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.

SAN DIEGO AIR POLLUTION CONTROL DISTRICT
9150 CHESAPEAKE DRIVE
SAN DIEGO, CA. 92123

SUMMARY:
SOURCE TEST OF PARTICULATE EMISSIONS TO THE ATMOSPHERE

TEST SITE: INDUSTRIAL ASPHALT - VISTA
1309 Sycamore Avenue
Vista, CA 92083

TEST #: 90282.1 P.O.# 4818 TEST DATE 10/9/90

EQUIPMENT: Asphalt batch plant, Hot-mix (300-ton/hr), Hetherington/berner Model 1290. Aggregate bin: vbrtig screen, rotary dryer, jet burner, cyclone, baghouse/9048 ft^2 filter, exhaust fan (appl # 8357) 0578.

UNIT TESTED: Baghouse

SITE PERSONNEL: RAY THOMPSON
APCD PERSONNEL: J. CAWYER, D. SHINA
REPORT BY: J. CAWYER DATE 1/7/91
APPROVED BY: [signature] DATE: 4/91
C.W. RIDENOUR
SENIOR AIR POLLUTION CHEMIST

PARAMETERS:	MEASURED:
STACK GAS FLOW RATE (DSCFM):	25695
STACK GAS TEMPERATURE °F (AVG):	197
PRODUCTION RATE (AVG): tons/hr	256

RESULTS: Based upon APCD Method 5 Standards relating to the entire impinger catch.

TEST	PERMIT LIMIT	MEASURED	PERFORMANCE
RULE 54 DUST AND FUME	40.00 lb/hr	3.49 lbs/hr	PASSED

TEST REFERENCE:
San Diego Air Pollution Control District Quality Assurance Manual Method 5 for Particulate Emissions from Stationary Sources.

TEST DESCRIPTION

Introduction: This report presents the results of particulate loading and gas volume tests at INDUSTRIAL ASPHALT - VISTA . The test was performed on the baghouse exhaust.

System Description:
This asphalt plant combines crushed rock and sand with hot asphalt oil in batch loads of varying sizes. The rock and sand are dried in a rotary dryer which is heated by natural gas. The exhaust from this dryer is pulled through a baghouse, the emissions to the atmosphere from this baghouse are the subject of this report.

Procedures:
The procedures and equipment utilized in performing these tests are based on EPA New Source Performance Standards Method 5. The sampling train was modified to exclude the front-end filter and include a back-end filter, per the San Diego Air Pollution Control District Method 5 testing guidelines. The calculations were designed to include the impinger catch so that the test results can be compared to Rule 54 of SDAPCD.

Velocity Traverse:
Preliminary calculations were based upon data from previous tests. Temperature and pitot tube data collected during actual sampling were used to calculate stack volume.

Particulate Sampling:
This sample consisted of 30 traverse points, 6 from each of 5 sample ports as shown in Figure 1. The sample was collected 53 inches below the top of the stack. Field data associated with sample collection has been transferred to computer printout and is shown in the report. Calculations were done by computer and are also shown within the report.

Gas Analysis:
An integrated bag sample was collected on site and measured. The oxygen and carbon dioxide content of the stack gas was measured using electronic instrumentation.

SITE: INDUSTRIAL ASPHALT - VISTA

OPERATOR: J. CAWYER

TEST DATE: 10/9/90

TEST: 90282.1

DATA SUMMARY: #

TRAVERSE POINT NUMBER	GAS METER READING (Vm), ft3	PRESS. DIFF. ACROSS PITOT TUBES	PRESS. DIFF. ACROSS ORIF.	DRY GAS METER TEMPERATURE		STACK TEMP	IMP. TEMP	STACK FLOW (velocity)
	855.377		ACTUAL	INLET	OUTLET			
1	857.337	0.80	2.00	69	85	196	57	55.97
2	859.494	0.90	2.30	69	97	193	53	59.23
3	861.587	0.85	2.20	68	101	195	54	57.65
4	863.682	0.85	2.20	68	103	196	55	57.70
5	865.88	0.90	2.30	68	104	197	56	59.41
6	867.875	0.75	2.00	69	105	198	60	54.28
7	870.313	1.10	2.90	71	98	199	61	65.78
8	872.838	1.20	3.10	71	103	200	62	68.76
9	875.132	0.95	2.50	71	106	198	61	61.09
10	877.172	0.75	2.00	72	107	199	62	54.32
11	879.111	0.70	1.80	71	109	199	62	52.48
12	881.014	0.70	1.80	73	108	198	60	52.44
13	883.100	0.85	2.20	76	102	203	61	58.00
14	885.228	0.85	2.20	75	105	203	60	58.00
15	887.332	0.82	2.20	75	110	198	58	56.75
16	889.418	0.80	2.10	76	111	201	58	56.19
17	891.428	0.75	2.00	77	113	199	58	54.32
18	893.065	0.50	1.30	77	112	197	60	44.28
19	895.312	1.00	2.60	82	100	181	61	61.86
20	897.568	1.00	2.60	81	110	185	62	62.05
21	899.791	0.85	2.20	82	114	190	61	57.43
22	901.762	0.80	2.10	83	117	193	61	55.84
23	903.819	0.75	2.00	84	119	197	62	54.24
24	905.752	0.70	1.80	85	120	200	61	52.52
25	907.963	0.90	2.30	88	112	203	62	59.68
26	910.396	1.10	2.90	92	116	187	61	65.18
27	912.789	1.00	2.60	94	120	192	62	62.39
28	915.143	1.05	2.70	92	125	199	60	64.27
29	917.458	1.00	2.60	93	127	202	59	62.87
30	919.402	0.71	1.80	94	128	205	60	53.09

Pressures are in inches of water, temperatures are in degrees Fahrenheit, velocities are in ft/sec. All measurements are actual - uncorrected - values.

Average:	Vm	ΔP	ΔH	t1	t2	ts	ti	vs
	64.025	0.86	2.24	78.20	109.57	196.77	59.67	57.94

DATA SUMMARY:

PRESSURES

P bar 29.65 in Hg

P static -0.60 in H2O

Ps 29.61 in Hg

AVERAGE TEMPERATURES

ts = 197 F

tm = 1/2(avg.t1+avg.t2) = 94 F

ti = 60 F

VOLUMES

Vm, meter 64.025 ft^3

Vlc, impingers 288.5 ml

VAPOR PRESSURES

Vpw @ imp = 0.5218 inHg

METER BOX PARAMETERS

ΔH@ = 2.6123 inH2O

ΔP = 0.86 inH2O

ΔH = 2.24 inH2O

METER BOX I.D.# D337

NOZZLE AND PROBE

Dn = 0.223 in

An = Dn^2*π/4 = .0391 in^2

Cp = 0.807

Y = .9796

STACK MEASUREMENTS

%CO2 3.40

%CO 0.00

%O2 15.60

%N2 81.00

Ø = sampling time 90 minutes

mn=particulate collect'd 0.0601 grams

STACK PARAMETERS

Stack Diameter = 27"x62" ft

Ao=Area stack = 11.63 ft^2

CALCULATIONS:

		UNITS		EQUATION NUMBER
corr Vwm = ((Vm'*Vpw@imp/Ps)*Pm*Tstd)/(Tm*Pstd) = water volume correction at meter w/o silica gel	=	1.05	ft^3	1
Vm std = (Vm'*Tstd*Pm/(Pstd*Tm))-corr Vwm = dry meter volume corrected to STP	=	58.53	ft^3	2
Pm= Pbar+(ΔH/13.6)= corrected pressure of meter	=	29.81	in Hg	3
Tm= (t1+t2)/2 + 460 = meter temperature	=	553.9	°R	4
Ts = ts+460 = corrected stack temperature	=	656.8	°R	5
Ps= Pbar + (P static/13.6)= corrected stack pressure	=	29.61	in Hg	6
Vw std = Vlc*∂*R*Tstd/(Pstd*MwH2O)+corr Vwm = water volume at STP	=	14.67	ft^3	7
Bws = (Vw std)/(Vw std+Vm std)*100 = percent moisture	=	20.04	%	8
mn= grams of particulate (from laboratory sheet)	=	0.0601	grams	9
Cs = 15.43*mn/Vm std = grain loading (dry)	=	0.016	grains/d dscf	10
Vm'= Vm*Y = Corrected dry gas meter volume	=	62.72	ft^3	11
Md=0.440(%CO2)+0.320*(%O2)+0.280(N2+inerts+CO) Dry gas molecular weight	=	29.17	g/g*mole	12
Ms=Md*(1-Bws)+18.0*(Bws) Stack gas molecular weight-wet basis	=	26.93	g/g*mole	13

		UNITS	EQUATION NUMBER
vs= 85.49*Cp*((Ts*ΔP)/(Ps*Ms))^.5 = stack velocity	57.94	(ft/s)	14
Qs = (vs)*Ao*60 = stack flow rate	40410	(acfm)	15
Qstd =17.64*Qs*(1-Bws)*Ps/Ts =flow rate at STP	25695	(dscfm)	16
I = 144*100*Ts*(.002669*Vlc+(Vm'/Tm)*Pm)/ (60*Ø*vs*Ps*An) =isokinetic	108.39	(%)	17
E = (0.00857)*(Qstd)*Cs = particulate emission rate	3.49	(lbs/hr)	18

SUMMARY OF CALCULATIONS:

Enter the type of plant. (Asphalt/Combustion) Asphalt

I = % isokinetics = 108.4 %

Cs = grain loading (dry) = 0.016 grains/dscf

E = particulate emission rate = 3.49 lbs/hr

% CO2 = 3.40 %

NOMENCLATURE:

* multiplication
/ division
^ exponentiation
Vm sample gas volume, uncorrected = (ft^3)
Vm sample gas volume, corrected = Vm*Y = ft^3
ΔP root mean pitot tube differential pressure
= (summation(press.diff. across pitot tubes^.5)/number entries)^2 = (in H2O)
ΔH average differential pressure across the orifice = (in H2O)
t1 dry gas meter inlet temperature = (°F)
t2 dry gas meter outlet temperature = (°F)
ts stack temperature = (°F)
ti Impinger out temperature = (°F)
vs stack gas velocity = 85.49*Cp*(Ts*ΔP/(Ps*Ms))^.5 = (ft/s)
Pbar = barometric pressure = (in Hg)
Pstatic = stack static pressure = (in Hg)
Ps = Absolute stack pressure = Pbar +(Pstatic/13.6) = (in Hg)
tm = dry gas meter temperature =(t1+t2)/2 = (°F)
Vlc = collected water,impingers = (ml)
Vpw = Vapor pressure of water = (in Hg)
ΔH @ = orifice pressure differential that equates to 0.75 cfm of air @ 68ºF and 29.92 in Hg
Dn = nozzle diameter = (in)
An = nozzle area = π*Dn^2/4 = (in^2)
π = the ratio of circumference of a circle to its diameter = 22/7 (dimensionless)
Cp = pitot tube coefficient = (dimensionless)
Y = meter box coefficient = (dimensionless)
CO2 = carbon dioxide = (%)
CO = carbon monoxide = (%)
O2 = oxygen = (%)
N2 = nitrogen = (%)
Ø = sampling time = (minutes)
mn = particulate found in sample train = (grams)
Ao = stack area = stack diameter^2*π/4 if round; length *width if rectanglar = (ft^2)
Corr Vwm = ((Vm'*Vpw@imp/Ps)*Pm*Tstd)/(Tm*Pstd) = (ft^3)
Pm = absolute meter pressure = Pbar+(ΔH/13.6) = (in Hg)
Tstd = temperature at standard conditions = (528°R)
Tm = dry gas meter temperature =(t1+t2)/2+460 = (°R)
Pstd = pressure at standard condition = (29.92 in. Hg)
Vm std = dry corrected volume of meter = Vm'*T std*Pm/(Pstd*Tm)-corr Vwm = (ft^3)
Ts = stack temperature = (°R)
Vw std = water volume at STP = Vlc*∂*R*Tstd/(Pstd*MwH2O) = (ft^3)

NOMENCLATURE: cont.

∂ = density of water at STP = 0.002201 = (lb/ml)
R = ideal gas constant = 21.85 in. Hg*ft^3/°R*lb*mole
Md = dry stack gas molecular weight = 0.32*%O2+0.44*%CO2+0.28(100-%O2-%CO2)
= (g/g*mole)
Bws = fractional stack gas moisture content = (Vw std+Corr Vwm)/(Vwstd+Corr Vwm+Vm std)
= (%/100)
Cs = grain loading = 15.430*mn/Vm std = (grains/dscf)
Mw = molecular weight = (g/g*mole)
Ms = wet stack gas molecular weight = Md*(1-Bws)+Bws*18 = (g/g*mole)
Qs = flow rate = vs*Ao*60 = (acfm)
Qstd = flow rate at standard conditions = 17.68*Qs*(1-Bws)*Ps/Ts = (dscfm)
I = isokinetics = 144*100*Ts*(.002669*Vlc+Vm'/Tm)*Pm/(60*Ø*vs*Ps*An) = (%)
E = particulate emissions rate = 0.00847*Cs*Qstd = (lbs/hr)
MwH2O = molecular weight of water = 17.98 (g/g*mole)

CONSTANTS:

0.00847 lb/(gr*min/hr) = 1 lb/7000grains*60 min/hr
13.6 in H2O/in Hg
17.68 °R/in Hg
60 sec/min
32 g/g*mole = O2 molecular weight
44 g/g*mole = CO2 molecular weight
28 g/g*mole = N2 molecular weight
18 g/g*mole = H2O molecular weight
85.49 (ft/sec)*(lb*in Hg/(lb*mole*°R*in H2O))^.5
0.04707 = ft^3/ml
460 (demensionless) = conversion °F to °R
144 in^2/ft^2
15.43 gr/g
0.002669 in Hg*ft^3/(°R*ml)

SAN DIEGO AIR POLLUTION CONTROL DISTRICT

TRAVERSE POINTS

INDUSTRIAL ASPHALT
HOT MIX BAGHOUSE EXHAUST DUCT

DUCT MEASURES 27" x 62"

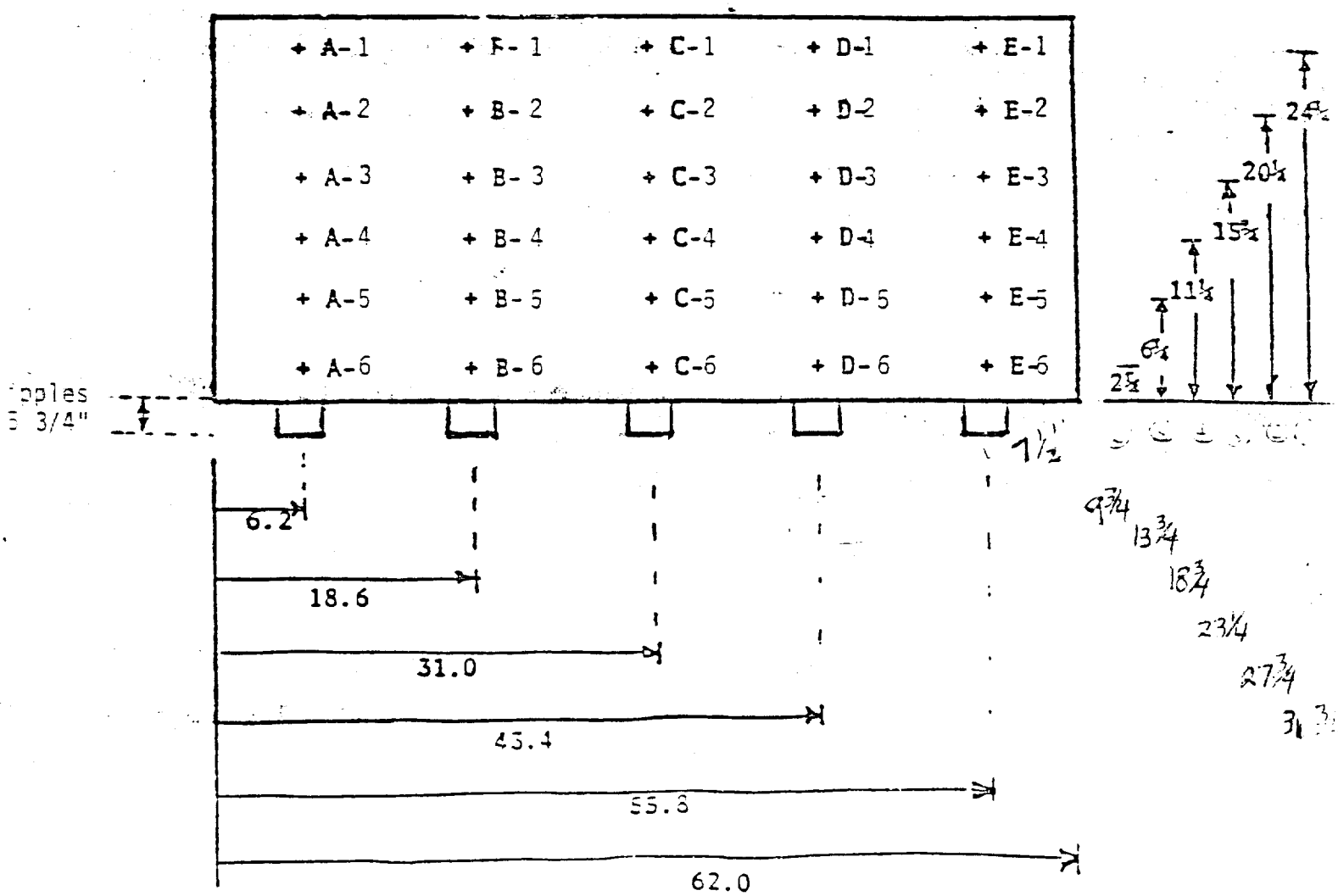
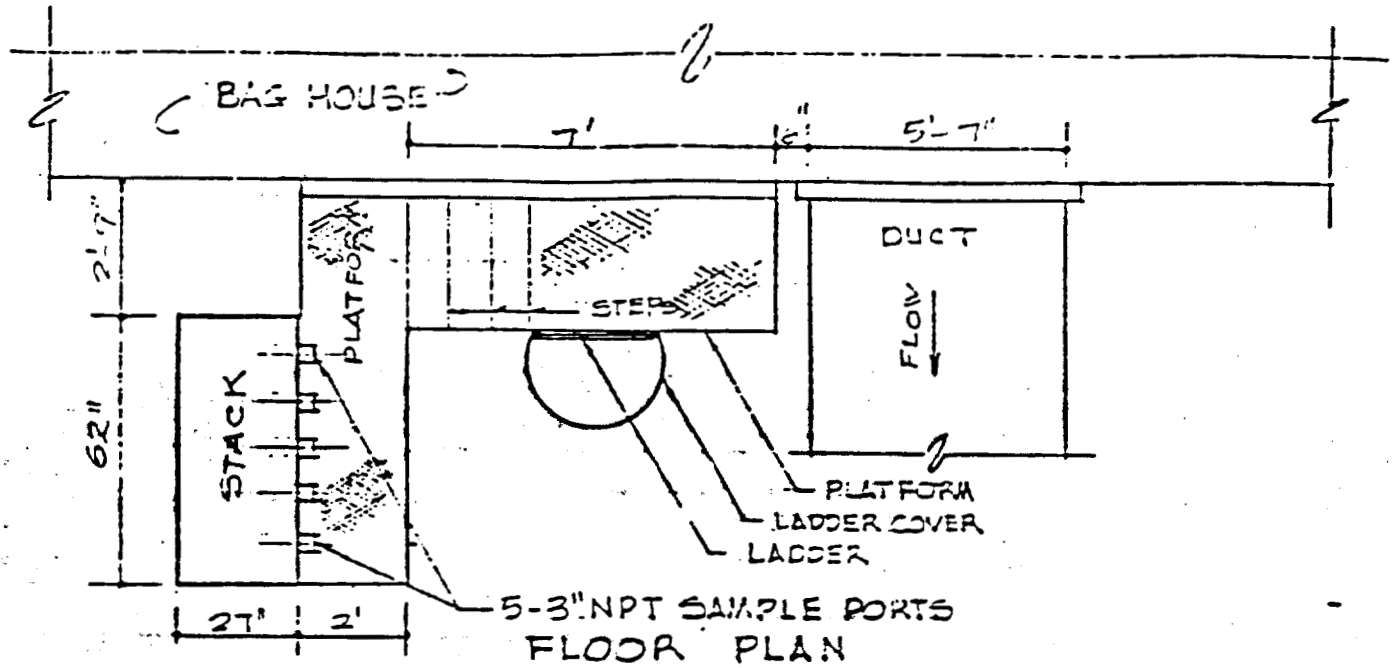
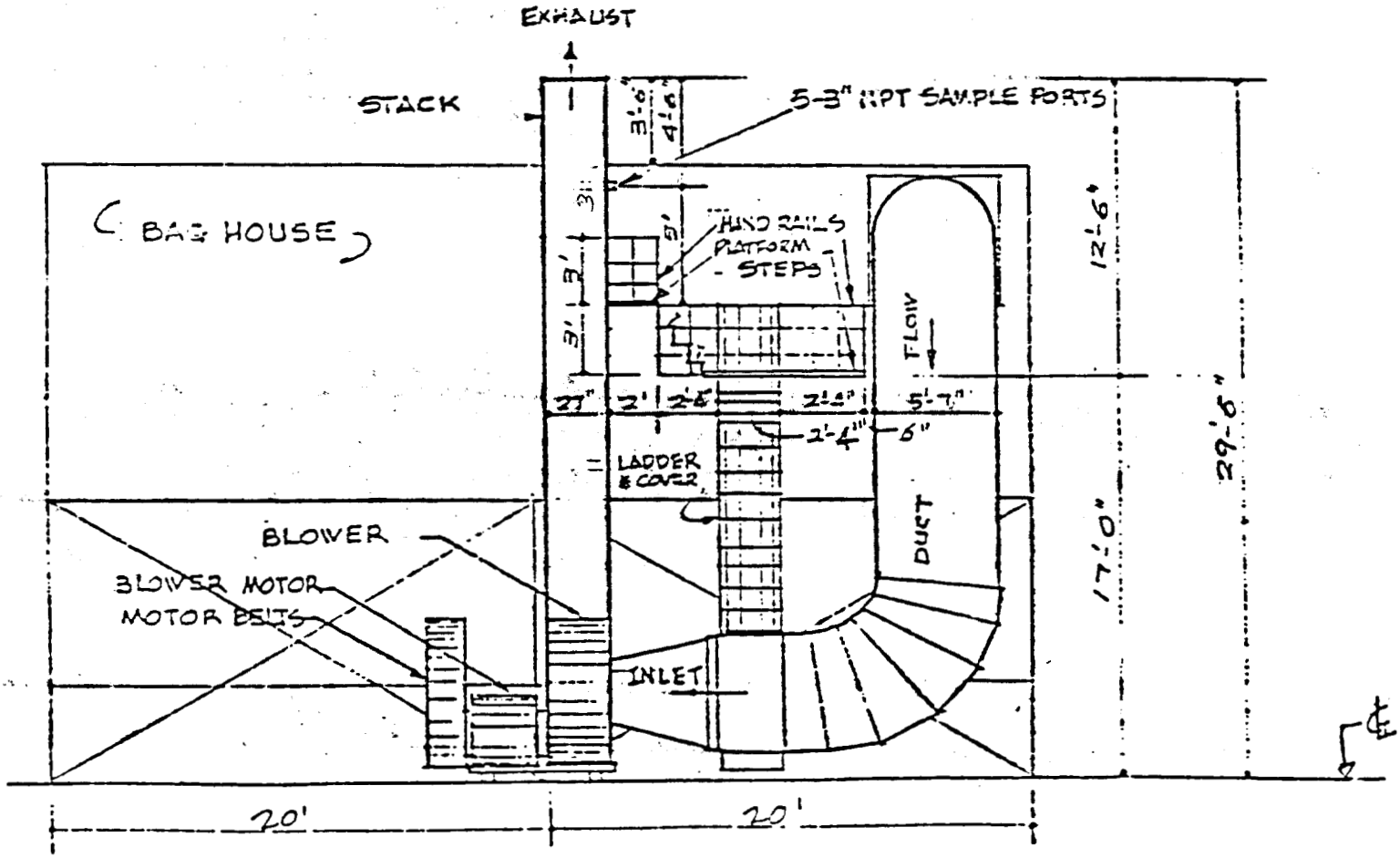


FIGURE 1



FLOOR PLAN
SCALE 1/4" = 1'-0"



SIDE VIEW
SCALE 1/8" = 1'-0"

FIGURE 2

San Diego County APCD METHOD 5 LAB SHEET

SITE = INDUSTRIAL ASPHALT - VISTA

TEST # = 90282

VOLUMES

(1) IMPINGER VOLUMES

	final		initial		Δ
#1	775.45 g	-	571.30 g	=	204.15 g
#2	625.90 g	-	561.03 g	=	64.87 g
#3	478.45 g	-	464.80 g	=	13.65 g
#4	493.22 g	-	487.40 g	=	5.82 g

† TOTAL VOLUME LIQUID COLLECTED = 288.49 ml

comments:

The Acetone and DI Water rinses were kept separated by front and back half. An Organic Extraction was not considered necessary and was not performed.

† The density of water is 1 g/ml

San Diego County APCD METHOD 5 LAB SHEET

TEST # = 90282

(2) BEAKER RINSES

ACETONE			WATER			PET ETHER		
BKR ID =	178/168		BKR ID =	205/212		BKR ID =	N/A	
FRONT HALF =	75.00	ml	FRONT HALF =	100.00	ml	FRONT HALF =		ml
F.H. RINSES =	30.00	ml	F.H. RINSES =	50.00	ml	F.H. RINSES =		ml
BACK HALF =	100.00	ml	BACK HALF =	100.00	ml	BACK HALF =		ml
B.H. RINSES =	20.00	ml	B.H. RINSES =	53.00	ml	B.H. RINSES =		ml
SEPERATORY FUNNEL RINSE =	0.00	ml	IMPINGERS =	200.00	ml			
total acetone =	225.00	ml	total water =	503.00	ml	total Pet Ether =	0.00	ml

* All data and calculations may be found on file at the San Diego County Air Pollution Control District.

TEST # = 90282

STANDARDS

volume Ac = 550 ml

volume water = 551 ml

volume Pet Ether = 0 ml

ACETONE		WATER		PET ETHER	
BKR ID =	192	BKR ID =	170	Bkr ID =	N/A
f:	30.5442 g	f:	29.1983 g	f:	g
i:	30.5354 g	i:	29.1976 g	i:	g
Δ:	0.0088 g	Δ:	0.0007 g	Δ:	0.0000 g

Limits:

limit for acetone is 10.0 µg/ml (10.0 * 10^-6 g/ml)
limit for water is 4 µg/ml (4 * 10^-6 g/ml)

The Acetone	The Water	The Pet Ether
FAILED	**PASSED**	**PASSED**
1.6E-05 g/ml	1.2704E-06 g/ml	0 g/ml

TEST # = 90282

(3) CORRECTIONS- (volume used)*(std wt)

ACETONE		WATER		PET ETHER	
FRONT HALF =	0.001680 g	FRONT HALF =	0.000191 g	FRONT HALF =	0.000000 g
BACK HALF =	0.001920 g	BACK HALF =	0.000194 g	BACK HALF =	0.000000 g
SEP. FUNNEL =	0.000000 g	IMPINGERS =	0.000254 g		

tot. front half = 0.001871 g

total back half = 0.002114 g

sep. funnel + impingers = 0.000254 g

total grams from solvents = 0.0042 g

San Diego County APCD METHOD 5 LAB SHEET

TEST # = 90282

WEIGHTS

	FRONT HALF	BACK HALF
ACETONE		
BKR ID =	178	168
f:	28.8431 g	30.6259 g
i:	28.8316 g	30.5952 g
Δ:	0.0115 g	0.0307 g
WATER		
BKR ID =	205	212
f:	29.2112 g	28.7727 g
i:	29.2090 g	28.7536 g
Δ:	0.0022 g	0.0191 g

San Diego County APCD METHOD 5 LAB SHEET

TEST # = 90282

ORGANIC

BKR ID = N/A	BKR ID = N/A
f: _____ g	f: _____ g
i: _____ g	i: _____ g
Δ: 0.0000 g	Δ: 0.0000 g

FILTERS

ID = N/A	ID = 89061
f: _____ g	f: 0.1223 g
i: _____ g	i: 0.1215 g
Δ: 0.0000 g	Δ: 0.0008 g

TEST # = 90282

(4) FINAL WEIGHTS

(total weight gained)

FRONT HALF= 0.0137 BACK HALF= 0.0498

TOTAL WEIGHT GAINED = 0.0635 g

correction for solvents (acetone and water)

TOTAL WEIGHT GAINED FROM SOLVENTS = 0.0042 g

(5) CORRECTED WEIGHTS

TOTAL WEIGHT GAINED CORRECTED = 0.0593 g

(6) FILTERS

FRONT HALF= 0.0000 BACK HALF= 0.0008

TOTAL WEIGHT GAINED = 0.0601 g

Comments -

FROM THE DESK OF
RAY TOMPKINS

INDUSTRIAL ASPHALT

748 Tons

7:20 - 10:15

10-9-90
Brad Ward

Received as production
rate from Brad Ward.
10-9-90 10:26 a.m.
Janet E Lauer

12/31/90
J. CAWYER.

TIME: 7:20a.m. - 10:15 a.m. = 2.92 hours.

TONNAGE = 748 TONS.

PRODUCTION RATE = $\frac{748 \text{ TONS}}{2.92 \text{ hours}}$ = 256 TONS / HR.

(1) K = 2.6.

PO # 4818

SAN DIEGO AIR POLLUTION CONTROL DISTRICT

P.O. # 90282

SITE I.A. VISTA

DATE 10/9/90

RUN # 1

Impinger Box # ~~D337~~ D337

T ambient

P bar 29.65

P static -.6

Probe I.D. SN 872

PROBE LENGTH 3'

NOZZLE I.D.# 1563

METER BOX # D337

Y= .9796

METER dH@ 2.6123

PITOT Cp .807

Nozzle size: .223

DIAM STACK 62" x 27"

START 7:40 a.m.

FILTER#: 89061

OPERATOR J. CAWYER

POINT NUMBER	TIME min	GAS METER READING (Vm), ft 3	VELOCITY HEAD (dP), In Hg	ORIFICE PRESSURE DIFFERENTIAL (dH), In Hg ACTUAL	ESIRED	STACK TEMP (Ts), F T1	SAMPLE BOX TEMP T2	IMPINGER TEMP ti T3	DRY GAS METER TEMP INLET (t1)	OUTLET (t2)	PUMP VACUUM In Hg
7:40 a.m.	0:00	855.377									
A1	3:00	857.337	.80	2.00	2.08	196	130	57	69°	85	2.5
A2	6:00	859.494	.90	2.30	2.34	193	132	53	69	97	3.2
3	9:00	861.587	.85	2.20	2.21	195	174	54	68	101	3.5
4	12:00	863.682	.85	2.20	2.21	196	209	55	68	103	3.5
5	15:00	865.880	.90	2.30	2.34	197	241	56	68	104	4.0
6	18:00	867.875	.75	2.00	1.95	198	264	60°	69	105	3.5
Stop. 7:58.											
START 8:05		867.875									
1	3:00	870.313	1.10	2.90	2.86	199	328	61°	71	98	5.0
2	6:00	872.938	1.20	3.10	3.12	200	334	62°	71	103	5.0
3	9:00	875.132	0.95	2.50	2.47	198	339	61°	71	106	4.5
4	12:00	877.172	0.75	2.00	1.95	199	339	62°	72	107	4.0
5	15:00	879.111	0.70	1.80	1.82	199	339	62°	71	109	3.5
6.	18:00	881.014	0.70	1.80	1.82	198	340	60°	73	108	3.0

Stop: 8:24

FIGURE 5-7 FIELD DATA SHEET #2