F							O ₂ , %	Vac.
		ΔP _s	ΔH	Meter Reading	Stack	Probe	Oven	Indingers		Meter			
								In	Out				
1	3min	.07	.46	477.53	435	235	175	120	35	35		2.0	
2		.075	.49	479.08	435	235	200	120	35	35		2.0	
3		.085	.55	480.56	435	235	205	125	35	35		3.1	
4		.095	.55	482.18	435	240	205	125	35	35		3.0	
5		.10	.77	484.00	435	240	210	125	35	35		3.1	
6		.115	.88	485.96	435	240	210	130	35	35		3.2	
7		.17	1.32	488.21	435	240	210	150	35	40		5.0	
8		.225	1.78	490.47	435	240	230	150	35	40		5.0	
9		.325	.50	492.41	440	235	240	135	35	35		2.2	
10		.33	.51	493.83	440	240	235	140	35	35		2.0	
11		.315	.48	495.31	435	235	235	155	35	35		2.1	
12		.205	.31	496.33	435	240	235	140	35	35		2.0	
13		.10	.153	497.03	425	230	245	120	32	35		1.0	
14		.115	.105	497.83	430	230	245	130	32	35		1.4	
15		.14	.30	498.95	430	240	240	135	32	35		1.5	
16		.15	.225	499.47	430	255	230	150	32	40		1.5	
17		.17	.260	501.00	430	255	235	145	32	40		2.0	
18		.175	.27	502.10	430	240	230	145	32	40		2.0	
19		.18	.28	503.40	430	235	225	145	30	38		2.0	
20		.16	.242	504.36	430	235	230	145	30	38		2.0	
21		.15	.235	505.30	430	235	240	150	30	38		1.5	
22		.14	.215	506.20	430	235	240	145	30	40		1.5	
23		.13	.20	507.02	430	235	240	140	30	40		1.5	
24	↓	.09	.14	507.95	430	235	240	135	30	40		1.0	
Average													

METER VOL.	END	
	START	
SAMPLE VOL.		ft ³
C _{pitot}	Stack Press.	Barometric Pressure
.837	-0.38	29.22
Percent O ₂	9.4	

Nomenclature Setup

P_{meter} = C
 P_{stack} = T_{stack}
 T_{meter} = ΔP
 ΔH_g = Noz(Ideal) =
 ΔH_{2O} = 7.0 Noz(Actual) =

Imp.	Vol. (End)	Vol. (Start)	ΔVol. (ml)
#1	130	120	10
#2	107	100	7
#3	6	0	6
Total			23
#4	g(End)	g(Start)	Δgrams
Silica Gel	1564	1503	61
Total Vol. H _{2O}			11 ml

Avg for 15th ΔP_s = 0.117 ΔH = 0.550 Vol = 14.74
 Avg for 15th ΔP_s = 0.183 ΔH = 0.280 Vol = 16.98
 16.98

PARTICULATE

DATA

Leak Check Rate

ISOKINETICS = 104.5

TEST NUMBER

DATE 3-27-77

OPERATOR

FUEL Soudby H₂ II

SITE 17

PROBE LOCATION Stack

Sampling Time
Per Point, Min
4

Vac
in. Hg ft³/min
Before
After

Sample Point	Time	METER CONDITIONS			TEMPERATURES, °F							O ₂ , %	Vac.
		ΔP _s	ΔH	Meter Reading	Stack	Probe	Oven	Imoinqers		Meter			
								In	Out				
East Bldg 1	4min	.175	.27	510.53	425	250	180	80	30	30		1.2	
2		.125	.27	511.76	425	250	180	8.5	30	35		1.2	
3		.185	.284	513.14	425	260	145	92	30	35		1.5	
4		.195	.31	514.61	425	265	205	92	30	35		1.8	
5		.21	.33	516.13	425	270	215	115	30	35		1.8	
6		.22	.34	517.68	425	270	215	115	30	35		1.9	
7		.21	.33	519.27	425	265	215	112	30	40		1.8	
8		.18	.28	520.68	425	265	215	115	30	40		1.8	
9		.16	.25	521.98	425	260	220	115	30	40		1.6	
10		.15	.23	523.31	425	260	225	115	30	40		1.5	
11		.13	.20	524.38	425	260	225	110	30	40		1.0	
12		.08	.125	525.05	425	250	230	105	30	40		1.0	
13		.20	.31	526.87	425	230	240	105	30	40		1.6	
14		.22	.34	528.40	425	240	240	130	30	40		1.7	
15		.25	.34	530.10	425	260	240	150	30	40		2.0	
16		.265	.42	531.78	425	260	245	155	30	40		2.1	
17		.28	.44	533.56	425	265	250	160	30	40		2.1	
18		.24	.37	535.21	425	268	260	168	30	40		1.8	
19		.19	.30	536.60	425	260	265	160	30	40		1.6	
20		.17	.26	538.00	425	260	265	150	30	45		1.5	
21		.15	.23	539.44	425	250	265	145	30	45		1.4	
22		.13	.20	540.58	425	250	265	140	30	45		1.3	
23		.13	.20	541.70	425	250	265	140	30	45		1.3	
24		.09	.14	542.70		250	265	140	30	45			
Average		0.183	0.284		425°F					420°F			

METER VOL. END 542.70
START 509.02
SAMPLE VOL. 33.7 ft³

C _p tot	Stack Press. In. Hg-Gauge	Barometric Pressure
0.837	-1.11	29.52

Percent O₂ =

Nomograph Setup

P_{meter} = C =
P_{stack} = T_{stack} =
T_{meter} = ΔP =
ΔH_g = Noz(Ideal) =
% H₂O = 6.0 Noz(Actual) =

Imp.	Vol. (End)	Vol. (Start)	ΔVol. (ml)
#1	12.9	- 100	= 29
#2	108	- 100	= 8
#3	2	- 0	= 2
Total			39

	g (End)	g (Start)	Δgrams
#4 Silica Gel	160.3	- 154.3	= 6.0
Total Vol. H ₂ O			45.6 ml

39

PARTICULATE

DATA

Leak Check Rate

ISOKINETICS = 1034

TEST NUMBER 8

Vac
in. Hg ft³/min

DATE 3-29-79

Sampling Time
Per Point, Min
3Before
After

OPERATOR

FUEL Suel's 14.11

SITE H

PROBE LOCATION Stack

Sample Point	Time	METER CONDITIONS			TEMPERATURES, °F							O ₂ , %	Vac.
		ΔP _s	ΔH	Meter Reading	Stack	Probe	Oven	Impingers		Meter			
								In	Out				
Fast	—	.00	—	545.07	—	—	—	—	—	—	—	—	
2	3 min	.02	.12	545.62	390	210	160	80	60	55		10	
3	3 min	.03	.18	546.48	390	250	180	100	60	60		15	
4	3 min	.035	.25	547.43	390	250	180	100	60	60		20	
5	3 min	.04	.30	548.48	390	200	180	110	60	63		20	
6	3 min	.035	.26	549.43	400	200	200	125	60	65		20	
7	4 min	.04	.30	551.20	390	200	200	110	60	65		30	
8	1	.025	.18	552.11	390	260	200	120	60	68		20	
9		.025	.18	553.14	380	280	200	125	55	65		20	
10		.01	—	—	—	—	—	—	—	—	—	—	
11		.015	.11	553.89	380	280	180	120	55	65		10	
12		—	—	—	—	—	—	—	—	—	—	—	
13		.02	.15	554.82	380	200	200	90	65	60		—	
14		.025	.20	556.05	380	240	180	100	50	60		20	
15		.03	.24	557.30	360	280	180	110	50	60		20	
16		.035	.29	558.65	380	280	180	100	50	60		20	
17		.04	.32	560.24	380	270	160	100	50	63		30	
18		.05	.40	561.89	375	260	200	100	50	63		50	
19		.09	.72	564.20	380	260	200	110	50	65		40	
20		.09	.72	566.49	370	260	200	125	50	65		40	
21		.085	.69	568.90	370	260	200	120	50	67		40	
22		.08	.64	571.10	370	270	210	130	50	67		40	
23		.07	.56	573.19	380	270	210	140	50	67		30	
24	1	.04	.32	574.72	—	270	220	140	55	70		20	
	74												
Average		0.038	0.340		381°F					63°F			

Nomenclature Setup

METER VOL. END 574.72
START 545.07
SAMPLE VOL. 24.63 ft³

C _{pitot}	Stack Press. In. Hg-Gauge	Barometric Pressure
0.53	-0.20	29.3

Percent O₂ = 3.21x Alim. Gauge
2x Stack 20" Diameter

P_{meter} = C
P_{stack} = T_{stack}
T_{meter} = ΔP
ΔH_g = Noz(Ideal) =
H₂O = 2 ft Noz(Actual) =

Imp.	Vol. (End)	Vol. (Start)	ΔVol. (ml)
#1	135	100	35
#2	102	100	2
#3	5	0	5
Total			42

#4	g(End)	g(Start)	Δgrams
Silica Gel	154.7	150.0	4.7
Total Vol. H ₂ O			51.4 ml

PARTICULATE

DATA

Leak Check Rate

ISO KINETICS = 97.7

TEST NUMBER 9

Vac
in. Hg ft³/min

DATE 3-30-79

Sampling Time
Per Point, Min
3

Before
After

OPERATOR

FUEL Sand's 17.11

SITE H

PROBE LOCATION 54.6

Sample Point	Time	METER CONDITIONS			TEMPERATURES, °F							O ₂ , %	Vac.
		ΔP _s	ΔH	Meter Reading	Stack	Probe	Oven	Impingers		Meter			
								In	Out				
1	3m	.02	.48	576.14	335	265	270	110	45	55		3.0	
2		.03	.73	577.55	335	270	270	100	45	55		3.8	
3		.04	.97	577.85	335	270	230	150	45	55		5.0	
4		.05	1.21	582.12	340	280	230	170	45	55		6.0	
5		.05	1.21	584.37	335	280	240	170	45	55		6.0	
6		.055	1.33	586.67		285	250	170	45	55		6.0	
7		.05	1.21	589.65		285	255	170	45	55		6.0	
8		.05	1.21	592.94		285	270	170	45	55		6.0	
9		.04	.97	593.95		295	280	175	45	55		4.2	
10		.03	.73	595.71		295	280	175	45	55		3.8	
11		.025	.60	597.35		270	290	170	45	58		3.0	
12		.015	.36	598.50		275	290	195	45	58		2.0	
13		.01	.221	599.67		240	275	130	48	58		1.3	
14		.01	.271	600.61		245	275	130	48	58		1.3	
15		.01	.221	601.52		245	275	150	48	58		1.3	
16		.01	.221	602.46		250	280	155	48	58		1.3	
17		.015	.36	603.60		250	280	160	48	58		2.0	
18		.025	.60	605.24				170	48	58		3.7	
19		.05	1.21	607.51						58		6.0	
20		.055	1.33	609.97						58		6.1	
21		.06	1.45	612.51		270	285	190	48	60		7.0	
22		.05	1.21	614.74						60			
23		.04	.97	616.70						60			
24	✓	.025	.60	618.31	✓					60			
	72												
Average		0.034	0.615		335°F					57.5			

Nomograph Setup

METER VOL. END 618.31

START 574.73

SAMPLE VOL. 43.59 ft³

C _p Pitot	Stack Press. In. Hg-Gauge	Barometric Pressure
1.837	-.18	29.34

Percent O₂ = 11.6

1/2 inch nozzle

P_{meter} = C
P_{stack} = T_{stack}
T_{meter} = ΔP
ΔH = Noz(Ideal) =
% H₂O = 7.8 Noz(Actual) =

Imp.	Vol. (End)	Vol. (Start)	ΔVol. (ml)
#1	14.5	10.0	4.5
#2	1.7	1.0	.7
#3	0	0	0
Total			4.7
#4	q(End)	q(Start)	Δgrams
Silica Gel	180.0	150.0	30.0
Total Vol. H ₂ O			77.0 ml

PARTICULATE LAB WORKSHEET

TEST NO. 3 (Inlet, Outlet) LOCATION H
 Date 3/22/70 Box No. _____ Eng. _____
 Test Description _____

Dry Gas Meter Vol (ft³)

Final _____
 Initial _____
 Δ DgV _____

Impinger Water Vol (ml)

	1	2	3	Total
Final				
Initial	100.0	100.0	0	
Δ Vlc				

CONTENT	H ₂ O RINSE	ACETONE RINSE	DRY FLASK	FILTER NO.	BLANK NO.	
BOTTLE NO.						
BEAKER NO.		2	4	#2		
DATE WT.		3.22	3.22	3/22/70		
TARE WT.	1	100.6057	100.7917	.7642		
	2	100.6053	100.7920	.7644		
	3	100.6059	100.7919	.7641		
	4					
AVG.		100.6058	100.7919	.7642		

POST TEST WTS.

	1	100.9557	104.6712	.7515		
	2	100.9557	104.6712	.7515		
	3	100.9557	104.6712	.7516		
	4					
AVG.		100.9557	104.6714	.9516		
Δ WT.		.3494	3.9145	.1874		

Δ Vlc = _____ ml LOAD _____ klb/hr
 Δ DgV = _____ ft³ O₂ _____ %
 Δ Mn 4421.8 mgm REMARKS: _____

PARTICULATE LAB WORKSHEET

TEST NO. 5 (Inlet, Outlet)

LOCATION SITE H

Date 3/26/79

Box No. _____

Eng. _____

Test Description MIN O₂, HIGH OPA

Dry Gas Meter Vol (ft³),

Final _____
Initial _____
Δ DgV _____

Impinger Water Vol (ml)

Final _____
Initial _____
Δ Vlc _____

1	2	3	Total

CONTENT	H ₂ O RINSE	ACETONE RINSE	DRY FLASK	FILTER NO.	BLANK NO.	
BOTTLE NO.						
BEAKER NO.		<u># 8</u>	<u># 5</u>	<u># 3</u>		
DATE WT.		<u>3/20/79</u>	<u>3/20/79</u>	<u>3/20/79</u>		
TARE WT.	1	<u>99.3337</u>	<u>99.9256</u>	<u>.7585</u>		
	2	<u>99.3341</u>	<u>99.9257</u>	<u>.7588</u>		
	3	<u>99.3340</u>	<u>99.9258</u>	<u>.7586</u>		
	4					
AVG.		<u>99.3339</u>	<u>99.9257</u>	<u>.7586</u>		

POST TEST WTS.

	1	<u>99.4510</u>	<u>100.7210</u>	<u>.8218</u>		
	2	<u>99.4528</u>	<u>100.7203</u>	<u>.8214</u>		
	3	<u>99.4506</u>	<u>100.7204</u>	<u>.8220</u>		
	4	<u>99.4504</u>	<u>100.7198</u>			
AVG.		<u>99.4512</u>	<u>100.7204</u>	<u>.8217</u>		
Δ WT.		<u>.1173</u>	<u>.7947</u>	<u>.0632</u>		

Δ Vlc = _____ ml

LOAD _____ klb/hr

Δ DgV = _____ ft³

O₂ _____ %

Δ Mn 975.2 mgm

REMARKS: _____

PARTICULATE LAB WORKSHEET

TEST NO. 6 (Inlet, Outlet) LOCATION SITE H
 Date 3/27/74 Box No. _____ Eng. _____
 Test Description HIGH O₂, HIGH OPA

Dry Gas Meter Vol (ft³)

Final _____
 Initial _____
 Δ DgV _____

Impinger Water Vol (ml)

	1	2	3	Total
Final				
Initial				
Δ Vlc				

CONTENT	H ₂ O RINSE	ACETONE RINSE	DRY FLASK	FILTER NO.	BLANK NO.	
BOTTLE NO.						
BEAKER NO.		#10	#11	#4		
DATE WT.		3/20/79	3/20/79	3/20/79		
TARE WT.	1	100.9350	99.8079	.7619		
	2	100.9351	99.8083	.7617		
	3	100.9352	99.8083	.7618		
	4	—	—	—		
AVG.		100.9351	99.8081	.7618		

POST TEST WTS.

	1	101.4588	99.9893	.8214		
	2	101.4585	99.9886	.8215		
	3	101.4505	99.9888	.8213		
	4					
AVG.		101.4559	99.9889	.8214		
Δ WT.		.5208	.1079	.0596		

Δ Vlc = _____ ml LOAD _____ klb/hr
 Δ DgV = _____ ft³ O₂ _____ %
 Δ Mn 688.3 mgm REMARKS: _____

PARTICULATE LAB WORKSHEET

TEST NO. 8 (Inlet, Outlet) LOCATION ABMA SITE H
 Date 3/29/79 Box No. _____ Eng. T. Dora
 Test Description 75% LIAD, NORMAL O₂ & O₂A

Dry Gas Meter Vol (ft³)

Final _____
 Initial _____
 Δ DgV _____

Impinger Water Vol (ml)

	1	2	3	Total
Final				
Initial				
Δ Vlc				

CONTENT	H ₂ O RINSE	ACETONE RINSE	DRY FLASK	FILTER NO.	BLANK NO.	
BOTTLE NO.						
BEAKER NO.		<u>12</u>	<u>15</u>	<u>5</u>		
DATE WT.		<u>3/20/79</u>	<u>3/20/79</u>	<u>3/20/79</u>		
TARE WT.	1	<u>100.9680</u>	<u>101.4094</u>	<u>.7681</u>		
	2	<u>100.9678</u>	<u>101.4096</u>	<u>.7680</u>		
	3	<u>100.9679</u>	<u>101.4097</u>	<u>.7681</u>		
	4					
AVG.		<u>100.9679</u>	<u>101.4096</u>	<u>.7681</u>		

POST TEST WTS.

	1	<u>101.0797</u>	<u>101.6676</u>	<u>.8745</u>		
	2	<u>101.0802</u>	<u>101.6672</u>	<u>.8750</u>		
	3	<u>101.0799</u>	<u>101.6669</u>	<u>.8752</u>		
	4					
AVG.		<u>101.0799</u>	<u>101.6672</u>	<u>0.8749</u>		
Δ WT.		<u>0.1120</u>	<u>0.2576</u>	<u>0.1068</u>		

Δ Vlc = _____ ml
 Δ DgV = _____ ft³
 Δ Mn 476.4 mgm

LOAD _____ klb/hr
 O₂ _____ %
 REMARKS: _____

PARTICULATE LAB WORKSHEET

TEST NO. 9 (Inlet, Outlet) LOCATION SITE H
 Date 3/30/79 Box No. _____ Eng. T. J. ...
 Test Description 50% LOAD, NORMAL O₂ & O₂A

Dry Gas Meter Vol (ft³)

Final _____
 Initial _____
 Δ DgV _____

Impinger Water Vol (ml)

	1	2	3	Total
Final				
Initial				
Δ Vlc				

CONTENT	H ₂ O RINSE	ACETONE RINSE	DRY FLASK	FILTER NO.	BLANK NO.	
BOTTLE NO.						
BEAKER NO.		31	30	829		
DATE WT.		3/20/79	3/20/79	3/20/79		
TARE WT.	1	103.9747	103.1091	.7615		
	2	103.9751	103.1095	.7618		
	3	103.9752	103.1094	.7620		
	4					
AVG.		103.9750	103.1093	.7618		

POST TEST WTS.

	1	104.0496	103.6868	.7739		
	2	104.0494	103.6866	.7741		
	3	104.0492	103.6863	.7746		
	4					
AVG.		104.0494	103.6866	.7742		
Δ WT.		0.0744	0.5773	0.0124		

Δ Vlc = _____ ml
 Δ DgV = _____ ft³
 Δ Mn 664.1 mgm

LOAD _____ klb/hr
 O₂ _____ %

REMARKS: _____

SECTION 3.0
GASEOUS DATA

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GASEOUS EMISSION SUMMARY

Location: TEST SITE #
 Fuel: SANDS HILL COAL

TEST NO.	DATE	LOAD %	CONDITIONS	Boiler Outlet										SO ₂ ppm Dry	SO ₃ ppm Dry	NOTES
				O ₂ % Dry	CO ₂ % Dry	CO ppm Dry	NO ppm Dry	NO ₂ ppm Wet	HC ppm Wet	O ₂ % Dry	CO ₂ % Dry	CO ppm Dry	NO ppm Dry			
01A	03-19-79	87.8	VARY O ₂ , NORM OFA	9.2	9.2	153	305									
01B	03-14-79	87.8	↓	10.5	7.6	239	360									
02A	03-20-79	96.0	VARY O ₂ , NORM OFA	7.2	11.0	163	270	0						1565		
02B	03-20-79	96.0	↓	8.4	9.6	96	275	0						1254		
02C	03-20-79	96.0		10.3	7.9	274	367	0						1473		
02D	03-20-79	96.0		9.3	8.9	196	276	4						1692		
02E	03-20-79	96.0		8.8	8.8	162	312	0						1918		
02F	03-20-79	96.0	↓	7.7	9.1	712	276	0						1618		
03	03-22-79	100.0	MIN O ₂ , LOW OFA	8.0	10.8	513	274	13						1359		
04	03-23-79	49.9	VARY OFA	9.8	8.4	41	279									
05	03-26-79	99.0	LOW O ₂ , HIGH OFA	9.4	9.2	41	339	1	5					1830		
06	03-27-79	91.3	HIGH O ₂ , HIGH OFA	10.6	9.1	69	331	9	35					1754		
07A	03-28-79	75.5	VARY O ₂ , LOW OFA	8.2	10.3	56	267	1	29					2631		
07B	03-28-79	75.5	↓	12.8	5.7	340	344	10	132					3821		
07C	03-28-79	75.5		10.1	9.4	99	314	2	99					3315		
07D	03-28-79	75.5	↓	5.3	13.2	665	161	0	64					2300		

NOTE: All parts per million (ppm) figures are corrected to a 3% O₂ constant dilution factor

#15900

Location: Test Site 4

Fuel: SHOPS HILL COAL

[illegible]

NOTE: All parts per million (ppm) figures are corrected to a 3% O₂ constant dilution factor

#15900

REV.

KVB

GASEOUS EMISSIONS DATA

TEST SITE H
TEST NO. 1 A x B
DATE 3-19-79

FUEL SANDS HILL COAL

LOAD

CONDITIONS VARY O_2 GASEOUS EMISSIONS

DATA TAKEN BY NORM. OFA

PORT 1 = PORT C

[illegible]

NOTE: Parts per million (ppm) figures are corrected to 3% O₂

KVB

GASEOUS EMISSIONS DATA

TEST SITE H
TEST NO. #2
DATE 3/20/79

FUEL Sandst/Hill
LOAD 100%
CONDITIONS Ver 7 O₂ NORM OFA
DATA TAKEN BY SEC

Probe Position	Time	O2 % (dry)	CO2 % (dry)	CO ppm(dry)		NO ppm(dry)		HOT LINE SAMPLES, PPM(WET)								Remarks	
				unc	cor	unc	cor	NOx		NO		NO2		SO2			
								unc	cor	unc	cor	unc	cor	unc	cor		unc
																	Test 2A
H	9:15	7.1	11.3	40	52	215	278										Hot line cont
H	9:30	7.2	10.6	210	274	200	261	175	228	175	228	0	0	1200	1565		for H/C 2-B
C	13:20	8.7	11.3														
H																	
C	13:30	7.3	12.5	80	105	210	276										
H																	Difficulty
	3/21/79																with SO2
C	8:25	8.4	9.1	70	100	191	267										inst. flg
H	8:45	8.8	9.5	70	103	180	266	190	280	165	243			850	1254		sample cell
C	9:00	8.1	10.2	60	84	210	293										lenses need
																	cleaning
	3/21/79																
C	9:45	10.25	8	160	269	250	385										
H	9:55	10.75	7.4	170	298	215	378	197	346	197	346	0	0	880	1473		
C	10:22	9.75	8.3	160	255	212	338										
	3/21/79																
C	11:12	9.3	8.9	115	177	178	274										
H	11:25	9.3	8.9	140	215	180	277	170	266	170	262	3	4	1100	1692		
	3/21/79																
C	13:44	9.8	8.6	60	88	210	310										
H	13:20	9.8	8.9	160	236	212	313	200	295	200	295	0	0	1300	1918		
	3/21/79																
C	13:45	7.3	9.8	790	1061	160	215										
H	13:55	8.1	9.5	260	363	170	237	158	220	158	220	0	0	1160	1618		
	AVG.																
	AVG.																
	AVG.																

NOTE: Parts per million (ppm) figures are corrected to 3% O₂

KVB

GASEOUS EMISSIONS DATA

TEST SITE H
TEST NO. 3 (PARTIC.)
DATE 3-20-79

FUEL SANDS HILL BIT. COAL

LOAD 100%

CONDITIONS MIN Q₂ NORM (LOW) DFA

DATA TAKEN BY Shumaker

[illegible]

NOTE: Parts per million (ppm) figures are corrected to 3% O₂

KVB

GASEOUS EMISSIONS DATA

TEST SITE 4
TEST NO. 4
DATE 3/23/73

FUEL SANDS HILL BIT. COAL

LOAD 50% FULL LOAD

CONDITIONS OFA TRAVEL VARY OFA

DATA TAKEN BY _____

[illegible]

NOTE: Parts per million (ppm) figures are corrected to 3% O₂

KVB

GASEOUS EMISSIONS DATA

TEST SITE ABMA SITE H
TEST NO. 5 (BrinkF. Partic.)
DATE 3-26-79

FUEL SANDS HILL BIT. COAL

LOAD 100%

CONDITIONS Low Q_2 , HIGH OFA

DATA TAKEN BY

[illegible]

NOTE: Parts per million (ppm) figures are corrected to 3% O₂

KVB

GASEOUS EMISSIONS DATA

TEST SITE H
TEST NO. 6 (PARTIC.)
DATE 3/27/79

FUEL Sandhill Coal

LOAD 100%

CONDITIONS High O₂ High OFA

DATA TAKEN BY JEC

[illegible]

NOTE: Parts per million (ppm) figures are corrected to 3% O₂

KVB

GASEOUS EMISSIONS DATA

TEST SITE ABMA SITE H
TEST NO. 7
DATE 3-28-79

FUEL SANDS HILL B.T. COAL
LOAD 75%
CONDITIONS VARY O₂
DATA TAKEN BY M. Gabriel

Probe Position	Time	O ₂ % (drv)	CO ₂ % (drv)	CO ppm(dry)		NO ppm(dry)		HOT LINE SAMPLES, FPM(WET)								SO ₂ Remarks	
				unc	cor	unc	cor	NOx		NO		NO ₂		SOHC		unc	cor
Hot X	0835	7.3	10.1	160		154		140		137		3		0		unc	cor
Cold X	condition change																
7A																	
Hot & Cold	0915	8.1	10.6	40	52.6	152	200	138	181	136	179	2	3	0	0	unc	cor
7A																	
Hot & Cold	0945	8.7	10.2	30	44	153	224	143	209	143	209	0	0	0	0	unc	cor
7A																	
Hot & Cold	1015	7.3	11.4	80	105	150	197	133	175	130	171	3	4	30	39	unc	cor
7A	condition change	7.9	10.2	25	34	140	192	128	176	128	176	0	0	40	55	unc	cor
Hot & Cold	1055	9.0	9.3	30	45	147	221	135	203	135	203	0	0	35	53	unc	cor
Test 7B																	
Hot & Cold	1130	12.7	5.7	160	347	150	325	143	310	140	304	3	7	60	130	unc	cor
Stable condition																	
Hot & Cold	1115	12.9	5.6	150	333	163	362	149	376	163	362	6	13	60	133	unc	cor
Test 7C																	
Hot & Cold	1210	10.1	9.4	60	99	190	314	179	296	178	294	1	2	60	99	over 2000 ppm	7345
Test 7D	1400	5.3	13.2	580	665	140	161	125	143	125	143	0	0	56	64	over 2000 ppm	7245
7	1410																
7a	AVG.	8.2	10.3	56		207		189		188		1		29		(SO ₂)cor	2631
7b	AVG.	12.8	5.7	340		344		343		333		10		132			3421
	AVG.																

NOTE: Parts per million (ppm) figures are corrected to 3% O₂

GASEOUS EMISSIONS DATA

LOAD

DATA TAKEN BY

NOTE: Parts per million (ppm) figures are corrected to 3% O₂

KVB

GASEOUS EMISSIONS DATA

TEST SITE ABMA SITE H
TEST NO. 9 (PARTIC.)
DATE 3-30-79

FUEL SANDS HILL COAL

LOAD 507

CONDITIONS 50% - Norm of A, NORM O₂

DATA TAKEN BY

[illegible]

NOTE: Parts per million (ppm) figures are corrected to 3% O₂

GASEOUS EMISSIONS DATA

DATA TAKEN BY Jackson

NOTE: Parts per million (ppm) figures are corrected to 3% O₂

KVB

GASEOUS EMISSIONS DATA

TEST SITE ABMA SITE H

FUEL SANDS HILL BIT. COAL

TEST NO. 11 (SASS & GORSEYR-ROSS)

LOAD _____

DATE 4-4-79

CONDITIONS MIN O₂ NORM OFA

DATA TAKEN BY M. Gabriel & R. Tidona

Probe Position	Time	O2 % (dry)	CO2 % (dry)	CO ppm(dry)		NO ppm(dry)		HOT LINE SAMPLES, PPM(WET)								302 Remarks unc. / cor	
				NOx		NO		NO2		HC							
				unc	cor	unc	cor	unc	cor	unc	cor	unc	cor	unc	cor	unc	cor
H	0905	9.65	9.0	110	174	215	341	195	309	195	309	0	0	21	33	1010 / 1602	
Hot	1340	9.4	9.4	135	209	237	368	216	335	216	335	0	0	88	137	1020 / 1583	
Hot-	1410	9.7	8.8	120	191	242	385	218	347	218	347	0	0	90	143	1080 / 1720	
Hot	1440	9.65	9.2	108	171	224	355	206	327	206	327	0	0	75	119	1260 / 1998	
Hot	1500	9.13	9.2	165	250	210	318	185	281	185	281	0	0	88	133	1360 / 2062	
Hot	1524	9.94	9.6	125	187	235	351	228	340	228	340	0	0	71	106	1090 / 1627	

NOTE: Parts per million (ppm) figures are corrected to 3% O₂

Background HC reading (on ambient air) at end of test = 120 ppm 15900



SO_x DATA SHEET (GOKSOYR-ROSS METHOD)

Test No. 11 Date 04-04-79 Location TEST SITE #
 Unit No. — Fuel SANDS HILL COAL
 Capacity 100 % Unit Type RILEY
 Engr. RJT Conditions MAN O₂, NORM O₂ PBAR = 29.10" Hg

Meter Finish 456.721
 Meter Start 454.850

Sample Volume Collected = 1.871 ADCF

Start Time	Stop Time	Elapsed Time (minutes)
<u>12:25</u>	<u>12:50</u>	<u>25 minutes</u>

Total Sampling Time = _____ min.

Time	Meter Vac. ("Hg)	Temperatures (°F)					Sample Flow Rate (ADCFM)
		Meter	Coil In	Coil Out	Water Bath	Stack	
<u>12:25</u>	<u>5</u>		<u>103</u>	<u>115</u>	<u>129</u>	<u>540</u>	<u>0.075</u>
<u>12:30</u>	<u> </u>		<u>104</u>	<u>115</u>	<u>128</u>	<u>540</u>	<u> </u>
<u>12:35</u>	<u> </u>		<u>112</u>	<u>114</u>	<u>137</u>	<u>536</u>	<u> </u>
<u>12:40</u>	<u> </u>		<u>109</u>	<u>112</u>	<u>133</u>	<u>540</u>	<u> </u>
<u>12:45</u>	<u> </u>		<u>102</u>	<u>110</u>	<u>136</u>	<u>540</u>	<u> </u>

NOTES: (1) Sample flow rate at meter should be 0.075 ADCFM
 or 0.01 cf/8 secs.

(2) Total sample volume collected should be ~1.5 cf (~ 20 minutes sampling time).

Date 6/14/79

K V B. INC.

Test No. 11

SOx DATA SHEET

TEST NO. 11 UNIT NO. _____ FUEL Coal LOAD 100% klb/hr Location #

Box No.					
Time					
Temp. in Gas Meter					
Press. in Gas Meter					
Meter Reading					
Barom. Press.					
Percent Oxygen					
N ₂ Purge Time					

Calculation: SO₃ or SO₂, ppm = $\frac{(A - B) \times N \times F \times (460 + T) \times 24}{V (P + p)}$ Excess O₂ _____ %

	SO ₂	SO ₃	SO _x
A = Ml of ^{N₂O₄ soln} lead perchlorate used for sample =	<u>1.5</u>	<u>3.4</u>	
B = Ml of ^{N₂O₄ soln} lead perchlorate used for blank =	<u>2.0</u>	<u>0.0</u>	
N = Normality of lead perchlorate titrant =	<u>0.0236</u>	<u>0.0236</u>	
F = Dilution factor =	<u>20.0</u>	<u>1.0</u>	
T = Average temp. in gas meter =	<u>42°F</u>		
V = Volume of gas sample ft ³ =	<u>1.52</u>	<u>1.52</u>	
P = Barometric pressure =	<u>29.10</u>	<u>29.10</u>	
p = Pressure in gas meter =	<u>27.10</u>	<u>27.10</u>	
Concentration, C, ppm =	<u>1450</u>	<u>21</u>	
^{C, ppm corrected} gm/dscm =	<u>2269</u>	<u>33</u>	
Emission, E, g/Mcal =			
E = CF $\left[\frac{2090}{20.9 - x_{O_2}} \right]$ lb/MBtu =			
where	ng/J =		

C = pollutant concentration, g/dscm
F, volume factor = _____ dscm/10⁴ cal_____ dscf/10⁴ Btu

from Fed. Reg. 9/11/74 p 32856

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60-14
rev. 1/2/75

SECTION 4.0
PARTICLE SIZE DISTRIBUTION

	<u>PAGE</u>
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4.2 SASS	67
4.3 BAHCO	68

KVB

BRINK CASCADE IMPACTOR DATA SHEET

TEST NO. 5 LOAD 100%
 TEST SITE H % O₂ 8
 TEST DATE 3/26/79 FUEL Sands Hill Coal
 SAMPLE LOCATION Blr. Out SPECIAL CONDITIONS Min. O₂, High OFA

GAS VELOCITY DETERMINATION

PITOT TUBE ΔP 0.14 BAROMETRIC PRESS in. Hg, P_{bar} 29.22
 GAS TEMP. °R, T_s 910 GAS STATIC PRESS in. H₂O -0.245
 PITOT CORRECTION FACTOR, C_p 0.837 GAS STATIC PRESS in. Hg abs, P_s 29.20
 MOLECULAR WT. FLUE GAS, MWs 29.4

$$V_s = 85.48 C_p \left(\frac{T_s \Delta P}{P_s M W_s} \right)^{1/2} = \underline{27.56} \text{ ft/sec}$$

IMPACTOR FLOW RATE DETERMINATION

NOZZLE DIAMETER inches, D_n 0.079
 NOZZLE AREA ft², A_n 3.404×10^{-5} $A_n = \pi (D_n/24)^2$
 $Q_n = V_s A_n 60 = \underline{5.811 \times 10^{-2}} \text{ ft}^3/\text{min}$ at nozzle
 $Q_c = Q_n \left(\frac{P_s M W_s}{1.3 T_s} \right)^{1/2} = \underline{4.322 \times 10^{-2}} \text{ ft}^3/\text{min}$ corrected to calibration conditions
 PRESSURE DROP ACROSS IMPACTOR FROM CALIBRATION CURVE 4.5 in. H₂O
 OPERATING VACUUM (corrected for static pressure of duct) 4.7 in. H₂O

ISOKINETICS DETERMINATION

	SAMPLE TIME (θ)	METER READING (V_m)	METER TEMP (T_m)
INITIAL	10:06	451.971	35
FINAL	11:40	454.464	40
Δ	81 min.	2.513	38

%H₂O = 6 %

$$I = \frac{1.667 T_s V_m P_{bar}}{\theta T_m V_s P_s A_n \left(1 - \frac{\%H_2O}{100} \right)} = \underline{107} \%$$

BRINK CASCADE IMPACTOR LAB WORKSHEET

TEST No. 5LOCATION ABMA SITE HTEST DATE 3/24/79ENGINEER T. DONATEST DESCRIPTION MIN O₂, HIGH OFA

PRE TEST WEIGHTS (GRAMS)



PLATE NO.		CYCLONE	1	2	3	4	5	FINAL FILTER
DATE WT.		3/20/79	3/24/79					
TARE WT.	1	100.0746	3.6607	3.3509	3.7344	3.2817	3.7558	0.0381
	2	100.0745	3.6607	3.3509	3.7344	3.2818	3.7558	0.0380
	3	100.0746	3.6607	3.3509	3.7343	3.2818	3.7558	0.0380
	4							
AVERAGE		100.0746	3.6608	3.3509	3.7344	3.2818	3.7558	0.0380

POST TEST WEIGHTS (GRAMS)

* Filter
Became wet
from condensation
after Test

DATE WT.								No good
GROSS WT.	1	100.0772	3.6626	3.3520	3.7350	3.2823	3.7561	.0626
	2	100.0769	3.6627	3.3521	3.7350	3.2823	3.7561	.0627
	3	100.0765	3.6626	3.3518	3.7349	3.2824	3.7565	.0629
	4							
AVERAGE		100.0769	3.6626	3.3520	3.7353	3.2823	3.7562	.0627

NET TEST RESULTS (MILLIGRAMS)

Net In
Total

NET WT.	.00233	.0018	.0011	.0009	.00053	.00043	.02473
PERCENT	32.9	25.4	15.5	12.7	7.5	6.1	

TOTAL NET WEIGHT 7.09 mgm

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BRINK CASCADE IMPACTOR DATA REDUCTION

TEST NO. 5 LOAD 100%
 TEST SITE H % O₂ B
 TEST DATE 3/26/79 FUEL Sand's Hill Coal
 SAMPLE LOCATION B/r. Out SPECIAL CONDITIONS Min. O₂, High OFA

Pp - Density of particles 2.5 g/cm³
 μ - Viscosity of flue gas 2.505 poise
 MWs - Molecular wt. flue gas 29.4 g/g mole
 ΔP_I - Pressure drop across impactor 4.5 in H₂O
 Ps - Absolute stack pressure 29.2 in. Hg
 Ts - Absolute stack temperature 910 °R
 Qs - Actual flow rate at stack conditions 0.0581 ft³/min
 Vm - Dry gas volume 2.513 SCF
 Mn - Total particulate mass 7.09 mgm
 Cn - Total concentration 0.044 grains/SCF
 I - Percent isokinetics 107 %
 Vs - Gas velocity 27.56 ft/sec.
 Dn - Nozzle diameter 0.079 in.

Stage Number	CYCLONE	1	2	3	4	5	FINAL FILTER
Dj - Jet Diameter, cm		0.2490	0.1775	0.1396	0.0946	0.0731	
Fj - Press. factor, n.d.		0.0210	0.0273	0.0395	0.0903	0.3277	
Ds, $\overline{50}$ Stokes diameter, μm		3.21	1.86	1.25	0.62	0.37	
D _A , $\overline{50}$ Aerodynamic diameter, μm		5.19	3.05	2.07	1.08	0.68	
D _{AI} , $\overline{50}$ Aerodynamic impaction diameter, μm		5.38	3.24	2.26	1.26	0.85	
Mn - Particulate mass, mgm	2.33	1.8	1.1	0.9	0.5	0.4	N.A.
% - Percent of Total	32.9	25.4	15.5	12.7	7.1	5.6	0
Cumulative percent	66.3	40.9	25.4	12.7	5.6	0	
Cn - Concentration, grains/SCF	0.014	0.011	0.007	0.006	0.003	0.002	N.A.
Cumulative concentration, grains/SCF	0.014	0.025	0.032	0.038	0.041	0.043	



SITE C
SASS GRAVIMETRICS

Test 11	10μ	17.1112	14.21 % passing
	3μ	1.9523	4.42 % passing
	1μ	0.2498	3.17 % passing
Filter		<u>0.6317</u>	
Total		19.9450 g	

KVB
6990-01
July 12, 1979

Sample No. K-23148
Sample Description Fly Ash
H-3
3/22/79

Bahco Particle
Size Determination

% Through #100 44.9
(149 Microns)

Results:	<u>Terminal Velocity</u>	<u>Diameter (Microns)</u>	<u>%Smaller</u>
	112.	25.	18.0
	79.	21.	16.0
	31.	13.	11.4
	12.3	8.3	6.9
	4.15	4.8	3.7
	0.96	2.3	1.6
	0.35	1.4	0.6

Density, gms/cc. (On
#100 Mesh Material
Only) 2.47

Screen Sizing

% Through #10	100.0
16	96.1
30	90.4
50	71.5
100	44.9
200	22.3
325	13.3

SECTION 5.0
FUEL AND ASH ANALYSIS

	<u>PAGE</u>
5.1 COMMERCIAL TESTING ANALYSIS	70
5.2 COMBUSTIBLE ANALYSIS	82
5.3 COAL SIEVE ANALYSIS	83

COMMERCIAL TESTING & ENGINEERING CO.

GENERAL OFFICES: 228 NORTH LA SALLE STREET, CHICAGO, ILLINOIS 60601 AREA CODE 312 726-8434



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16130 VAN DRUNEN RD., SOUTH HOLLAND, IL 60473
OFFICE TEL. (312) 264-1173

KVB, INC.
6176 Olson Memorial Highway
Minneapolis, MN 55422

April 16, 1979

Sample identification
by KVB, Inc.

Kind of sample reported to us	Coal	Site H
		Test #3
Sample taken at	-----	
Sample taken by	KVB, Inc.	
Date sampled	3/22/79	
Date received	4/9/79	

Analysis report no. 71- 29662

PROXIMATE ANALYSIS

	<u>As Received</u>	<u>Dry Basis</u>
% Moisture	10.76	xxxxx
% Ash	7.10	7.96
% Volatile	35.88	40.21
% Fixed Carbon	46.26	51.83
	<u>100.00</u>	<u>100.00</u>
Btu/lb.	11773	13193
% Sulfur	1.57	1.76

FUSION TEMPERATURE OF ASH

	<u>Reducing</u>	<u>Oxidizing</u>	
Initial Deformation	xxxx °F	xxxx °F	
Softening (H = W)	xxxx °F	xxxx °F	
Softening (H = ½ W)	xxxx °F	xxxx °F	
Fluid	xxxx °F	xxxx °F	

H = Cone Height
W = Cone Width

Respectfully submitted,
COMMERCIAL TESTING & ENGINEERING CO.

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R. A. Houser
R. A. HOUSER, Manager, Midwest Division



Charter Member

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KVB, INC.
6176 Olson Memorial Highway
Minneapolis, MN 55422

April 16, 1979

Sample identification
by KVB, Inc.

Kind of sample reported to us	Coal	Site H
		Test #5
Sample taken at	-----	
Sample taken by	KVB, Inc.	
Date sampled	3/26/79	
Date received	4/9/79	

Analysis report no. 71- 29663

PROXIMATE ANALYSIS

	<u>As Received</u>	<u>Dry Basis</u>
% Moisture	13.01	xxxxx
% Ash	8.73	10.04
% Volatile	33.53	38.54
% Fixed Carbon	44.73	51.42
	<u>100.00</u>	<u>100.00</u>
Btu/lb.	11421	13129
% Sulfur	1.97	2.26

FUSION TEMPERATURE OF ASH

	<u>Reducing</u>	<u>Oxidizing</u>	
Initial Deformation	xxxx °F	xxxx °F	
Softening (H=W)	xxxx °F	xxxx °F	
Softening (H= 1/2 W)	xxxx °F	xxxx °F	
Fluid	xxxx °F	xxxx °F	

H = Cone Height
W = Cone Width

Respectfully submitted,
COMMERCIAL TESTING & ENGINEERING CO.

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R. A. HOUSER, Manager, Midwest Division



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OFFICE TEL. (312) 264-1173

KVB, INC.
6176 Olson Memorial Highway
Minneapolis, MN 55422

April 25, 1979

Kind of sample
reported to us Coal

Sample identification
by KVB, Inc.

Sample taken at Site H

Test #6

Sample taken by KVB, Inc.

Date sampled 3/27/79

Date received 4/9/79

Analysis report no. 71- 29664			% Weight		
PROXIMATE ANALYSIS	As received	Dry basis	ULTIMATE ANALYSIS	As received	Dry basis
% Moisture	12.31	xxxxx	Moisture	12.31	xxxxx
% Ash	12.34	14.07	Carbon	59.29	67.62
% Volatile	33.43	38.13	Hydrogen	4.15	4.73
% Fixed Carbon	41.92	47.80	Nitrogen	1.04	1.19
	100.00	100.00	Chlorine	0.09	0.10
Btu/lb.	10577	12062	Sulfur	1.82	2.08
% Sulfur	1.82	2.08	Ash	12.34	14.07
% Alk. as Na ₂ O	xxxxx	0.23	Oxygen (diff)	8.96	10.21
				100.00	100.00
SULFUR FORMS			MINERAL ANALYSIS OF ASH		
% Pyritic Sulfur	0.86	0.98	% Weight Ignited Basis		
% Sulfate Sulfur	0.23	0.26	Silica, SiO ₂	47.93	
% Organic Sulfur	0.73	0.84	Alumina, Al ₂ O ₃	27.35	
			Titania, TiO ₂	1.06	
WATER SOLUBLE ALKALIES			Ferric oxide, Fe ₂ O ₃	16.19	
% Na ₂ O =	xxxxx	----	Lime, CaO	1.59	
% K ₂ O =	xxxxx	----	Magnesia, MgO	0.72	
FUSION TEMPERATURE OF ASH			Potassium oxide, K ₂ O	2.03	
	Reducing	Oxidizing	Sodium oxide, Na ₂ O	0.29	
Initial Deformation	2400 °F	---- °F	Sulfur trioxide, SO ₃	0.78	
H is Cone Height Softening (H = W)	2550 °F	---- °F	Phos. pentoxide, P ₂ O ₅	0.33	
W is Cone Width Softening (H = 1/2 W)	2595 °F	---- °F	Undetermined	1.61	
Fluid	2700+ °F	---- °F		100.00	
% EQUILIBRIUM MOISTURE =	-----		SILICA VALUE =	72.15	
HARDGROVE GRINDABILITY INDEX =	43		BASE: ACID RATIO	0.27	
FREE SWELLING INDEX =	1-1/2		T ₂₅₀ Temperature =	2595 °F	
*These ignited basis results were used to calculate undetermined value above					
%Strontium oxide, SrO		0.00	Respectfully submitted,		
%Barium oxide, BaO		0.10	COMMERCIAL TESTING & ENGINEERING CO.		
%Manganese oxide, Mn ₂ O ₄		0.02			



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Respectfully submitted,
COMMERCIAL TESTING & ENGINEERING CO.

R. A. HOUSER, Manager, Midwest Division



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OFFICE TEL. (312) 264-1173

KVB, INC.
6176 Olson Memorial Highway
Minneapolis, MN 55422

April 16, 1979

Sample identification
by KVB, Inc.

Kind of sample reported to us	Coal	Site H
		Test #8
Sample taken at	-----	
Sample taken by	KVB, Inc.	
Date sampled	3/29/79	
Date received	4/9/79	

Analysis report no. 71- 29665

PROXIMATE ANALYSIS

	<u>As Received</u>	<u>Dry Basis</u>
% Moisture	11.19	xxxxx
% Ash	9.62	10.83
% Volatile	36.21	40.77
% Fixed Carbon	42.98	48.40
	100.00	100.00
Btu/lb.	11201	12612
% Sulfur	2.06	2.32

FUSION TEMPERATURE OF ASH

	<u>Reducing</u>	<u>Oxidizing</u>
Initial Deformation	xxxx °F	xxxx °F
Softening (H = W)	xxxx °F	xxxx °F
Softening (H = 1/2 W)	xxxx °F	xxxx °F
Fluid	xxxx °F	xxxx °F

H = Cone Height
W = Cone Width

Respectfully submitted,
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R. A. HOUSE, Manager, Midwest Division



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KVB, INC.
6176 Olson Memorial Highway
Minneapolis, MN 55422

April 16, 1979

Sample identification
by KVB, Inc.

Kind of sample reported to us	Coal	Site H
		Test #9
Sample taken at	-----	
Sample taken by	KVB, Inc.	
Date sampled	3/30/79	
Date received	4/9/79	

Analysis report no. 71- 29666

PROXIMATE ANALYSIS

	<u>As Received</u>	<u>Dry Basis</u>
% Moisture	10.90	xxxxx
% Ash	8.38	9.40
% Volatile	34.42	38.63
% Fixed Carbon	46.30	51.97
	<u>100.00</u>	<u>100.00</u>
Btu/lb.	11566	12981
% Sulfur	2.21	2.48

FUSION TEMPERATURE OF ASH

	<u>Reducing</u>	<u>Oxidizing</u>	
Initial Deformation	xxxx °F	xxxx °F	
Softening (H=W)	xxxx °F	xxxx °F	
Softening (H=½W)	xxxx °F	xxxx °F	
Fluid	xxxx °F	xxxx °F	

H = Cone Height
W = Cone Width

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R. A. ROUSER, Manager, Midwest Division

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KVB, INC.
6176 Olson Memorial Highway
Minneapolis, MN 55422

April 25, 1979

Kind of sample
reported to us Coal

Sample identification
by KVB, Inc.

Sample taken at Site H

Test #11

Sample taken by KVB, Inc.

Date sampled 4/4/79

Date received 4/9/79

Analysis report no. 71- 29667			% Weight		
PROXIMATE ANALYSIS	As received	Dry basis	ULTIMATE ANALYSIS	As received	Dry basis
% Moisture	11.20	xxxxx	Moisture	11.20	xxxxx
% Ash	5.52	6.22	Carbon	67.17	75.65
% Volatile	37.51	42.24	Hydrogen	4.56	5.13
% Fixed Carbon	45.77	51.54	Nitrogen	1.11	1.25
	100.00	100.00	Chlorine	0.05	0.06
Btu/lb.	11963	13473	Sulfur	1.62	1.83
% Sulfur	1.62	1.83	Ash	5.52	6.22
% Alk. as Na ₂ O	xxxxx	0.09	Oxygen (diff)	8.77	9.86
			100.00	100.00	
<u>SULFUR FORMS</u>			<u>MINERAL ANALYSIS OF ASH</u>	% Weight Ignited Basis	
% Pyritic Sulfur	0.96	1.08	Silica, SiO ₂	39.73	
% Sulfate Sulfur	0.00	0.00	Alumina, Al ₂ O ₃	23.32	
% Organic Sulfur	0.66	0.75	Titania, TiO ₂	1.12	
<u>WATER SOLUBLE ALKALIES</u>			Ferric oxide, Fe ₂ O ₃	28.23	
% Na ₂ O =	xxxxx	----	Lime, CaO	1.91	
% K ₂ O =	xxxxx	----	Magnesia, MgO	0.62	
<u>FUSION TEMPERATURE OF ASH</u>	Reducing	Oxidizing	Potassium oxide, K ₂ O	1.74	
Initial Deformation	2010 °F	----	Sodium oxide, Na ₂ O	0.23	
Softening (H = W)	2175 °F	----	Sulfur trioxide, SO ₃	0.66	
Softening (H = 1/2 W)	2215 °F	----	Phos. pentoxide, P ₂ O ₅	0.36	
Fluid	2495 °F	----	Undetermined	1.99	
% EQUILIBRIUM MOISTURE =	----		100.00		
HARDGROVE GRINDABILITY INDEX =	49		SILICA VALUE =	56.36	
FREE SWELLING INDEX =	2		BASE: ACID RATIO	0.51	
*These ignited basis results were used to calculate undetermined value above			T ₂₅₀ Temperature =	2300 °F	
% Strontium oxide, SrO	0.00				
% Barium oxide, BaO	0.07				
% Manganese oxide, Mn ₃ O ₄	0.02				

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Respectfully submitted,
COMMERCIAL TESTING & ENGINEERING CO.

R. A. HOUSER, Manager, Midwest Division



Charter Member

COMMERCIAL TESTING & ENGINEERING CO.

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OFFICE TEL. (312) 264-1173

KVB, INC.
A Research-Cottrell Company
6176 Olson Memorial Highway
Minneapolis, Minnesota

April 11, 1979

Sample Identification
by KVB, Inc.

Kind of sample reported to us	Bottom Ash	Test # 3
Sample taken at	Site H	
Sample taken by	KVB, Inc.	
Date sampled	3/22/79	
Date received	4/9/79	

Analysis report no. 71- 29656

DRY

% COMBUSTIBLE ----- 19.57

% SULFUR ----- 0.58

Respectfully submitted,
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R. A. HOUSER, Manager, Midwest Division



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► KVB, INC.
A Research-Cottrell Company
6176 Olson Memorial Highway
Minneapolis, Minnesota

April 11, 1979

Sample identification
by KVB, Inc.

Kind of sample reported to us Bottom Ash

Test # 5

Sample taken at Site H

Sample taken by KVB, Inc.

Date sampled 3/26/79

Date received 4/9/79

Analysis report no. 71- 29657

DRY

% COMBUSTIBLE ----- 20.72

% SULFUR ----- 0.75

Respectfully submitted,
COMMERCIAL TESTING & ENGINEERING CO.

R. A. Houser
R. A. HOUSER, Manager, Midwest Division



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RAH/ gk

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PLEASE ADDRESS ALL CORRESPONDENCE TO:
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OFFICE TEL. (312) 264-1173

KVB, INC.
A Research-Cottrell Company
6176 Olson Memorial Highway
Minneapolis, Minnesota

April 11, 1979

Sample Identification
by KVB, Inc.

Kind of sample reported to us Bottom Ash

Test # 6

Sample taken at Site H

Sample taken by KVB, Inc.

Date sampled 3/27/79

Date received 4/9/79

Analysis report no: 71- 29658

DRY
% COMBUSTIBLE ----- 14.56
% SULFUR ----- 0.30

Respectfully submitted,
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► KVB, INC.
A Research-Cottrell Company
6176 Olson Memorial Highway
Minneapolis, Minnesota

April 11, 1979

Sample identification
by KVB, Inc.Kind of sample
reported to us Bottom Ash

Test # 8

Sample taken at Site H

Sample taken by KVB, Inc.

Date sampled 3/29/79

Date received 4/9/79

Analysis report no. 71- 29659

DRY
% COMBUSTIBLE ----- 18.18
% SULFUR ----- 0.77

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OFFICE TEL. (312) 264-1173

KVB, INC.
A Research-Cottrell Company
6176 Olson Memorial Highway
Minneapolis, Minnesota

April 11, 1979

Sample identification
by KVB, Inc.

Kind of sample reported to us	Bottom Ash	Test # 9
Sample taken at	Site H	
Sample taken by	KVB, Inc.	
Date sampled	3/30/79	
Date received	4/9/79	

Analysis report no. 71- 29660

DRY

% COMBUSTIBLE ----- 18.10

% SULFUR ----- 0.50

Respectfully submitted,
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► KVB, INC.
A Research-Cottrell Company
6176 Olson Memorial Highway
Minneapolis, Minnesota

April 11, 1979

Sample identification
by KVB, Inc.

Kind of sample reported to us Bottom Ash

Test # 11

Sample taken at Site H

Sample taken by KVB, Inc.

Date sampled 4/4/79

Date received 4/9/79

Analysis report no. 71- 29661

DRY

% COMBUSTIBLE ----- 7.10

% SULFUR ----- 0.24

Respectfully submitted,
COMMERCIAL TESTING & ENGINEERING CO.

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R. A. House
R. A. HOUSE, Manager, Midwest Division



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COMBUSTIBLES DATA SHEET

SITE H - BLR INT

Crucible Number	Sample Origin	Crucible Weight grams	Crucible & Sample Weight Post 110°C gms	Sample Weight grams	Post 750°C grams	Δ Weight grams	% Combustibles
36	TEST #5	9.4569	10.2304	0.7732	10.0525	0.1779	23.0
	3-26-79	9.4566	10.2306		10.0528		
		9.4578	10.2300		—		
	AVG.	9.4571	10.2303		10.0524		
38	TEST #6	10.1458	10.6454	0.4991	10.5193	0.1260	25.2
	3-27-79	10.1457	10.6452		10.5191		
		10.1468	10.6450		—		
	AVG.	10.1461	10.6452		10.5192		
39	TEST #8	9.9974	10.2433	0.2456	10.1685	0.0151	30.5
	3-27-79	9.9973	10.2436		10.1680		
		9.9986	10.2432		—		
	AVG.	9.9978	10.2434		10.1683		
23	TEST #9	10.1023	10.6597	0.5574	10.4734	0.1863	33.4
	3-30-79	10.1024	10.6597		10.4734		
		10.1023					
	AVG.	10.1023	10.6597		10.4734		
	AVG.						
	AVG.						
	AVG.						
	AVG.						
	AVG.						
	AVG.						

KVB

SIEVE ANALYSIS TEST REPORT

TEST NO. 3

DATE SAMPLE TAKEN 3-22-79

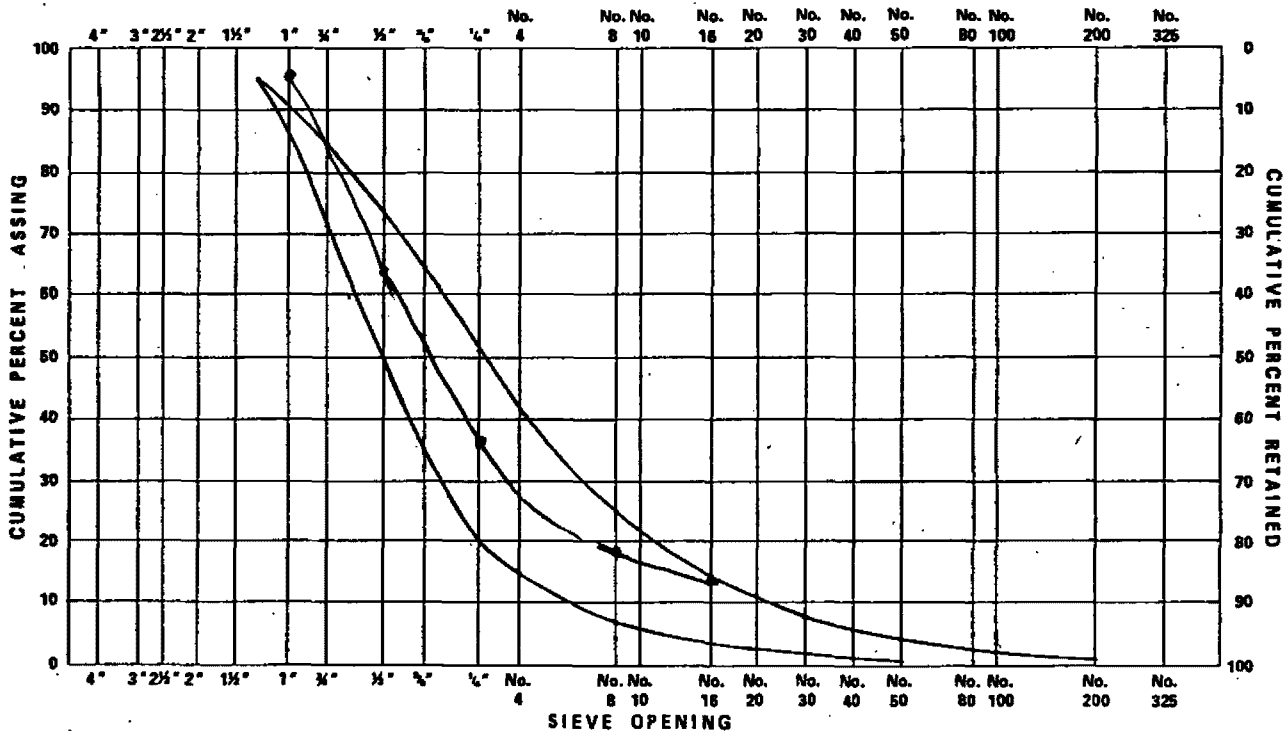
TEST SITE +

TEST PERFORMED BY TIDONA

SAMPLE IDENTIFICATION SANDS HILL BITUMINOUS COAL

Screen Size Passing	Tare Weight (gm)	Gross Weight (gm)	Net Weight (gm)	Percent (%)	Cumulative Weight Passing (gm)	Cumulative Percent Passing (%)	Sieve Shaker Duration (min)
Top			197.1	4.15	4748.4	100.00	1
1"			<u>1198.3</u> <u>348.2</u> 1546.5	32.57	4551.3	95.85	2
1/2"			1268.3	26.71	3004.8	63.28	4
3/4"			857.9	18.07	1736.5	36.57	8
No. 8			247.1	5.20	878.6	18.50	16
No. 16			631.5	13.30	631.5	13.30	16

Totals = 4748.4 100.00



KVB

SIEVE ANALYSIS TEST REPORT

TEST NO. 5

DATE SAMPLE TAKEN 3-26-79

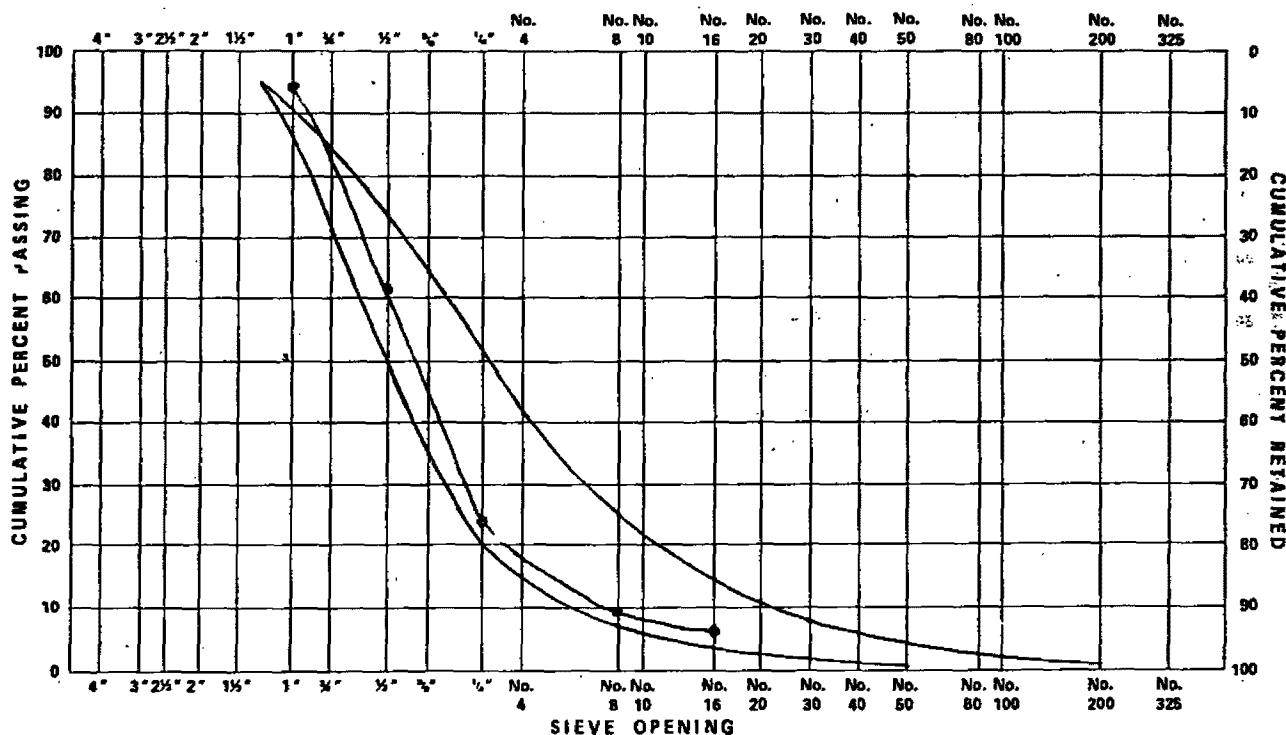
TEST SITE H

TEST PERFORMED BY TIDONIA

SAMPLE IDENTIFICATION SANDS HILL BIT. COAL

Screen Size Passing	Tare Weight (gm)	Gross Weight (gm)	Net Weight (gm)	Percent (%)	Cumulative Weight Passing (gm)	Cumulative Percent Passing (%)	Sieve Shaker Duration (min)
Top			234.8	5.18	4532.6	100.0	0
1"			1537.5	33.92	4297.8	94.8	1
1/2"			1693.8	37.37	2760.3	60.9	2
1/4"			621.0	13.70	1066.5	23.5	4
No. 8			154.4	3.41	445.5	9.8	8
No. 16			291.1	6.42	291.1	6.4	16

Totals = 4532.6 100.00



KVB

SIEVE ANALYSIS TEST REPORT

TEST NO. 6

DATE SAMPLE TAKEN 3-27-79

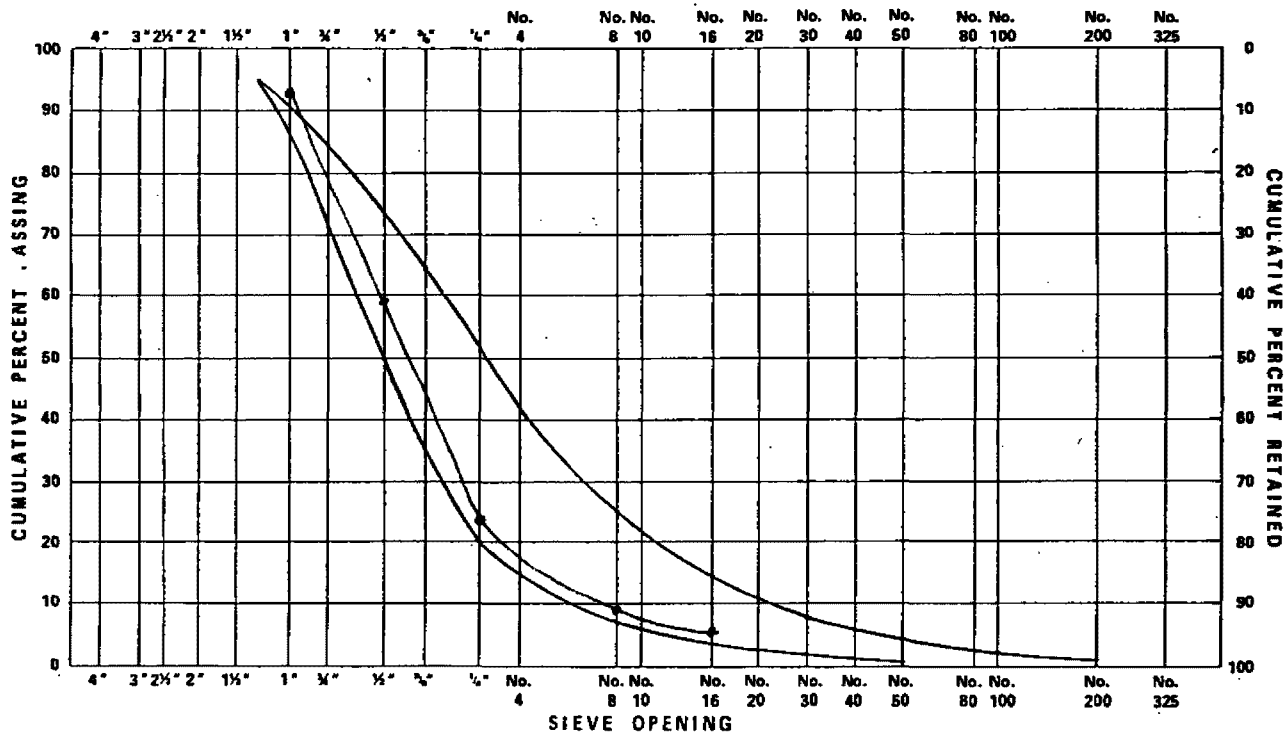
TEST SITE H

TEST PERFORMED BY TIDONA

SAMPLE IDENTIFICATION SANDS HILL BIT. COAL

Screen Size Passing	Tare Weight (gm)	Gross Weight (gm)	Net Weight (gm)	Percent (%)	Cumulative Weight Passing (gm)	Cumulative Percent Passing (%)	Sieve Shaker Duration (min)
Top			274.4	7.32	3749.4	100.0	0
1"			1246.6	33.25	3475.0	92.7	1
1/2"			1360.3	36.28	2228.4	59.4	2
1/4"			516.2	13.77	868.1	23.2	4
No. 8			118.4	3.16	351.9	9.4	8
No. 16			233.5	6.23	233.5	6.2	16

Totals = 3749.4 100.01



KVB

SIEVE ANALYSIS TEST REPORT

TEST NO. 8

DATE SAMPLE TAKEN 3-29-79

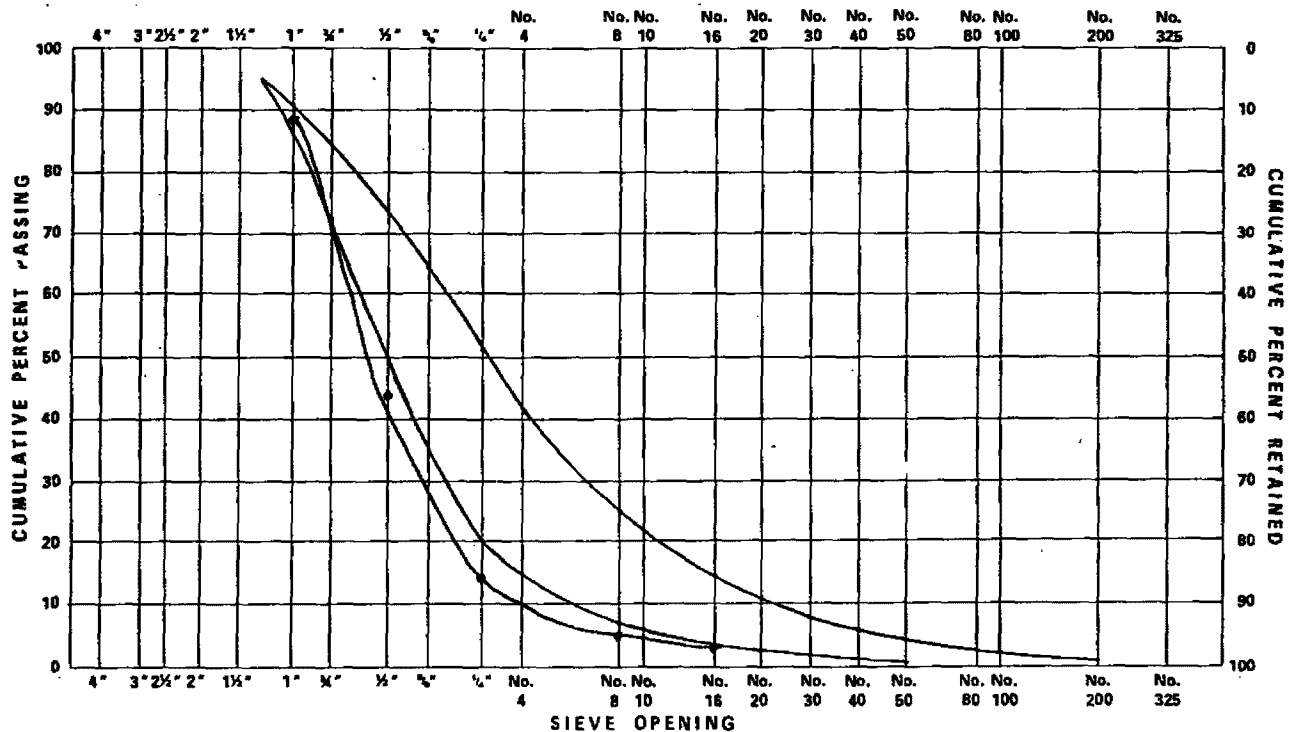
TEST SITE H

TEST PERFORMED BY TIDONA

SAMPLE IDENTIFICATION SANDS HILL BITUMINOUS COAL

Screen Size Passing	Tare Weight (gm)	Gross Weight (gm)	Net Weight (gm)	Percent (%)	Cumulative Weight Passing (gm)	Cumulative Percent Passing (%)	Sieve Shaker Duration (min)
Top			552.6	11.54	4788.6	100.0	0
1"			2128.6	44.45	4036.0	88.5	1
1/2"			1419.6	29.65	2107.4	44.0	2
1/4"			438.4	9.15	687.8	14.4	4
No. 8			97.2	2.03	249.4	5.2	8
No. 16			152.2	3.18	152.2	3.2	16

Totals = 4788.6 100.00



KVB

SIEVE ANALYSIS TEST REPORT

TEST NO. 9

DATE SAMPLE TAKEN 3-30-79

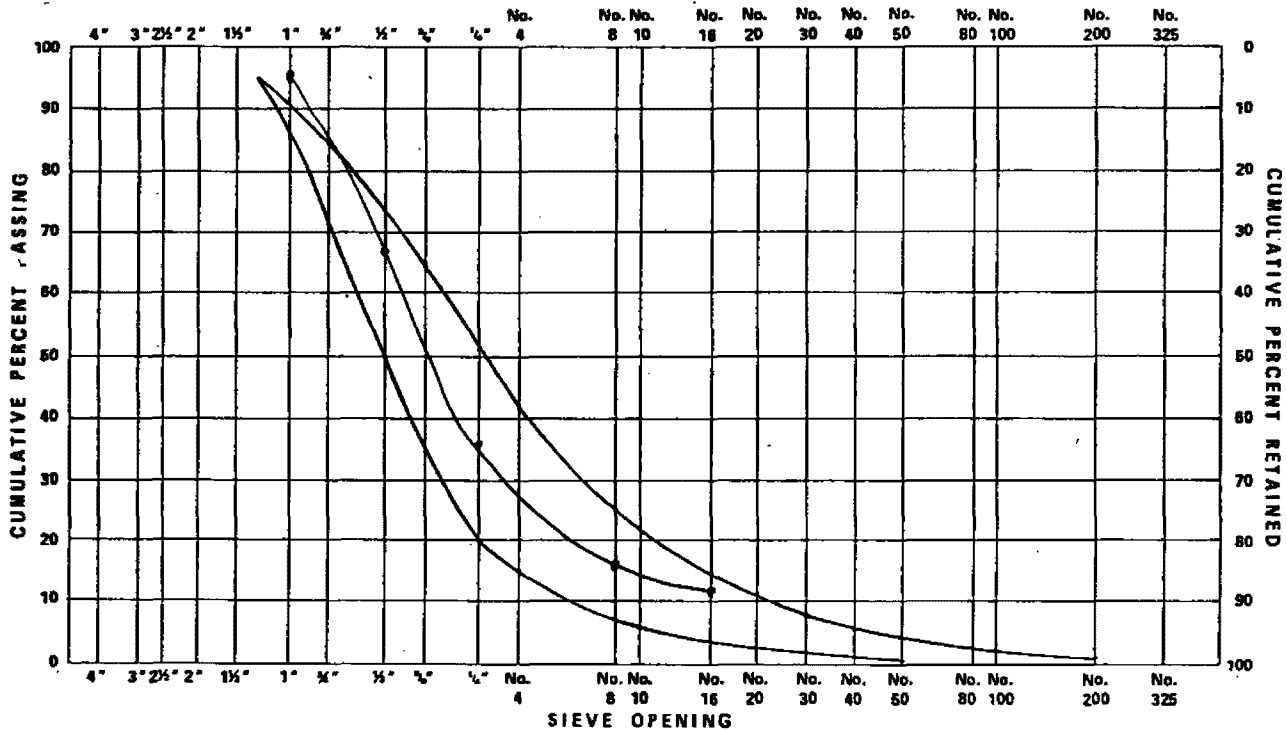
TEST SITE H

TEST PERFORMED BY JIC

SAMPLE IDENTIFICATION SANDS HILL BIT. COAL

Screen Size Passing	Tare Weight (gm)	Gross Weight (gm)	Net Weight (gm)	Percent (%)	Cumulative Weight Passing (gm)	Cumulative Percent Passing (%)	Sieve Shaker Duration (min)
Top			203.2	4.91	4139.0	100.0	1
1"			757.1	27.96	3935.8	95.1	2
1/2"			1297.2	31.34	2778.7	67.1	4
1/4"			810.7	19.35	1481.5	35.8	8
#8			221.2	5.34	680.8	16.4	16
#16			459.6	11.10	459.6	11.1	

Totals = 4139.0 100.00



KVB

SIEVE ANALYSIS TEST REPORT

TEST NO. 11

DATE SAMPLE TAKEN 4-4-79

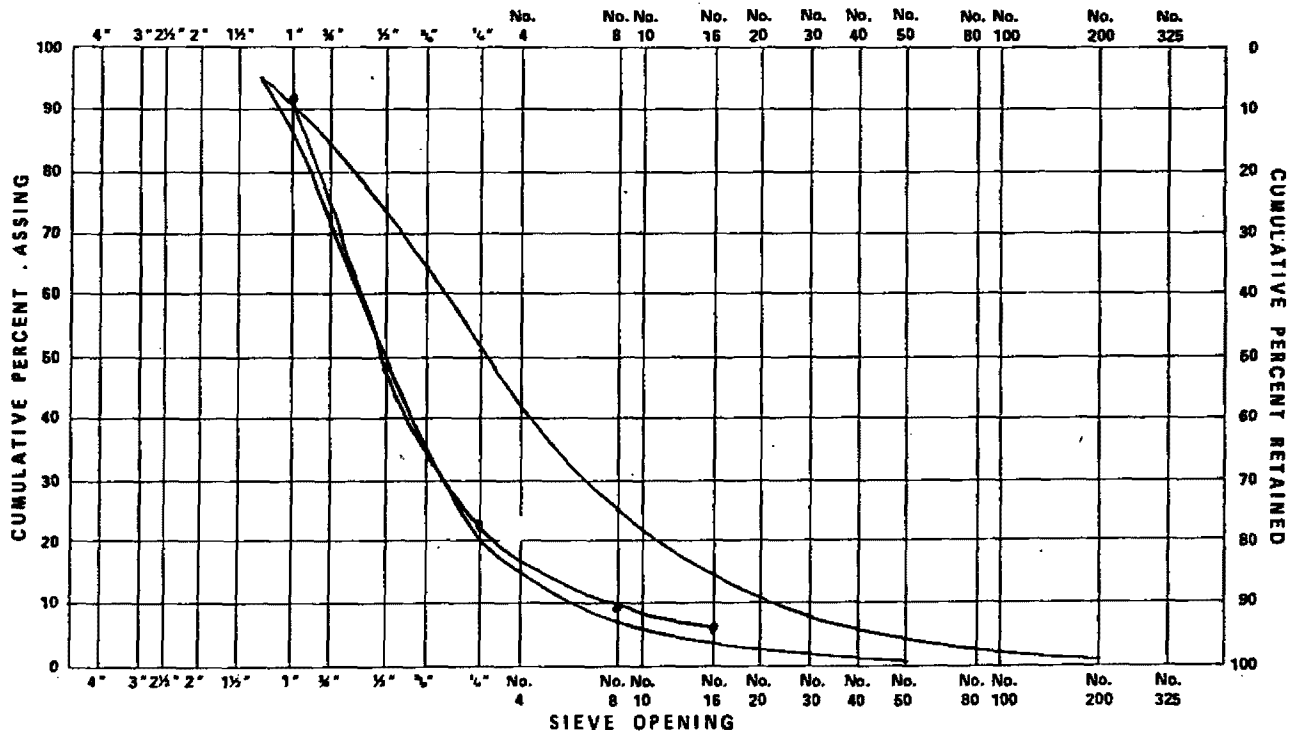
TEST SITE H

TEST PERFORMED BY Tidma

SAMPLE IDENTIFICATION SANDS HILL BITUM. COAL

Screen Size Passing	Tare Weight (gm)	Gross Weight (gm)	Net Weight (gm)	Percent (%)	Cumulative Weight Passing (gm)	Cumulative Percent Passing (%)	Sieve Shaker Duration (min)
Top			313.6	8.48	3696.3	100.0	0
1"			1591.3	43.05	3382.7	91.5	1
1/2"			978.1	26.46	1791.4	48.5	2
1/4"			454.2	12.29	813.3	22.0	4
No. 8			106.7	2.89	359.1	9.7	8
No. 16			252.4	6.83	252.4	6.8	16

Totals = 3696.3 100.00

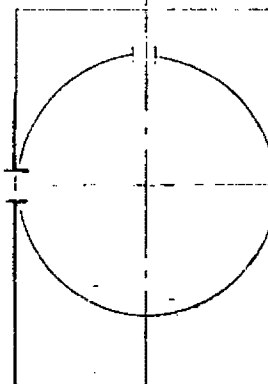


SECTION 6.0
OVERFIRE AIR TRAVERSES

	<u>PAGE</u>
6.1 OVERFIRE AIR DATA SHEETS	90

OVER FIRE AIR TRAVERSE SMOKESTACK FLOW PROFILE

TEST NO. 4 min OFA
LOCATION NO. ABMA SITE H
DATE 3-23-79
SAMPLING LOCATION OFA duct
INSIDE OF FAR WALL TO
OUTSIDE OF NIPPLE, (DISTANCE A) _____ BAROMETRIC PRESS, in. Hg 28.92
INSIDE OF NEAR WALL TO
OUTSIDE OF NIPPLE, (DISTANCE B) _____ STACK PRESS., Ps, in. Hg 2.8
STACK I.D. (DISTANCE A - DISTANCE B) 12" STK. GAS SP. GRAVITY, G_s 1.0
NEAREST UPSTREAM DISTURBANCE 2 duct diam
NEAREST DOWNSTREAM DISTURBANCE 1



1043

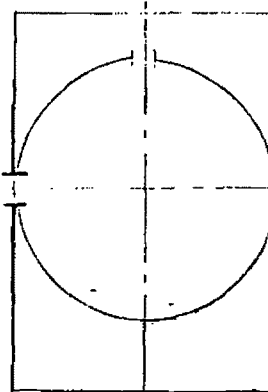
OFA press. = 2.8 "H₂O

TRAVERSE POINT NUMBER	% OF STACK DIAMETER	DISTANCE FROM INSIDE WALL	VELOCITY HEAD (Δp_s), in. H ₂ O	STACK TEMPERATURE (T _s , °F)	OXYGEN %	STACK GAS SPEED, V _s ft/min
1.	8.5	1"	-0.15			
2.	12.5	1 1/2"	-0.11			
3.	16.9	2"	0.0			
4.	22.0	2 5/8"	+0.16			
5.	28.3	3 3/8"	+0.26			
6.	37.5	4 1/2"	0.0			
7.	42.5	5"	-0.26			
8.	51.7	5 5/8"	-0.22			
9.	78.0	9 3/8"	-0.17			
10.	83.1	10"	-0.21			
11.	87.5	10 1/2"	-0.21			
12.	91.5	11"	-0.24			
13.						
14.						
15.						
16.						
17.						
18.						
Average						

$$\text{STACK GAS, } V_s = 174 F_s \sqrt{\frac{\text{Average } \Delta P (T_s + 460)}{P_s} \left(\frac{407}{P_s} \right) \left(\frac{1.00}{G_s} \right)}$$

SPEED

OVERFIRE AIR TRAVERSE
SMOKESTACK FLOW PROFILE



TEST NO. 4
LOCATION NO. ABMA H
DATE 3-22-79
SAMPLING LOCATION _____
INSIDE OF FAR WALL TO _____
OUTSIDE OF NIPPLE, (DISTANCE A) _____ BAROMETRIC PRESS, in.Hg _____
INSIDE OF NEAR WALL TO _____
OUTSIDE OF NIPPLE, (DISTANCE B) _____ STACK PRESS., Ps, iwq 7.2
STACK I.D. (DISTANCE A - DISTANCE B) 12" STK. GAS SP. GRAVITY, G_S _____
NEAREST UPSTREAM DISTURBANCE _____
NEAREST DOWNSTREAM DISTURBANCE _____

2043

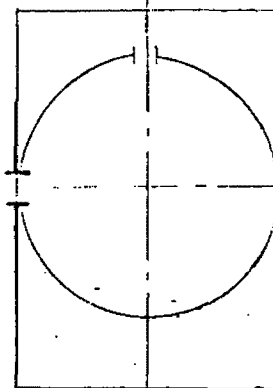
OFA press. = 7.2" H₂O

TRAVERSE POINT NUMBER	% OF STACK DIAMETER	DISTANCE FROM INSIDE WALL	VELOCITY HEAD (ΔP_s), in. H ₂ O	STACK TEMPERATURE (T _s , °F)	OXYGEN %	STACK GAS SPEED, V _s ft/min
1.	8.5	1"	+0.31			
2.	12.5	1 1/2"	+0.34			
3.	16.9	2"	+0.41			
4.	22.0	2 5/8"	+0.52			
5.	28.3	3 3/8"	+1.25			
6.	37.5	4 1/2"	+1.20			
7.	62.5	7 1/2"	+2.65			
8.	71.7	8 3/4"	+0.58			
9.	78.0	9 1/2"	+0.34			
10.	83.1	10"	+0.25			
11.	87.5	10 1/2"	+0.24			
12.	91.5	11"	+0.25			
13.						
14.						
15.						
16.						
17.						
18.						
Average						

$$\text{STACK GAS, } V_s = 174 F_s \sqrt{\frac{\text{Average } \Delta P (T_s + 460)}{P_s} \left(\frac{407}{P_s} \right) \left(\frac{1.00}{G_s} \right)}$$

SPEED

OVERFIRE AIR TRAVERSE SMOKESTACK FLOW PROFILE



TEST NO. 4
 LOCATION NO. ADMA H
 DATE 3-23-79
 SAMPLING LOCATION _____
 INSIDE OF FAR WALL TO _____
 OUTSIDE OF NIPPLE, (DISTANCE A) _____ BAROMETRIC PRESS, in.Hg _____
 INSIDE OF NEAR WALL TO _____
 OUTSIDE OF NIPPLE, (DISTANCE B) _____ STACK PRESS., Ps, iwg 11.2
 STACK I.D. (DISTANCE A - DISTANCE B) 12" STK. GAS SP. GRAVITY, G_s _____
 NEAREST UPSTREAM DISTURBANCE _____
 NEAREST DOWNSTREAM DISTURBANCE _____

3 of 3

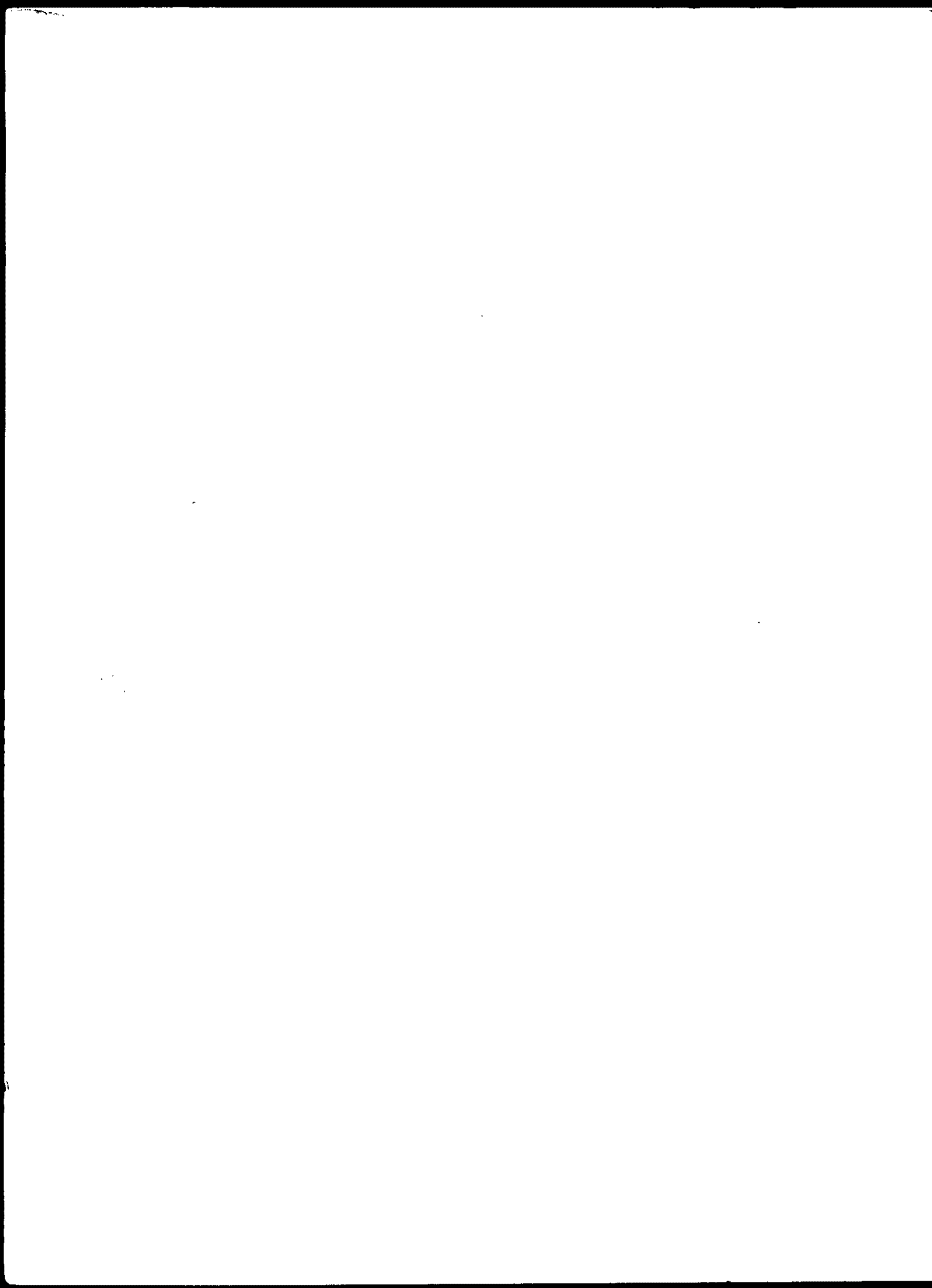
OFA press. = 11.2" H₂O

TRAVERSE POINT NUMBER	% OF STACK DIAMETER	DISTANCE FROM INSIDE WALL	VELOCITY HEAD (Δp_s), in. H ₂ O	STACK TEMPERATURE (T _s , °F)	OXYGEN %	STACK GAS SPEED, V _s ft/min
1.	8.5	1"	+0.03			
2.	12.5	1 1/2"	-0.05			
3.	16.9	2"	+0.07			
4.	22.0	2 3/8"	+0.08			
5.	28.3	3 3/8"	+0.24			
	37.5	4 1/4"	+0.66			
	62.5	7 1/4"	+0.47			
8.	71.7	8 5/8"	+1.25			
9.	79.0	9 3/4"	+1.35			
10.	83.1	10"	+1.05			
11.	87.5	10 1/2"	+0.67			
12.	91.5	11"	+0.42			
13.						
14.						
15.						
16.						
17.						
18.						
Average						

$$\text{STACK GAS, } V_s = 174 F_s \sqrt{\frac{\text{Average } \Delta P (T_s + 460)}{P_s} \left(\frac{407}{G_s} \right) \left(\frac{1.00}{G_s} \right)}$$

SPEED

TECHNICAL REPORT DATA (Please read Instructions on the reverse before completing)			
1. REPORT NO. EPA-600/7-80-112b		3. RECIPIENT'S ACCESSION NO.	
4. TITLE AND SUBTITLE Field Tests of Industrial Stoker Coal-fired Boilers for Emissions Control and Efficiency Improvement-- Site H (Data Supplement)		5. REPORT DATE May 1980	
7. AUTHOR(S) R. J. Tidona, J. E. Cook, W. M. Jackson, and M. G. Gabriel		6. PERFORMING ORGANIZATION CODE	
9. PERFORMING ORGANIZATION NAME AND ADDRESS KVB, Inc. 6176 Olson Memorial Highway Minneapolis, Minnesota 55422		8. PERFORMING ORGANIZATION REPORT NO.	
12. SPONSORING AGENCY NAME AND ADDRESS EPA, Office of Research and Development * Industrial Environmental Research Laboratory Research Triangle Park, NC 27711		10. PROGRAM ELEMENT NO. EHE-624	
		11. CONTRACT/GRANT NO. EPA-1AG-D7-E681 and DoE-EF-77-C-01-2609	
		13. TYPE OF REPORT AND PERIOD COVERED Supplement; 3-4/79	
		14. SPONSORING AGENCY CODE EPA/600/13	
15. SUPPLEMENTARY NOTES (*)Cosponsors are DoE and the American Boiler Manufacturers Assn. Project officers are R. Hall (EPA) and W. Harvey Jr. (DoE). The final technical report is "a" of this same series.			
16. ABSTRACT The Data Supplement is a compilation of test data presented in greater detail than was practical in the final technical report. It is intended to provide the necessary details to other researchers who are interested in performing their own analysis. Readers are referred to the contract final report for information as to objectives, description of facility tested and coals fired, test equipment and procedures, interpretations, and conclusions. The final technical report also contains data summaries not found in this Supplement. The Supplement contains panel board data for each test, detailed particulate; O ₂ , CO ₂ , CO, NO, NO ₂ , SO ₂ , and SO ₃ data, particle size distribution data, chemical analysis of the coal, coal size consistency data, and combustible analysis data.			
17. KEY WORDS AND DOCUMENT ANALYSIS			
a. DESCRIPTORS		b. IDENTIFIERS/OPEN ENDED TERMS	c. COSATI Field/Group
Air Pollution	Improvement	Air Pollution Control	13B
Boilers	Efficiency	Stationary Sources	13A
Combustion	Flue Gases	Combustion Modification	21B
Coal	Fly Ash	Spreader Stokers	21D
Field Tests	Particle Size	Particulate	14B
Dust	Nitrogen Oxides		11G
Stokers	Sulfur Oxides		07B
18. DISTRIBUTION STATEMENT Release to Public		19. SECURITY CLASS (This Report) Unclassified	21. NO. OF PAGES 101
		20. SECURITY CLASS (This page) Unclassified	22. PRICE



EP 600/7 EPA
80-112b IERL

AUTHOR

Field tests of industrial

TITLE stoker coal-fired boilers for
emissions control & efficiency

DATE DUE improvement Site W (data

supp

DATE DUE			

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