AP42 Section:	9.9.3
Related	2
Title:	Test Protocol at Heinz Pet Products Facility Bloomsburg, PA Stack test to determine total non-methane hydrocarbon destruction efficiency of fume collection system. Oct 1993 Inactive section – pet foods

SCOTT ENVIRONMENTAL TECHNOLOGY

A DIVISION OF NATIONAL AIR NETWORK, INC.

NAN

6205 Route 611 • P.O. Box 369 • Plumsteadville, PA 18949 • Phone: (215) 766-7230 • Fax (215) 766-2051

October 7, 1993
SET 1711

Mr. Richard St. Louis
Pennsylvania Department of Environmental Resources
Bureau of Technical Services and Monitoring
P.O. Box 8468
Harrisburg, PA 17105-8468

Re: Heinz Pet Products
Permit No. 19-318-016
CSM Catalytic Afterburner
Emission Compliance Test

Dear Mr. St. Louis:

Enclosed is a copy of a test protocol for a compliance evaluation to be conducted at the Heinz Pet Products facility in Bloomsburg, Pennsylvania. Scott Environmental Technology will be responsible for conducting a stack test to determine the total non-methane hydrocarbon destruction efficiency of catalytic afterburner system. Additionally the VOC capture efficiency of the fume collection system will be evaluated.

If I can provide any additional information regarding this project, please feel free to give me a call.

Sincerely,

Robert M. McKinney
Manager - Field Services

RMM/pds

Enclosures

cc: Richard Maxwell - PADER Wiliamsport & John Twardowski
Michael Hutnick - Heinz
Disk 227

11/30

SCOTT ENVIRONMENTAL TECHNOLOGY

A DIVISION OF NATIONAL AIR NETWORK, INC.

6205 Route 611 • P.O. Box 369 • Plumsteadville, PA 18949 • Phone: (215) 766-7230 • Fax (215) 766-2051

Preparation of Standards by Dilution of Cylinder Standard

Cylinder standard: Organic _____ Certified concentration _____ ppm

Standards Preparation Data: Date _____

Stage 1	Mixture 1	Mixture 2	Mixture 3
Standard gas flowmeter reading			
Diluent gas flowmeter reading			
Laboratory temperature (°K)			
Barometric pressure (mm Hg)			
Flowmeter gage pressure (mm Hg)			
Flow rate cylinder gas at standard conditions (ml/min)			
Flow rate diluent gas at standard conditions (ml/min)			
Calculated concentration (ppm)			
Stage 2 (if used)			
Standard gas flowmeter reading			
Diluent gas flowmeter reading			
Flow rate stage 1 gas at standard conditions (ml/min)			
Flow rate diluent gas at standard conditions (ml/min)			
Calculated concentration (ppm)			
GC Operating Conditions:			
Sample loop volume (ml)			
Sample loop temperature (°C)			
Carrier gas flow rate (ml/min)			
Column temperature:			
Initial (°C)			
Program rate (°C/min)			
Final (°C)			
Organic Peak Identification and Calculated Concentrations:			
Injection time (24-hr clock)			
Distance to peak (cm)			
Chart speed (cm/min)			
Retention time (min)			
Attenuation factor			
Peak area (mm^2)			
Peak area x attenuation factor			

Plot peak area x attenuation factor against calculated concentration to obtain calibration curve.

Figure 18-7. Standards prepared by dilution of cylinder standard.

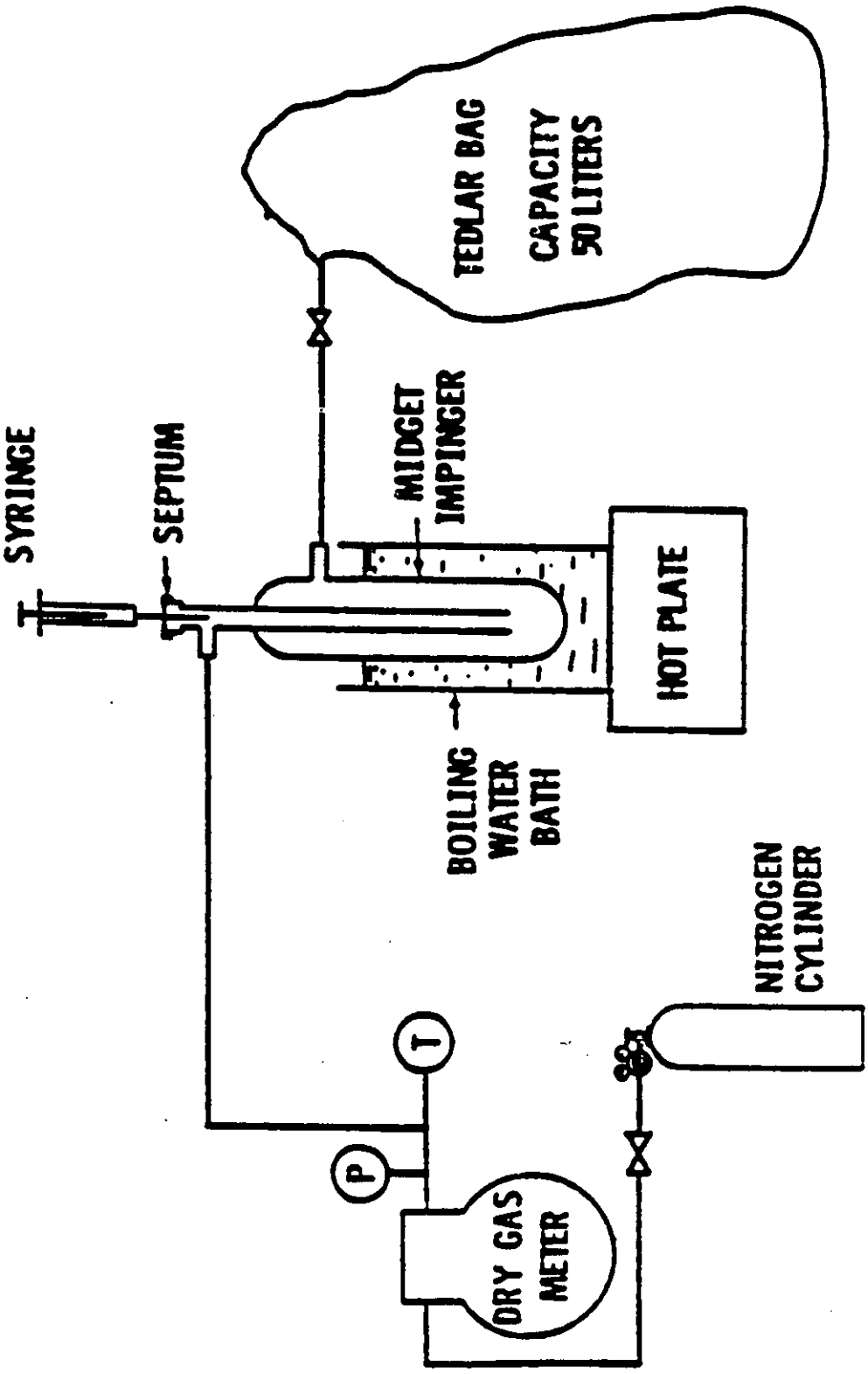


Figure 18-8. Apparatus for preparation of liquid materials.

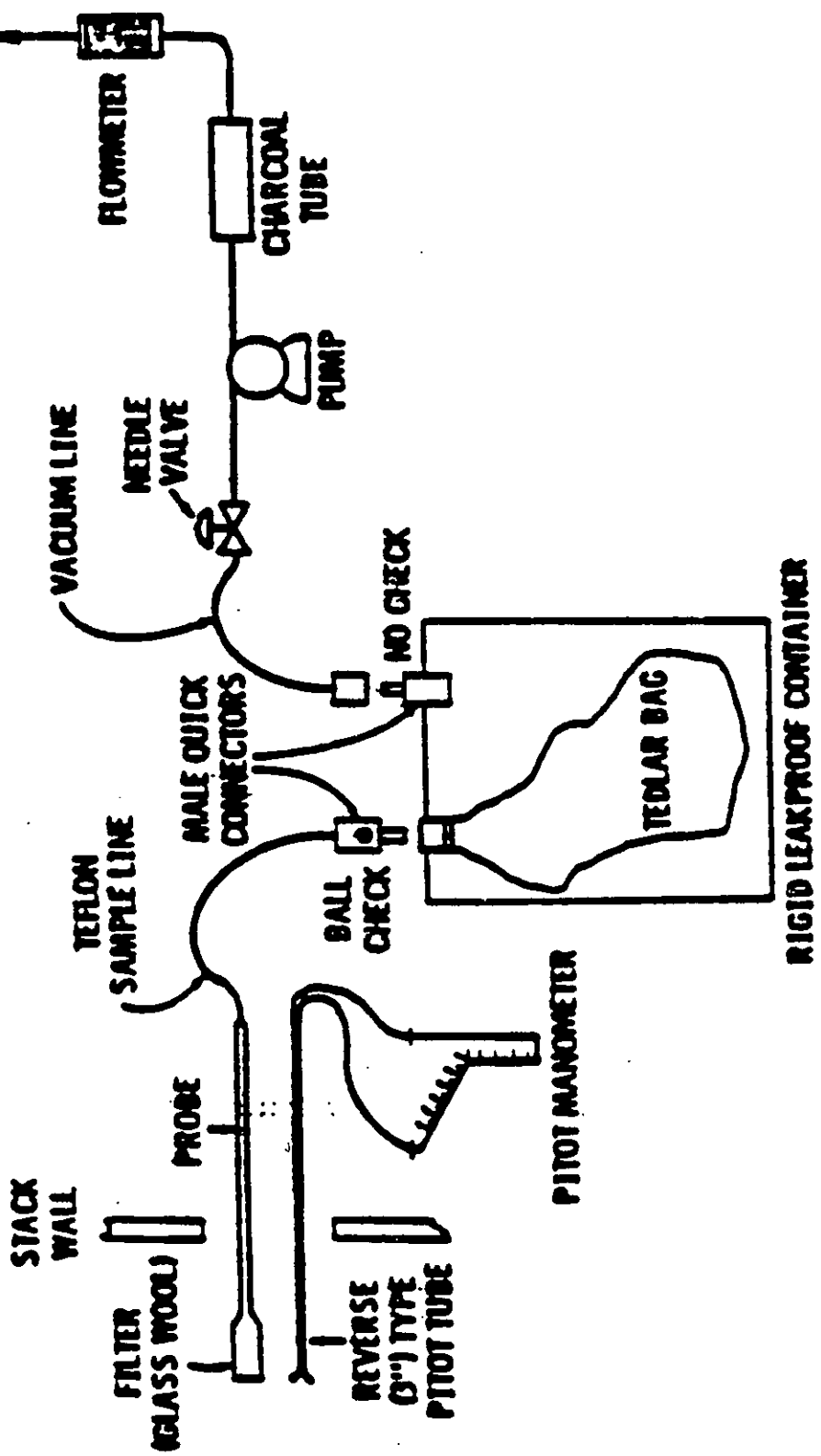


Figure 18-9. Integrated bag sampling train.

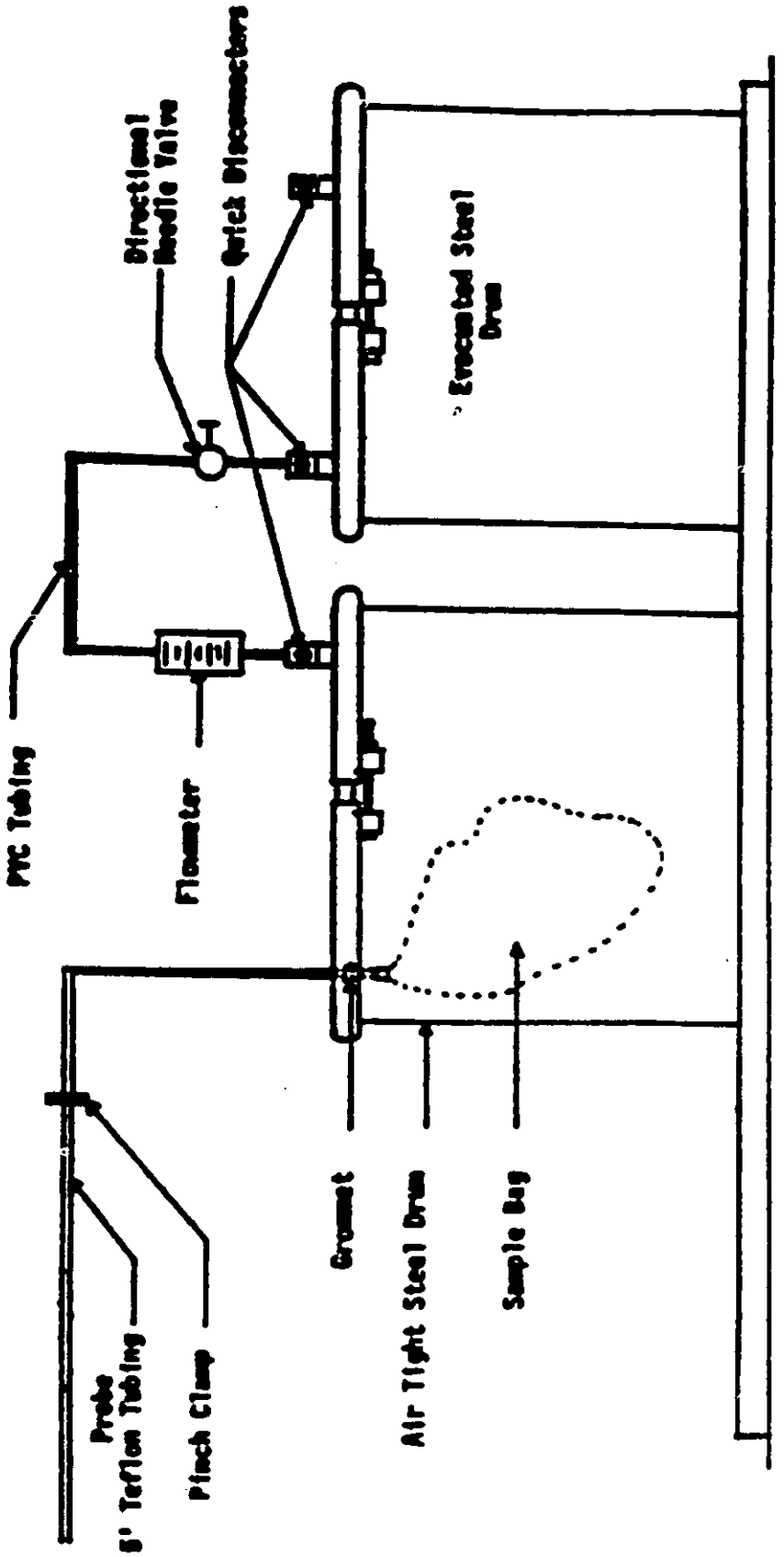


Figure 18-9a. Explosion risk gas sampling method.

Plant _____ Date _____

Site _____

	Sample 1	Sample 2	Sample 3
Source temperature (°C)			
Barometric pressure (mm Hg)			
Ambient temperature (°C)			
Sample flow rate (appr.)			
Bag number			
Start time			
Finish time			

Figure 18-10. Field sample data sheet - Tedlar bag collection method.

Plant_____ Date_____

Location_____

1. General information

Source temperature (°C)	_____
Probe temperature (°C)	_____
Ambient temperature (°C)	_____
Atmospheric pressure (mm)	_____
Source pressure (°Hg)	_____
Absolute source pressure (mm)	_____
Sampling rate (liter/min)	_____
Sample loop volume (ml)	_____
Sample loop temperature (°C)	_____
Columnar temperature:	
Initial (°C)/time (min)	_____
Program rate (°C/min)	_____
Final (°C)/time (min)	_____
Carrier gas flow rate (ml/min)	_____
Detector temperature (°C)	_____
Injection time (24-hour basis)	_____
Chart speed (mm/min)	_____
Dilution gas flow rate (ml/min)	_____
Dilution Gas used (symbol)	_____
Dilution ratio	_____

Figure 18-11. Field analysis data sheets.

2. Field Analysis Data - Calibration Gas

Run No._____ Time_____

Components	Area	Attenuation	A x A Factor	Conc. (ppm)

Run No._____ Time_____

Components	Area	Attenuation	A x A Factor	Conc. (ppm)

Run No._____ Time_____

Components	Area	Attenuation	A x A Factor	Conc. (ppm)

Figure 18-11 (continued). Field analysis data sheets.

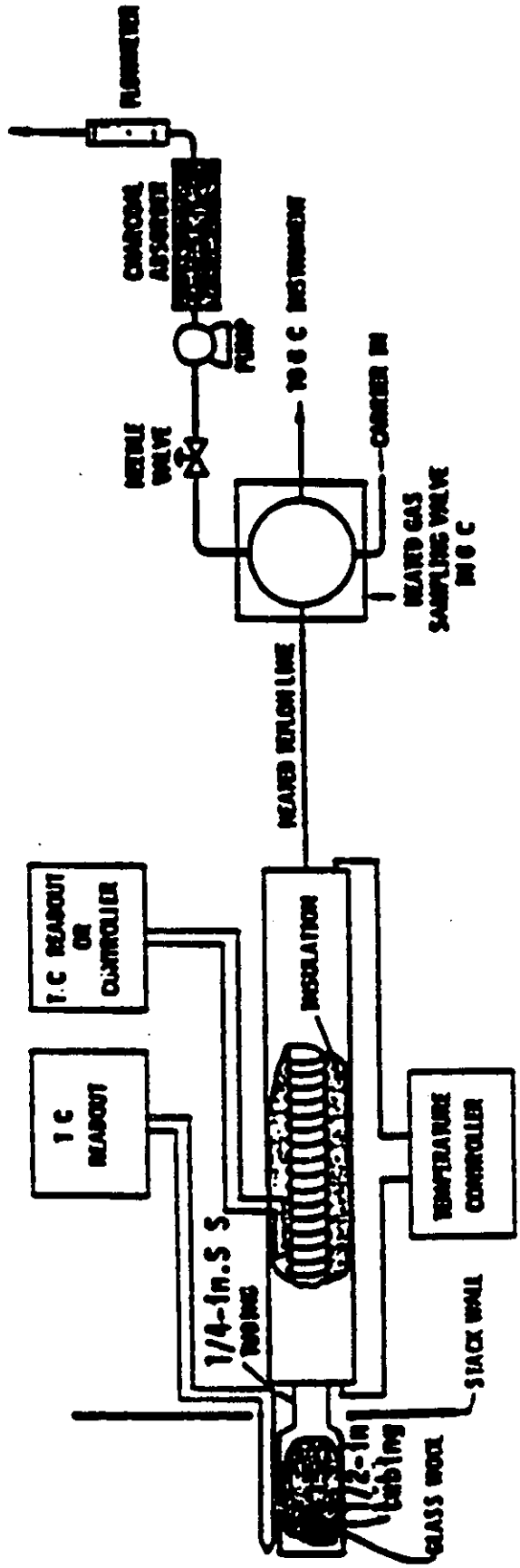


Figure 18-12. Direct interface sampling system.

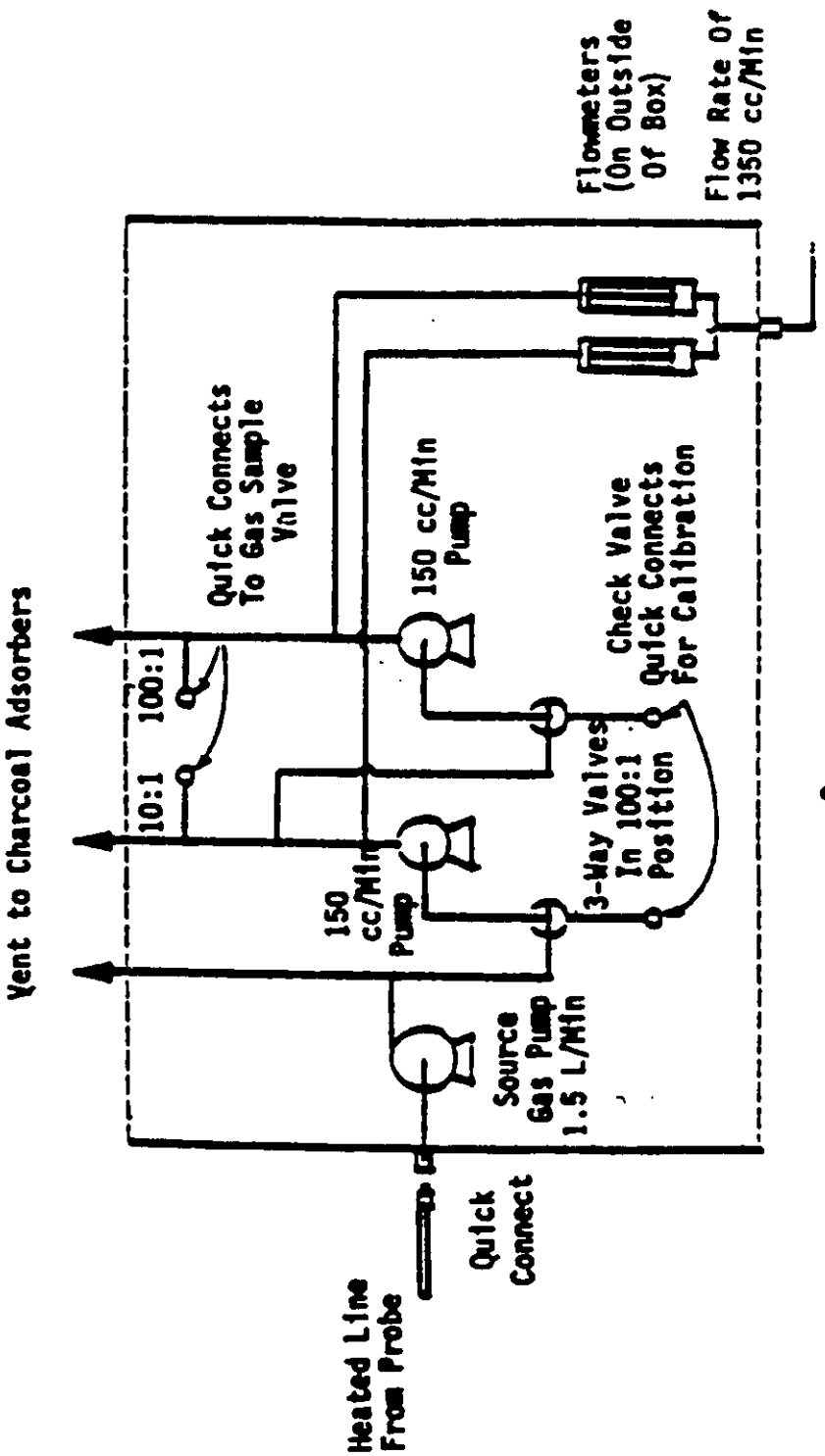


Figure 18-13. Schematic diagram of the heated box required for dilution of sample gas.

GASEOUS ORGANIC SAMPLING AND ANALYSIS CHECK LIST

(Respond with initials or number as appropriate)

		Date
1. Presurvey data:		
A. Grab sample collected	☐	.....
B. Grab sample analyzed for composition	☐	.....
Method GC	☐	☐
GC/MS	☐	☐
Other	☐	☐
C. GC-FID analysis performed	☐	.....
2. Laboratory calibration data:		
A. Calibration curves prepared	☐	.....
Number of components	☐	☐
Number of concentrations/component (3 required)	☐	☐
B. Audit samples (optional):		
Analysis completed	☐	.....
Verified for concentration	☐	.....
OK obtained for field work	☐	.....
3. Sampling procedures:		
A. Method:		
Bag sample	☐	☐
Direct interface	☐	☐
Dilution interface	☐	☐
B. Number of samples collected	10	.....
4. Field analysis:		
A. Total hydrocarbon analysis performed	☐	.....
B. Calibration curve prepared	☐	.....
Number of components	☐	☐
Number of concentrations per component (3 required)	☐	☐

Figure 18-14. Sampling and analysis check.

GASEOUS ORGANIC SAMPLING AND ANALYSIS DATA

Plant_____

Date_____

Location_____

	Source sample 1	Source sample 2	Sour samp 3
1. General information:			
Source temperature (°C)			
Probe temperature (°C)			
Ambient temperature (°C)			
Atmospheric pressure (mm Hg)			
Source pressure (mm Hg)			
Sampling rate (ml/min)			
Sample loop volume (ml)			
Sample loop temperature (°C)			
Sample collection time (24-hr basis)			
Column temperature:			
Initial (°C)			
Program rate (°C/min)			
Final (°C)			
Carrier gas flow rate (ml/min)			
Detector temperature (°C)			
Chart speed (cm/min)			
Dilution gas flow rate (ml/min)			
Diluent gas used (symbol)			
Dilution ratio			

Performed by (signature): .....

Date: .....

Figure 18-14. Sampling and analysis sheet

METHOD 25A—DETERMINATION OF TOTAL GASEOUS ORGANIC CONCENTRATION USING A FLAME IONIZATION ANALYZER

1. *Applicability and Principle*

1.1 Applicability. This method applies to the measurement of total gaseous organic concentration of vapors consisting primarily of alkanes, alkenes, and/or arenes (aromatic hydrocarbons). The concentration is expressed in terms of propane (or other appropriate organic calibration gas) or in terms of carbon.

1.2 Principle. A gas sample is extracted from the source through a heated sample line, if necessary, and glass fiber filter to a flame ionization analyzer (FIA). Results are reported as volume concentration equivalents of the calibration gas or as carbon equivalents.

2. *Definitions*

2.1 Measurement System. The total equipment required for the determination of the gas concentration. The system consists of the following major subsystems:

2.1.1 Sample Interface. That portion of the system that is used for one or more of the following: sample acquisition, sample transportation, sample conditioning, or protection of the analyzer from the effects of the stack effluent.

2.1.2 Organic Analyzer. That portion of the system that senses organic concentration and generates an output proportional to the gas concentration.

2.2 Span Value. The upper limit of a gas concentration measurement range that is specified for affected source categories in the applicable part of the regulations. The span value is established in the applicable regulation and is usually 1.5 to 2.5 times the applicable emission limit. If no span value is provided, use a span value equivalent to 1.5 to 2.5 times the expected concentration. For convenience, the span value should correspond to 100 percent of the recorder scale.

2.3 Calibration Gas. A known concentration of a gas in an appropriate diluent gas.

2.4 Zero Drift. The difference in the measurement system response to a zero level calibration gas before and after a stated period of operation during which no unscheduled maintenance, repair, or adjustment took place.

2.5 Calibration Drift. The difference in the measurement system response to a mid-level calibration gas before and after a stated period of operation during which no unscheduled maintenance, repair or adjustment took place.

2.6 Response Time. The time interval from a step change in pollutant concentration at the inlet to the emission measurement system to the time at which 95 percent of the corresponding final value is reached as displayed on the recorder.

2.7 Calibration Error. The difference between the gas concentration indicated by the measurement system and the known concentration of the calibration gas.

3. *Apparatus*

A schematic of an acceptable measurement system is shown in Figure 25A-1. The essential components of the measurement system are described below:

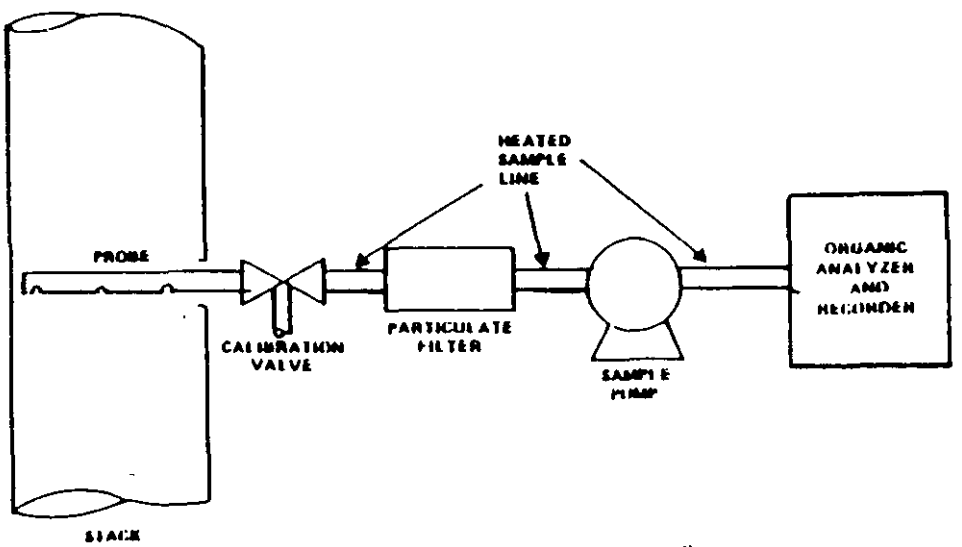


Figure 25A-1 Organic Concentration Measurement System.

3.1 Organic Concentration Analyzer. A flame ionization analyzer (FIA) capable of meeting or exceeding the specifications in this method.

3.2 Sample Probe. Stainless steel, or equivalent, three-hole rake type. Sample holes shall be 4 mm in diameter or smaller and located at 16.7, 50, and 83.3 percent of the equivalent stack diameter. Alternatively, a single opening probe may be used so that a gas sample is collected from the centrally located 10 percent area of the stack cross-section.

3.3 Sample Line. Stainless steel or Teflon * tubing to transport the sample gas to the analyzer. The sample line should be heated, if necessary, to prevent condensation in the line.

3.4 Calibration Valve Assembly. A three-way valve assembly to direct the zero and calibration gases to the analyzers is recommended. Other methods, such as quick-connect lines, to route calibration gas to the analyzers are applicable.

3.5 Particulate Filter. An in-stack or an out-of-stack glass fiber filter is recommended if exhaust gas particulate loading is significant. An out-of-stack filter should be heated to prevent any condensation.

3.6 Recorder. A strip-chart recorder, analog computer, or digital recorder for recording measurement data. The minimum data recording requirement is one measurement value per minute. Note: This method is often applied in highly explosive areas. Caution and care should be exercised in choice of equipment and installation.

4. *Calibration and Other Gases*

Gases used for calibrations, fuel, and combustion air (if required) are contained in compressed gas cylinders. Preparation of calibration gases shall be done according to the procedure in Protocol No. 1, listed in Citation 2 of Bibliography. Additionally, the manufacturer of the cylinder should provide a recommended shelf life for each calibration gas cylinder over which the concentration does not change more than ±2 percent from the certified value. For calibration gas values not generally available (i.e., organics between 1 and 10 percent by volume), alternative methods for preparing calibration gas mixtures, such as dilution systems, may be used with prior approval of the Administrator.

Calibration gases usually consist of propane in air or nitrogen and are determined in terms of the span value. Organic compounds other than propane can be used following the above guidelines and making the appropriate corrections for response factor.

4.1 Fuel. A 40 percent H_2 60 percent He or 40 percent H_2 60 percent N_2 gas mixture is recommended to avoid an oxygen synergism effect that reportedly occurs when oxygen concentration varies significantly from a mean value.

4.2 Zero Gas. High purity air with less than 0.1 parts per million by volume (ppmv) of organic material (propane or carbon equivalent) or less than 0.1 percent of the span value, whichever is greater.

4.3 Low-level Calibration Gas. An organic calibration gas with a concentration equivalent to 25 to 35 percent of the applicable span value.

4.4 Mid-level Calibration Gas. An organic calibration gas with a concentration equivalent to 45 to 55 percent of the applicable span value.

4.5 High-level Calibration Gas. An organic calibration gas with a concentration equivalent to 80 to 90 percent of the applicable span value.

5. *Measurement System Performance Specifications*

5.1 Zero Drift. Less than ±3 percent of the span value.

5.2 Calibration Drift. Less than ±3 percent of span value.

5.3 Calibration Error. Less than ±5 percent of the calibration gas value.

6. *Pretest Preparations*

6.1 Selection of Sampling Site. The location of the sampling site is generally specified by the applicable regulation or purpose of the test; i.e., exhaust stack, inlet line, etc. The sample port shall be located at least 1.5 meters or 2 equivalent diameters upstream of the gas discharge to the atmosphere.

6.2 Location of Sample Probe. Install the sample probe so that the probe is centrally located in the stack, pipe, or duct and is sealed tightly at the stack port connection.

6.3 Measurement System Preparation. Prior to the emission test, assemble the measurement system following the manufacturer's written instructions in preparing the sample interface and the organic analyzer. Make the system operable.

FIA equipment can be calibrated for almost any range of total organics concentrations. For high concentrations of organics (>1.0 percent by volume as propane) modifications to most commonly available analyzers are necessary. One accepted method of equipment modification is to decrease the size of the sample to the analyzer through the use of a smaller diameter sample capillary. Direct and continuous measurement of organic concentration is a necessary consideration when determining any modification design.

6.4 Calibration Error Test. Immediately prior to the test series, (within 2 hours of the start of the test) introduce zero gas and high-level calibration gas at the calibration valve assembly. Adjust the analyzer output to the appropriate levels, if necessary. Calculate the predicted response for the low-level and mid-level gases based on a linear response line between the zero and high-level responses. Then introduce low-level and mid-level calibration gases successively to the measurement system. Record the analyzer responses for low-level and mid-level calibration gases and determine the differences between the measurement system responses and the predicted responses. These differences must be less than 5 percent of the respective calibration gas value. If not, the measurement system is not acceptable and must be replaced or repaired prior to testing. No adjustments to the measurement system shall be conducted after the calibration and before the drift check (Section 7.3). If adjustments are necessary before the completion of the test series, perform the drift checks prior to the required adjustments and repeat the calibration following the adjustments. If multiple electronic ranges are to be used, each additional range must be checked with a mid-level calibration gas to verify the multiplication factor.

6.5 Response Time Test. Introduce zero gas into the measurement system at the calibration valve assembly. When the system output has stabilized, switch quickly to the high-level calibration gas. Record the time from the concentration change to the measurement system response equivalent to 95 percent of the step change. Repeat the test three times and average the results.

*Mention of trade names or specific products does not constitute endorsement by the Environmental Protection Agency.

[Part 60, Appendix A, Method 25A]

0013-9211/92/$0+.50

APPENDIX B

PADER PERMIT

COMMONWEALTH OF PENNSYLVANIA
DEPARTMENT OF ENVIRONMENTAL RESOURCES
NORTHCENTRAL REGION
FIELD OPERATIONS - AIR QUALITY
200 Pine Street
Williamsport, PA 17701-6510

Heinz Pet Products
6670 Low St.
Bloomsburg, PA 17815

Attn: Mr. Michael Hutnick, Plant Engineer

Dear Mr. Hutnick:

Attached is a Department plan approval to construct, modify, reactivate, or install an air cleaning device on, an air contamination source. A regular Department operating permit will subsequently be issued IF (1) the special conditions incorporated within the plan approval have all been fulfilled; (2) it has been demonstrated to the Department's satisfaction that the project was carried out as proposed in the application, and that the operation of the source(s) and any associated air pollution control equipment conforms with the operational information stated on the application, and (3) it has been demonstrated to the Department's satisfaction that the air contaminant emissions from the source(s) are in compliance with the requirements specified in, or established pursuant to, all applicable Department Rules and Regulations.

This plan approval contains special conditions which must be fulfilled. Failure to do so constitutes a violation of Section 127.25 of the Department's Rules and Regulations, upon which legal action could be taken, and such failure is also grounds for denial of a regular operating permit.

Any person aggrieved by this action may appeal, pursuant to Section 4 of the Environmental Hearing Board Act, 35 P.S. Section 7514, and the Administrative Agency Law, 2 Pa. C.S., Chapter 5A, to the Environmental Hearing Board, Second Floor, Market Street State Office Building, 400 Market Street, P.O. Box 8457, Harrisburg, PA 17105-8457, (717) 787-3483. TDD users may contact the Board through the Pennsylvania Relay Service, (800) 654-5984. Appeals must be filed with the Environmental Hearing Board within 30 days of receipt of written notice of this action unless the appropriate statute provides a different time period. Copies of the appeal form and the Board's rules of practice and procedure may be obtained from the Board. The appeal form and the Board's rules of practice and procedure are also available in braille or on audiotape from the Secretary to the Board at (717) 787-3483. This paragraph does not, in and of itself, create any right of appeal beyond that permitted by applicable statutes and decisional law.

Should you have any questions about this matter, please contact Richard L. Maxwell, Jr., Chief, Engineering Services, at (717) 327-3637.

Very truly yours,

Joseph W. Cooper
Regional Environmental Protection Manager

COMMONWEALTH OF PENNSYLVANIA
DEPARTMENT OF ENVIRONMENTAL RESOURCES
BUREAU OF AIR QUALITY

PLAN APPROVAL

Plan Approval No. 19-318-016
Owner Heinz Pet Products
Address 6670 Low St.
Bloomsburg, PA. 17815
Attn: Mr. Michael Hutnick,
Plant Engineer

Source & Air Cleaning Device: can side stripe surface coating operation controlled by a catalytic fume incinerator

Location: South Centre Twp.
Columbia Co.

In accordance with provisions of the Air Pollution Control Act, the Act of January 8, 1960, P.L. 2119, as amended, and with Chapter 127 of the rules and regulations of the Department of Environmental Resources, the Department on MAY 25 1993 approved plans for the construction of the above indicated air contamination source.

This PLAN APPROVAL expires 5/31/95.

The plan approval is subject to the following conditions:

(1) The side stripe coating operation is to be construed in accordance with the plans submitted with the application (as approved herein).

see attached for additional conditions

Notify the person noted below when the installation is completed so that the source can be inspected for issuance of an OPERATING PERMIT.

Regional Environmental Protection Manager
Air Quality Control
Northcentral Region

cc: Harrisburg
File

PLAN APPROVAL CONDITIONS
APPROVAL NO. 19-318-016
COMPANY: Heinz Pet Products

2. This plan approval is issued for the construction of a can side stripe surface coating operation consisting of a coating application station, a curing oven and a spray nozzle cleaning station. The volatile organic compound emissions from this side stripe coating operation shall be controlled by a CSM Environmental Systems model 25A Torvex catalytic fume incinerator.

3. The coating used in the side stripe coating operation shall be limited to Valspar 9849-501 having the composition identified in Valspar's Material Safety Data Sheet and "Coating Supplier Environmental Data Sheet" dated 4/15/93 unless an alternate coating, or alternate composition of this coating, is approved by the Department. The side stripe coating material, as received from the vendor, shall not be thinned, reduced or otherwise modified prior to use.

4. The catalytic fume incinerator shall be equipped with an operable continuous catalyst inlet and outlet temperature monitoring and recording system at all times. The temperature records generated by this monitoring and recording system shall be maintained on site for at least 2 years and shall be provided to the Department upon request.

5. The catalyst outlet temperature shall be maintained at 800°F or greater at all times that the side stripe coating operation is in use (including the nozzle cleaning station).

6. The catalytic fume incinerator shall maintain a volatile organic compound destruction efficiency of at least 95% and the volatile organic compound capture system and catalytic fume incinerator shall, in combination, maintain an overall volatile organic compound reduction efficiency of at least 85%.

7. No more than 100 gallons of cleaning solvent shall be used per year for side stripe coating operation cleanup activities performed outside of the nozzle cleaning station fume hood unless the cleaning solvent used in the subject activities is captured and disposed of in liquid form. Chlorinated solvents shall not be used as cleaning solvents.

8. The company shall maintain comprehensive accurate records of the amount of side stripe coating material and cleaning solvent used in the side stripe coating operation per calendar year as well as the amount of spent cleaning solvent from this operation which is shipped off site in liquid form and shall make this information available to the Department upon request.

9. Within 60 days of achieving the maximum production rate on the side stripe coating operation, but not later than 180 days after initial startup, the company shall perform 3 volatile organic compound stack tests on the associated catalytic fume incinerator, each test consisting of the simultaneous testing of the incinerator inlet and outlet. This testing shall be performed in accordance with procedures deemed to be acceptable by the Department of Environmental Resources while the line is operating at its maximum production rate. The company shall additionally accurately determine the amount of coating used during each test.

PLAN APPROVAL CONDITIONS
APPROVAL NO. 19-318-016
COMPANY: Heinz Pet Products

10. At least 45 days prior to the scheduled performed of the testing required by condition 9 herein, the company shall submit a pre-test plan to the Department for evaluation. This plan shall contain a description of the testing and analytical methods to be used for the testing as well as a description of the proposed method of determining the coating usage during the tests and shall be accompanied by dimensioned drawings of the fume incinerator inlet and outlet ductwork which shows the location of the proposed sampling ports.

11. The Department shall be given at least 10 days advance notice of the scheduled date(s) for the testing required by condition 9 herein so that Department personnel can arrange to be present. The Department is under no obligation to accept the results of tests performed without sufficient advance notice having been given.

12. Within 60 days of completion of the testing required by condition 9 herein, a test report shall be submitted to the Department. This report shall contain the results of the testing, a description of the testing and analytical procedures actually used, the coating material usage determinations made for the test periods, a copy of all raw test data generated during the testing and a copy of all associated calculations.

13. Issuance of an operating permit for the side stripe coating operation is contingent upon the coating operation and associated catalytic fume incinerator being constructed, maintained and operated as specified in the application and supplemental materials submitted for plan approval, as well as in accordance with all conditions contained herein, and upon satisfactory demonstration that any air contaminants emitted from the side stripe coating operation are in compliance with the requirements specified in, or established pursuant to, all applicable rules and regulations contained in Article III of the Rules and Regulations of the Department of Environmental Resources.

14. The company shall immediately notify the Department of any malfunction of the source(s) or associated air cleaning device(s) which results in, or may possibly be resulting in, the emission of air contaminants in excess of the limitations specified in, or established pursuant to, any applicable rule or regulation contained in Article III of the Rules and Regulations of the Department of Environmental Resources.

15. This Plan Approval authorizes temporary operation of the source(s) covered by this Plan Approval provided the following conditions are met.

    (a) The Department must receive written notice from the Owner/Operator of the completion of construction and the Operator's intent to commence operation at least five (5) working days prior to the completion of construction. The notice should state when construction will be completed and when Operator expects to commence operation.

PLAN APPROVAL CONDITIONS
APPROVAL NO. 19-318-016
COMPANY: Heinz Pet Products

(b) Operation is authorized only to facilitate the start-up and shake-down of sources and air cleaning devices, to permit operations pending the issuance of an Operating Permit or to permit the evaluation of the source(s) for compliance with all applicable regulations and requirements.

(c) This condition authorizes temporary operation of the source(s) for a period of 180 days from the date of commencement of operation, provided the Department receives notice from the Owner/Operator pursuant to subpart (a), above.

(d) The Owner/Operator may request an extension if compliance with all applicable regulations and Plan Approval requirements has not been established. The extension request shall be submitted in writing at least 15 days prior to the end of this period of temporary operation and shall provide a description of the compliance status of the source, a detailed schedule for establishing compliance, and the reasons compliance has not been established.

(e) The notice submitted by the Owner/Operator pursuant to subpart (a), above, prior to the expiration of this Plan Approval, shall modify the plan approval expiration date. The new plan approval expiration date shall be 180 days from the date of the written notice.

16. Any notification required as a result of any condition herein should be directed to: Richard L. Maxwell, Jr., Chief, Engineering Services, 200 Pine Street, Williamsport, PA 17701-6510, telephone (717) 327-3640.

APPENDIX C
CALCULATIONS

SAMPLE CALCULATIONS FOR MOISTURE AND FLOW

Client: _____ Plant: _____

Test Run No.: _____ Test Date: _____

Test Location: _____ Test Period: _____

1. Volume of dry gas sampled at standard conditions (68 °F, 29.92 in. Hg), dscf.

$$Vm(std) = \frac{17.64 \times Y \times Vm \times \left(Pb + \frac{\Delta H}{13.6} \right)}{(Tm + 460)}$$

$$Vm(std) = \frac{17.64 \times \quad \times \quad \times \left(\quad + \frac{\quad}{\quad} \right)}{\quad + 460} =$$

Where:

Vm(std) = Volume of gas sample measured by the dry gas meter, corrected to standard conditions, dscf.

Vm = Volume of gas sample measured by the dry gas meter at meter conditions, dcf.

Pb = Barometric Pressure, in Hg.

ΔH = Average pressure drop across the orifice meter, in H20.

Tm = Average dry gas meter temperature , °F.

Y = Dry gas meter calibration factor.

17.64 = Factor that includes ratio of standard temperature (528 °R) to standard pressure (29.92 in. Hg), °R/in. Hg.

13.6 = Specific gravity of mercury.

2. Volume of water vapor in the gas sample corrected to standard conditions, scf.

Vw(std) = (0.04707 x Vwc) + (0.04715 x Wwsg)

Vw(std) = (0.04707 x) + (0.04715 x) =

Where:

Vw(std) = Volume of water vapor in the gas sample corrected to standard conditions, scf.

Vwc = Volume of liquid condensed in impingers, ml.

Wwsg = Weight of water vapor collected in silica gel, g.

0.04707 = Factor which includes the density of water (0.002201 lb/ml), the molecular weight of water (18.0 lb/lb-mole), the ideal gas constant 21.85 (in. Hg) (ft^3)/lb-mole)(°R); absolute temperature at standard conditions (528 °R), absolute pressure at standard conditions (29.92 in. Hg), ft^3/ml.

0.04715 = Factor which includes the molecular weight of water (18.0 lb/lb-mole), the ideal gas constant 21.85 (in. Hg) (ft^3)/lb-mole)(°R); absolute temperature at standard conditions (528 °R), absolute pressure at standard conditions (29.92 in. Hg), and 453.6 g/lb, ft^3/g.

3. Moisture content

$$Bws = \frac{Vw(std)}{Vw(std) + Vm(std)}$$

Bws = ---------- =

Where:

Bws = Proportion of water vapor, by volume, in the gas stream, dimensionless.

4. Mole fraction of dry gas.

Md = 1 - Bws

Md = 1 - =

Where:

Md = Mole fraction of dry gas, dimensionless.

5. Dry molecular weight of gas stream, lb/lb-mole.

MWd = (0.440 x % CO2) + (0.320 x % O2) + (0.280 x (% N2 + % CO))

MWd = (0.440 x) + (0.320 x) + (0.280 x (+))

=

Where:

MWd = Dry molecular weight , lb/lb-mole.

% CO2 = Percent carbon dioxide by volume, dry basis.

% O2 = Percent oxygen by volume, dry basis.

% N2 = Percent nitrogen by volume, dry basis.

% CO = Percent carbon monoxide by volume, dry basis.

0.440 = Molecular weight of carbon dioxide, divided by 100.

0.320 = Molecular weight of oxygen, divided by 100.

0.280 = Molecular weight of nitrogen or carbon monoxide, divided by 100.

6. Actual molecular weight of gas stream (wet basis), lb/lb-mole.

MWs = (MWd x Md) + (18 x (1 - Md))

MWs = (x) + 18 (1 -)) =

Where:

MWs = Molecular weight of wet gas, lb/lb-mole.

18 = Molecular weight of water, lb/lb-mole.

7. Average velocity of gas stream at actual conditions, ft/sec.

$$Vs = 85.49 \times Cp \times ((\Delta p)^{1/2})avg \times \left(\frac{Ts\ (avg)}{Ps \times MWs} \right)^{1/2}$$

$$Vs = 85.49 \times \quad \times \quad \times \left(\frac{\quad}{\quad} \right)^{1/2} =$$

Where:

Vs = Average gas stream velocity, ft/sec.

$$85.49 = \text{Pitot tube constant, ft/sec} \times \frac{(lb/lb\text{-mole})(\text{in. Hg})^{1/2}}{(°R)(\text{in } H_2O)}$$

Cp = Pitot tube coefficient, dimensionless.

Ts = Absolute gas stream temperature, °R = Ts, °F + 460.

$$Ps = \text{Absolute gas stack pressure, in. Hg.} = Pb + \frac{P(\text{static})}{13.6}$$

Δ p = Velocity head of stack, in. H2O.

8. Average gas stream volumetric flowrate at actual conditions, wacf/hr.

Qs(act) = 3,600 x Vs x As

Qs(act) = 3,600 x x

=

Where:

Qs(act) = Volumetric flowrate of wet stack gas at actual conditions, wacf/hr.

As = Cross-sectional area of stack, ft^2.

9. Average gas stream dry volumetric flowrate at standard conditions, dscf/hr.

$$Qs(std) = 17.64 \times Md \times \frac{Ps}{Ts} \times Qs(act)$$

Qs(std) = 17.64 x x ---------- x

=

Where:

Qs(std) = Volumetric flowrate of dry stack gas at standard conditions, dscf/hr.

SAMPLE CALCULATIONS FOR BIAS AND MOISTURE CORRECTION AND MASS RATES OF TOTAL HYDROCARBONS

Client:	_____	Plant:	_____
Test Run No.:	_____	Test Date:	_____
Test Location:	_____	Test Period:	_____

1. Bias corrected value of total hydrocarbons as methane.

$$C(corr) = \frac{AVG - ZERO}{BIAS - ZERO} \times SPAN\ GAS$$

$$C(corr) = \frac{\quad}{\quad} \times$$

$$C(corr) =$$

Where:

AVG = Average THC concentration for the test run as methane as reported by the analyzer.

ZERO = The average of pre and post test zero bias check of the complete system with "zero" air.

BIAS = The average of pre and post test bias check of the complete system with the calibration span gas.

SPAN GAS = The calibration gas closest to the gas stream concentration, which was used for a BIAS check.

C(corr) = The bias corrected THC concentration as methane.

2. Moisture corrected value of total hydrocarbons as methane.

$$CTHC = \frac{C(corr)}{(100 - \%\ MOISTURE) / 100}$$

$$CTHC = \frac{\quad}{(100 - \quad) / 100}$$

CTHC =

Where:

CTHC = The concentration of total hydrocarbons, corrected for bias and moisture.

% MOISTURE = The precentage of water vapor in the gas stream.

3. Total hydrocarbon mass emission rate, lbs/hr.

$$PMR(THC) = \frac{CTHC \times Qs(std) \times 16.01 \times 60\ min/hr}{385.35 \times 10^{6}}$$

$$PMR(THC) = \frac{\quad \times \quad \times 16.01 \times 60\ min/hr}{385.35 \times 10^{6}}$$

=

Where:

PMR(THC) = Total hydrocarbon mass emission rate, lbs/hr.

Qs(std) = Average volumetric gas stream flow rate at standard conditions, dscf/min.

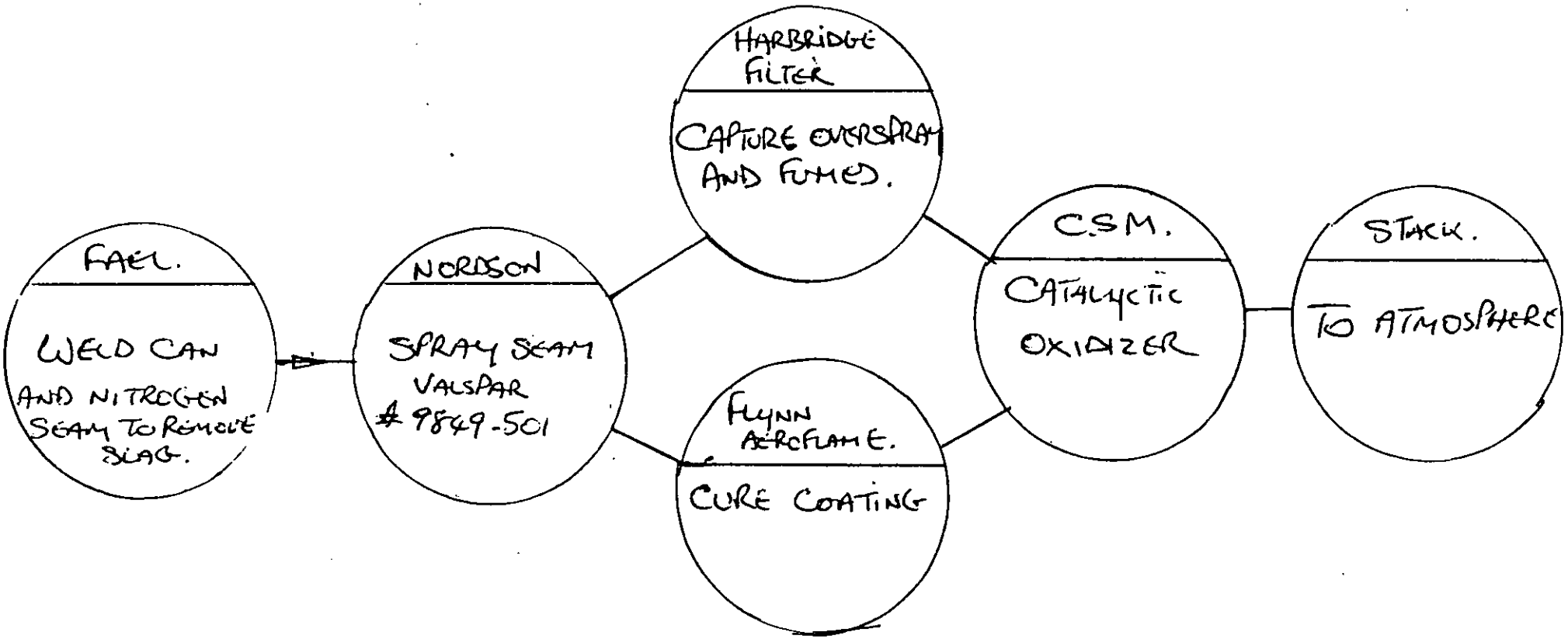
16.01 = Molecular weight of methane.

385.35x10^6 = Conversion factor from ppm to lbs.

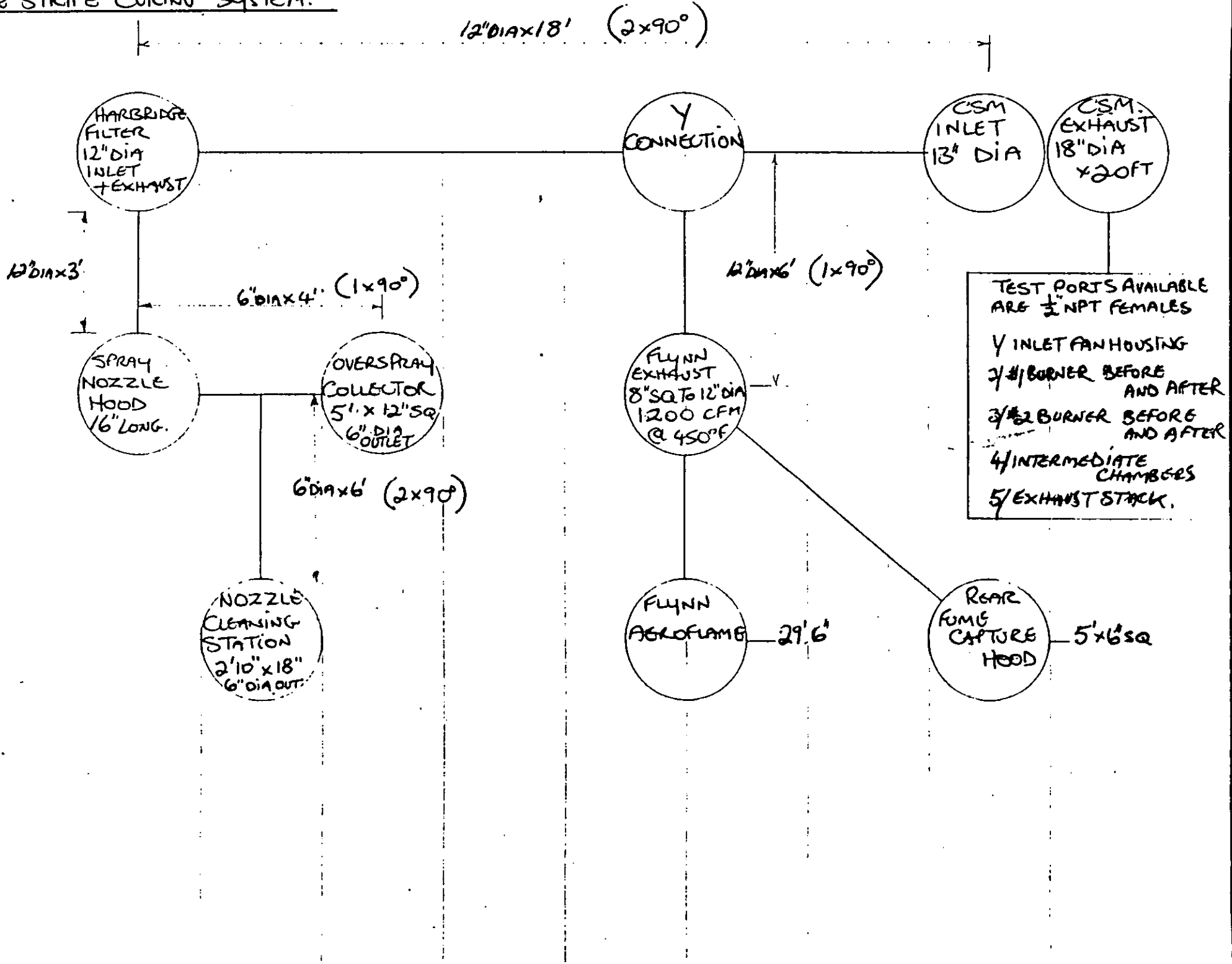
APPENDIX D

PROCESS INFORMATION

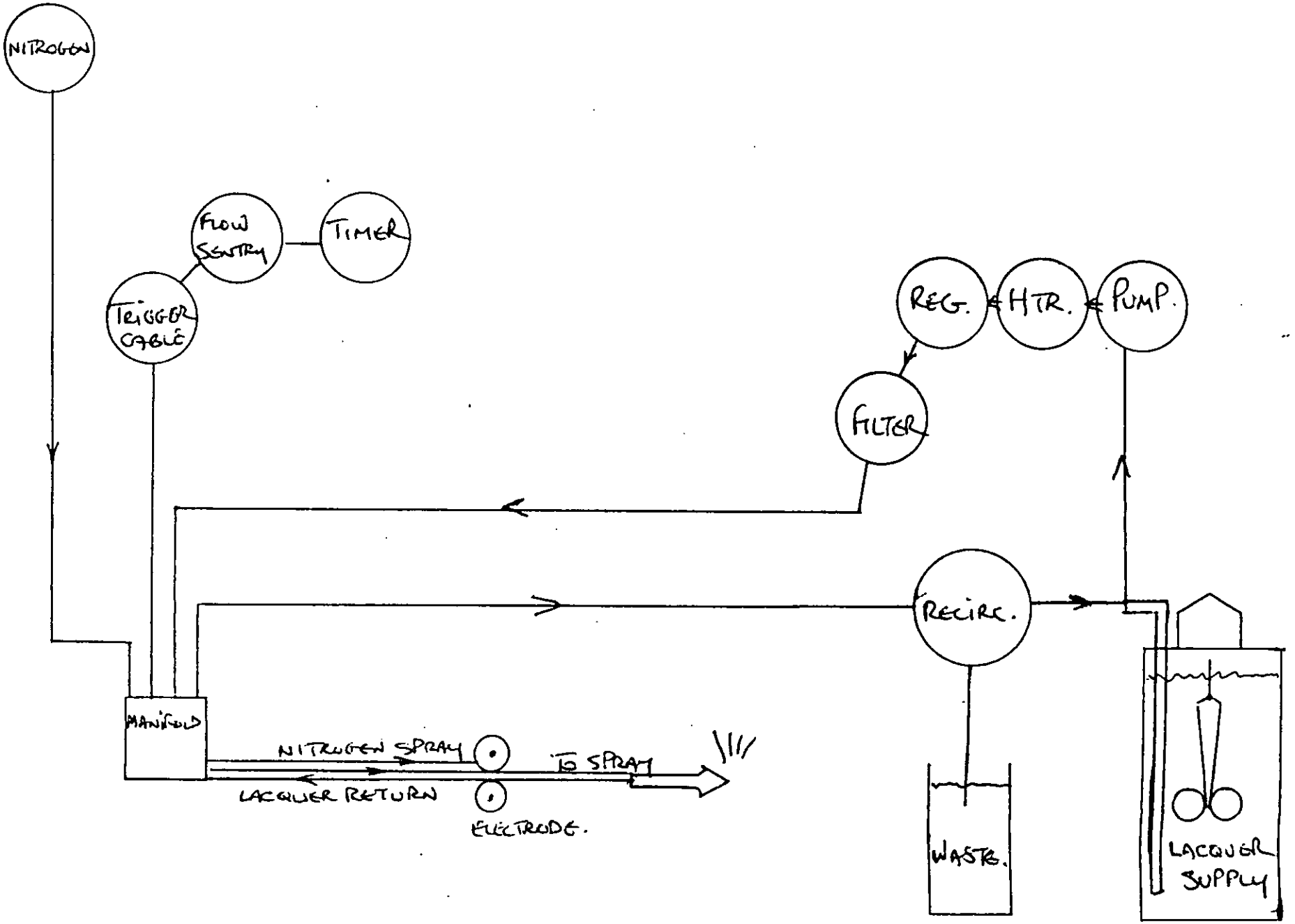
SIDE STRIPE PROCESS FLOW.



SIDE STRIPE CURING SYSTEM.



LACQUER FLOW.



JCP-630-02

VALSPAR CORPORATION

PAGE: 1
DATE: 06/09/93
CONTROL NO: IB3468066

CUSTOMER: HEINZ PET PRODUCTS

SARA SECTION 313 CHEMICAL REPORT
CUSTOMER NUMBER: 388282000

PRODUCT	PRODUCT NAME	(5) 311/312 CATEGORY	(6) 311/312 TYPE	(3) SECTION 313
9849501	9849501 SEAM STRIP	H-1 H-2 P-3	A	YES

SUMMARY OF COMPONENTS

CAS NUMBER	CHEMICAL NAME	PCT WT.	(7) VOLTL	(5) 311/312 CATEGORY	(3) SEC 313	(4) 313 CAT	(1) EXT HAZ RQ	(2) SUB TPQ
64742-95-6	SOLVENT NAPHTHA(PETROLEUM),LT. AROM.	0.2	100%	H-1 P-3	NO			
100-41-4	BENZENE, ETHYL	0.6	100%	H-1 H-2 P-3	YES			
1330-20-7	PHENYL,DIMETHYL	2.7	100%	H-1 H-2 P-3	YES			
71-36-3	1-BUTANOL	0.9	100%	H-1 H-2 P-3	YES			
108-88-3	PHENYL, METHYL	0.1	100%	H-1 H-2 P-3	YES			
107-98-2	1-METHOXY 2-PROPANOL	0.9	100%	H-1 H-2 P-3	NO			
28064-14-4	PHENOL, POLYMER WITH FORMALDEHYDE, GLYCIDYL ETHER	3.2	000%	H-1	NO			
108-10-1	2-PENTANONE, 4-METHYL-	2.4	100%	H-1 H-2 P-3	YES			
78-93-3	2-BUTANONE (MEK)	11.2	100%	H-1 H-2 P-3	YES			
111-76-2	ETHANOL, 2-BUTOXY-	6.3	100%	H-1 H-2 P-3		YES		
67-63-0	2-PROPANOL	0.4	100%	H-1 H-2 P-3	NO			
112-34-5	ETHANOL,2-(2-BUTOXYETHOXY)-	3.2	100%	H-1 H-2		YES		
108-65-6	2-PROPANOL, 1-METHOXY-, ACETATE	13.2	100%	H-1 H-2 P-3	NO			
123-86-4	ACETIC ACID, BUTYL ESTER	6.4	100%	H-1 H-2 P-3	NO			
1119-40-0	MIXTURE OF HEXANEDIOIC ACID,DIMETHYL ESTER; PENTANEDIOIC ACID,DIMETHYL ESTER; BUTANEDIOIC ACID,DIMETHYL ESTER	14.7	100%	H-1 H-2	NO			

FOOTNOTES

(1) = REPORTABLE QUANTITY OF EXTREMELY HAZARDOUS SUBSTANCE, SEC. 302
(2) = THRESHOLD PLANNING QUANTITY, EXTREMELY HAZARDOUS SUBSTANCE, SEC. 302
(3) = TOXIC CHEMICAL, SEC. 313
(4) = CATEGORY AS REQUIRED BY SEC. 313 (40 CFR 372.42), MUST BE USED ON TOXIC RELEASE INVENTORY FORM
(5) = HAZARD CATEGORY FOR SARA SEC. 311/312 REPORTING
HEALTH H-1 = IMMEDIATE (ACUTE) HEALTH HAZARD H-2 = DELAYED (CHRONIC) HEALTH HAZARD
PHYSICAL P-3 = FIRE HAZARD P-4 = SUDDEN RELEASE OF PRESSURE HAZARD
P-5 = REACTIVE HAZARD
(6) = TYPE A = LIQUID MIXTURE D = PURE LIQUID
B = SOLID MIXTURE E = PURE SOLID
C = GASEOUS MIXTURE F = PURE GAS
(7) = VOLATILE PERCENT

CUSTOMER NAME HEINZ PET PRODUCTS CUSTOMER NUMBER 388282000

CUSTOMER INVOICE : 3468066

********** SECTION 1 PRODUCT IDENTIFICATION **********

MANUFACTURERS ADDRESS : 6101 THIRD STREET SOUTH, MINNEAPOLIS, MN 55415
MFG TELEPHONE NUMBER : (612) 332 7371
24 HR EMERGENCY PHONE NO : 1-800 228 5635
CHEMICAL NAME OR FAMILY : PAINT PRODUCT
FORMULA : 9849501-134-A-00
TRADE NAME : 72 9849501 9849501 SEAM STRIP
ISSUE DATE : 01 15-93 DATE PRINTED 06 09 93

********** SECTION 2. HAZARDOUS INGREDIENTS **********

NAME	APPROX WT %		
*COMMON (NA) : ETHYLBENZENE	< 1%	TLV TWA	100 00 PPM
		TLV STEL	125 00 PPM
CAS 100-41 4 CHEMICAL BENZENE, ETHYL	.	OSHA PEL	100.00 PPM
		CEILING	NOT ESTAB
		RECOMND	NOT ESTAB
*COMMON (NA) XYLENE	5%	TLV TWA	100 00 PPM
		TLV STEL	150 00 PPM
CAS 1330-20-7 CHEMICAL PHENYL, DIMETHYL		OSHA PEL	100 00 PPM
		CEILING	NOT ESTAB
		RECOMND	NOT ESTAB
*COMMON (NA) PHOSPHORIC ACID	< 1%	TLV TWA	1 00 MG/CU M
		TLV STEL	3 00 MG/CU M
CAS: 7664-38 2 CHEMICAL: PHOSPHORIC ACID		OSHA PEL	1.00 MG/CU M
		CEILING	NOT ESTAB
		RECOMND	NOT ESTAB
*COMMON (NA) TOLUENE	< 1%	TLV TWA	100 00 PPM
		TLV STEL	150.00 PPM
CAS: 108-88 3 CHEMICAL: PHENYL, METHYL		OSHA PEL	100.00 PPM
		CEILING	NOT ESTAB
		RECOMND	NOT ESTAB
COMMON (NA) EPOXY RESIN	5%	TLV TWA	NOT ESTAB
		TLV STEL	NOT ESTAB
CAS 28064 14 4 CHEMICAL PHENOL, POLYMER WITH FORM ALDEHYDE, GLYCIDYL ETHER		USHA PEL	NOT ESTAB
		CEILING	NOT ESTAB
		RECOMND	NOT ESTAB
*COMMON (NA) METHYL ISOBUTYL KETONE	1%	TLV TWA	50 00 PPM
		TLV STEL	75.00 PPM
CAS: 108-10-1 CHEMICAL: 2-PENTANONE, 4-METHYL-		OSHA PEL	50.00 PPM
		CEILING	NOT ESTAB
		RECOMND	NOT ESTAB
*COMMON (NA): METHYL ETHYL KETONE	10%	TLV TWA	200 00 PPM
		TLV STEL	300 00 PPM
CAS 78-93-3 CHEMICAL 2 BUTANONE		OSHA PEL	200.00 PPM
		CEILING	NOT ESTAB
		RECOMND	NOT ESTAB
*COMMON (1) BUTYL CELLOSOLVE	5%	TLV TWA	25.00 PPM
		TLV STEL	NOT ESTAB
CAS 111-76 2 CHEMICAL ETHANOL, 2 BUTOXY		OSHA PEL	25 00 PPM
		CEILING	NOT ESTAB
		RECOMND	NOT ESTAB

********** SECTION 2: HAZARDOUS INGREDIENTS ****CONTINUED****

*COMMON (NA): BUTYL CARBITOL	5%	TLV TWA	NOT ESTAB
		TLV STEL	NOT ESTAB
CAS: 112-34-5 CHEMICAL: ETHANOL, 2-(2-BUTOXYETHOXY)-		OSHA PEL	NOT ESTAB
		CEILING	NOT ESTAB
		RECOMND	35.00 PPM
COMMON (NA): PROPYLENE GLYCOL MONO METHYL ETHER AC ETATE	15%	TLV TWA	NOT ESTAB
		TLV STEL	NOT ESTAB
CAS: 108-65-6 CHEMICAL: 2-PROPANOL, 1-METHOXY-, A CETATE		OSHA PEL	NOT ESTAB
		CEILING	NOT ESTAB
		RECOMND	NOT ESTAB
COMMON (NA): BUTYL ACETATE	5%	TLV TWA	150.00 PPM
		TLV STEL	200.00 PPM
CAS: 123-86-4 CHEMICAL: ACETIC ACID, BUTYL ESTER		OSHA PEL	150.00 PPM
		CEILING	NOT ESTAB
		RECOMND	NOT ESTAB
COMMON (NA): MIXED DIBASIC ESTERS	15%	TLV TWA	NOT ESTAB
		TLV STEL	NOT ESTAB
CAS: 1119-40-0 CHEMICAL: MIXTURE OF HEXANEDIOIC AC ID, DIMETHYL ESTER; PENTANEDIOIC ACID, DIMETHY L ESTER; BUTANEDIOIC ACID, DIMETHYL ESTER		OSHA PEL	NOT ESTAB
		CEILING	NOT ESTAB
		RECOMND	NOT ESTAB

********** SECTION 2: OTHER NON-HAZARDOUS INGREDIENTS **********

COMMON (NA): EPOXIDIZED LINSEED OIL 10%
CAS: UNKNOWN CHEMICAL:

COMMON (NA): VINYL RESIN 15%
CAS: UNKNOWN CHEMICAL:

CHEMICALS NOTED WITH A (*) ARE REPORTABLE UNDER SECTION 313 OF SARA TITLE III

(1) = GLYCOL ETHER. SEE SECTION 5

********** SECTION 3: PHYSICAL DATA **********

BOILING POINT: 156 DEG F.
VAPOR PRESSURE MM HG AT 68 DEG F: 78.0
VAPOR DENSITY (AIR = 1 0): 5.6
SPECIFIC GRAVITY: 1 01
PERCENT VOLATILE BY VOLUME: 70 44
EVAPORATION RATE (BUTYL ACETATE = 1): 5 6
SOLUBILITY IN WATER: NO
APPEARANCE AND ODOR: NORMAL FOR A COATINGS PRODUCT.

********** SECTION 4: FIRE AND EXPLOSION HAZARD **********

FLASH POINT (CC/PM DEG F : 51
LOWER EXPLOSIVE LIMIT : 1 00
UPPER EXPLOSIVE LIMIT : 16.00

EXTINGUISHING MEDIA: CARBON DIOXIDE, DRY CHEMICAL, FOAM, AND/OR WATER FOG.

SPECIAL FIRE FIGHTING PROCEDURES:
FIRE FIGHTERS MUST WEAR SELF CONTAINED BREATHING APPARATUS OR AIR MASKS.
CONTAINERS EXPOSED TO FIRE SHOULD BE KEPT COOL WITH WATER SPRAY.

UNUSUAL FIRE AND EXPLOSIVE HAZARDS:
NONE

********** SECTION 5: HEALTH HAZARD DATA **********

THRESHOLD LIMIT VALUE NOT REQUIRED FOR MIXTURE

EFFECTS OF OVEREXPOSURE:

PACKAGING COATINGS DEPARTMENT
2000 WESTHALL STREET
PITTSBURGH, PENNSYLVANIA 15233

TECHNICAL DATA SHEET

CODE 91X139

FILM COLOR Gold TYPE Modified Vinyl

SUGGESTED USE Interior Side Seam Stripe for Welded Food Cans

SPECIFICATIONS (AS MANUFACTURED)	
VISCOSITY #4 F.C.@ 80°F 18-22 sec. SOLIDS (% by weight) 34.4 ± 1.0 WEIGHT PER U.S.GALLON (Lbs.) 8.40 + 0.06	VOC 5.43 by ASTM D-2369 ASTM SOLIDS (% by weight) 35. ASTM SOLIDS (% by volume) 29.

APPLICATION SUGGESTIONS

SURFACE Tinplate - with proper basecoat.

PREPARATION Welded Seam

COATING WEIGHT 2-10 mgs./linear inch depending on product to be packe

METHOD Spray

SUGGESTED THINNER MEK - For slower solvent system use Butyl Cellosolv

"WASH-UP" SOLVENT(S) MIBK (FOR ABOVE ALSO).

BAKE (Time@PMT) Bake required in addition to residual heat of weldin

SPECIAL INSTRUCTIONS Mix thoroughly before use. Do not store in direc sunlight. Store below 90°F. Avoid temperature extremes.

* 5-12 seconds total time reaching 440-500°F PMT or equivalent. Line curing conditions remain the responsibility of the can maker.

CAUTION: Overbake or underbake may result in off-flavor. Stripe must be qualified with basecoat to assure acceptable adhesion blush resistance properties. Do not exceed 110°F fluid temperature.

Must be test packed to assure performance with specific food products

WHEN PROPERLY BAKED MEETS FDA 175.300 YES ☒ NO ☐

CONTAINS LUBRICANT YES ☒ NO ☐ **SHELF LIFE** 4 Months @ 80°F

SUBMITTED TO

COMPANY Heinz Pet Products **ATTENTION** Mr. R.T. Hancoc

ADDRESS Bloomsburg, PA.

SUBMITTED BY E.A. Babinecz/ssf **DATE** 2/24/92

SECTION 1 - GENERAL DATA

1.1 Safety Notice

A. Reactor Operation

The TORVEX Catalytic Abatement System is designed to oxidize hydrocarbons and carbon monoxide as they pass over LoTemp Supported Catalyst at temperatures normally in the range of 700° to 950°F. The maximum design operating temperature for this system is 1000°F exit the catalyst bed.

All operations should be directed toward minimizing the possibility of high concentrations of combustible material in the exhaust that could in turn produce hazardous or explosive conditions. Typically, the concentration of flammable vapors being processed should be kept below one quarter of the lower explosive limit. Catalyst can serve as an ignition source to cause a fire or explosion if the concentration of flammable vapors exceeds the lower flammability limit (LEL). Caution must also be exercised in preventing the buildup of condensible material at any place in the duct work leading up to the system. Access doors that allow periodic inspection of connection duct work should be provided.

This system has been designed with built-in safety features, including the shut down provisions noted in Sections 4.7. Due to operating temperatures (up to 1050°F), the unit has been insulated for personnel protection. However, care should always be taken to avoid direct contact with any portion of the unit while in operation.

The combustion system meets IRI regulations and the Honeywell BC7000 Microprocessor Burner Control System will perform numerous safety checks and diagnostics prior to each burner flame. Also refer to the general literature regarding safety (Maxon literature).

Caution should always be used in working around the system during a shut down period, since dampers sometimes leak. Maintain good ventilation in the area in which the system is located. If the system shuts down because of high temperature or any other automatic shut down, operators should pay particular attention to hot surfaces and adequate area ventilation. This is especially important when removing or installing catalyst modules. Open all doors, and if necessary, use a ventilation fan to keep fresh air flowing in the reactor during module removal or installation. Do not use the vacuum pump as a ventilation source.

At any time that the reactor is not in operation because of the necessity to perform maintenance work, a lockout tag should be placed on the incinerator control panel and the remote control panel POWER ON/OFF selector switch.

The system should be installed in an open area free of obstructions and tripping hazards. External connections, such as fuel and electrical services should be made in the best possible manner according to applicable codes.

B. Housekeeping

The area should be maintained free from any hazards that would prevent easy movement around the system and control panel. No flammable or otherwise hazardous materials should be stored in the immediate vicinity of the reactor. No work materials, papers or other materials should be placed on the system.

C. Safety Review

Review the operation of the reactor with your plant safety officer before starting the unit. Any suggestions and additions should be included with the instructions.

All those involved in the operation of the system should read and understand the complete operating instructions before starting the unit. Safety meetings of all those involved with the system should be held periodically in conjunction with housekeeping reviews.

1.2 Catalyst Maintenance

A. Catalyst life is dependent upon its exposure to "poisons" such as elemental phosphorus, arsenic, antimony, halogens iron, mercury, and other heavy metals. It can also be "fouled" or "masked" by condensed organic high boilers and/or particulate materials. Organic condensates can usually be removed by elevating the operating temperature to 1000° - 1050°F for 4-8 hours. Other fouling materials, such as metallic oxides and particulate dirt, can in most cases, be removed by an air lance and/or cleaning the modules with an aqueous solution. True, "poisoning" will irreversibly damage the catalyst. However, in the case of phosphorous contamination, aqueous cleaning has been used to effectively restore activity.

B. Determination of the catalyst efficiency in hydrocarbon oxidation is made by gas analysis of samples drawn from the emission inlet to the system and immediately after the catalyst exit face or system outlet. In the event the operator suspects any loss of catalytic activity via visual inspection or less than usual temperature increase across the catalyst, contact CSM Environmental Systems, Inc. before attempting any corrective measures. We will assist in determining the course of action to correct the situation, and if applicable, will provide specific cleaning or maintenance instructions.

SECTION 2 - SYSTEM DESCRIPTION

2.1 Drawing List

Drawing #	Revision	Title
D-92-6891-00	B	Process & Instrument Diagrams
D-92-6891-01	A	Electrical Schematics
D-92-6891-03	B	Control Panel Assembly
D-92-6891-04	A	Gas Train
D-92-6891-07	B	General Arrangement
SPD-100049	O	Catalyst Module Installation Dwg

2.2 General Description

Reference to Process & Instrument Diagram, process inlet air 2500 SCFM at 300°F and 0" w.c., goes through process fan. Volume of process inlet is controlled by Louver Damper attached at process fan discharge. Process fan push air to oxidizer unit. Air passes through Maxon Pre-heat Burner #1 (LV-3), where it gets heated by using natural gas as a fuel. Natural gas coming to burner through gas train, air stream is heated to 350°F temperature. Air stream push through CROSSFLOW module and temperature of air stream is controlled by Honeywell Controller UDC-3000 at 350°F. Air stream push through KALEX 222-8 heat exchanger and gets heated. Air stream then passes through main Burner #2 (LV-3) and temperature is increased to desired catalyst inlet temperature. The catalyst inlet temperature is controlled by a Honeywell ARC-4100 Truline Circular Chart Recorder/Controller located on the control panel. The air/vapor mixture then passes through the TORVEX supported catalyst where organics are oxidized to carbon dioxide and water. The temperature increase across the catalyst bed will be a function of the hydrocarbon content in the air. Thus, it is necessary to limit the hydrocarbon content in the air stream so that the maximum design temperature of 950°F is not exceeded. If maximum catalyst exit temperature is exceeded, an alarm will activate and the system will shut down, at 1050°F.

Now clean air stream pass through KALEX heat exchanger (61% efficiency) and goes to stack.

SECTION 3 - SYSTEM CONSTRUCTION

3.1 Utilities Required

Natural Gas - ~~225~~ 3000 SCFH at 1 1/2 to 3 PSI at gas train.
Cooling Air - 10 SCFH at 1 PSIG at Scanner.
Electrical System - 460V, 60 Hz, 3 ϕ at control panel.

3.2 Catalyst Abatement System

The Catalytic Abatement System consists of the following:

a) Catalytic Reactor/Catalyst Frames
b) KALEX® Heat Exchanger System
c) Maxon "LV" Raw Gas Burner
d) Gas Train System
e) Process Fan

3.2.1 BURNER

The burner is a Maxon LV-3 propane or natural gas type capable of operating down to 16% oxygen content in the stream. The mixing plates shall be rated for at least 1000°F. The adjustable burner plates will be profiled for maximum efficiency based on the fuel of choice. The burner will be spark ignited by a pilot system and equipped with an ultra violet scanner. The burner heat duty will be capable of a 20:1 turndown ratio. A 3 inch sight glass is provided for observing the flame. For further details refer to the Maxon Product literature (Section 5.8)

3.2.2 Gas Train System (IRI)

Gas flow will be modulated by a controller based on a catalyst temperature input signal. The gas train components must comply with IRI recommendations as follows:

Two (2) Automatic Motorized Safety Shut-Off Valves
Fuel Low Pressure Switch
Fuel High Pressure Switch
Process Air Flow Switch
Main Fuel Shut-Off Valve
Main Fuel Pressure Regulator
Fuel Inlet Pressure Gauge
Regulator Outlet Pressure Gauge
Pilot Fuel Regulator
Pilot Fuel Solenoid Valves (2 N.C./1 N.O.)
Pilot Pressure Gauge
Low Fire Start on Modulating Fuel Gas Valve
Pilot Vent Solenoid

3.2.3 KALEX® Heat Exchanger System (222-8)

The heat exchanger will be a KALEX 222-8, of modular, fin and plate design, constructed of 304 ss and configured so that the heat exchanger modules can be easily removed for cleaning. The heat exchanger will be capable of 61% efficiency.

A motor driven modulating valve will be opened proportional to a 12-20 ma signal from the catalyst inlet temperature thermocouple/recorder.

3.3 Catalytic Reactor

The TORVEX Catalytic Reactor is of double wall construction with stainless steel inside and aluminized carbon steel outside separated by 4" of insulation.

The system internals will be welded stainless steel of no less than fourteen (14) gauge and will be insulated with four (4) inches of high temperature insulation material. A 18 in. x 36 in. bolted access-way to the catalyst chamber will be provided. The outer skin of the system will be at least eighteen (18) gauge aluminized steel and suitable for location outdoors.

3.3.1 Catalyst Frames and Catalyst Modules

The TORVEX supported catalyst modules are illustrated in the attached product literature. Each catalyst module consists of TORVEX ceramic honeycomb coated with Engelhard P-3 noble metal catalyst. The module is sealed against the frame with 1200°F, "E" glass tadpole gasket provided with the catalyst module. The reactor contains one stainless steel T-bar frame.

The catalyst will be TORVEX catalyst, platinum on activated alumina on ceramic honeycomb substrate. The catalyst will be canisterized in stainless steel modules with stainless steel protection mesh at the inlet and outlet. The catalyst modules will be gasketed within a stainless steel T-bar frame to prevent bypassing and allow for thermal expansion.

3.4 Installation

3.4.1 Catalyst Module Installation (Dwg # SPD-100049)

Before installing or reinstalling catalyst modules, be sure all loose dirt, metal chips, welding residue, etc., are cleaned out of the duct work upstream of the catalyst and in minutes prior to catalyst installation is usually acceptable, but vacuum cleaning and wiping all surfaces with an oily rag is preferred.

The catalyst modules are ready for installation as received. The end, including the lid is the upside with the tadpole gasket mounted on the opposite end (see typical catalyst module Drawing enclosed). Be sure the sewn joint of the gasket is in the middle of the module side - **not** on a corner. The module is placed in the support frame with the self-contained gasket forming the seal against the frame. The module is centered over the 11-5/8" x 11-5/8" frame opening and is held in place by the hold-down clips and nuts on the stud bolts. Be sure the gasket does not roll when placing the module in the frame. Tighten the nuts enough to compress the gasket and to insure there is no air leakage around the modules, (about 50 in. lbs. torque is enough). Double (JAM) nuts should be used on all studs. For further details regarding catalyst installation refer to catalyst module installation drawing (refer to Table "A" for corresponding system drawing no.)

3.4.2.1 Junction Box (NEMA 4)

A Junction Box is provided by the CSM TORVEX Oxidizer System. Junction box consist of all terminals, ignition transformer and emergency stop push button (to stop system locally).

3.4.2.2 Control Panel (NEMA 12)

The control panel is located on remote to oxidizer. The control panel (NEMA 12) consists of the following:

A) Pushbuttons

B) Indication Lights

C) Alarm Lights

D) Control Instrumentation

1. (Two) Honeywell BC7000L Microcomputer Burner Control Systems
2. (Two) Micrometer Flame Signals (BI-3 and 7)
3. Catalyst Temperature Recorder/Controller (TIRC-8)
4. Alarm Horn
5. CROSSFLOW temperature Controller (TIC-5)

3.4.3 Test Connections

A 1/2" NPT coupling and plug is installed at the following locations:

a) Pre-heat Burner #1 Inlet and Outlet
b) Heat Exchanger Inlet and Outlet
c) Main Burner #2 Inlet and Outlet
d) Catalyst Inlet and Outlet
e) Stack Outlet

These connections may be used for air sampling during startup; off pressure measurements and regular scheduled emissions testing.

3.4.4 Panel-Skid Connections

Connect 480V, 60Hz, 3Ph power into main control panel. The internal control transformer will provide the required 120V power.

Connect 120V, 60 Hz power into the local control panel. Connect process inlet to the process fan. Connect natural gas supply to the 1 NPT gas inlet. Support the process inlet connection such that the load is not transmitted to the process inlet butterfly valve.

3.4.5 Flame Detector

The UV flame detector is shipped loose to prevent damage. It can be found in a package taped inside the junction box or control panel. The detector should be installed when the system is installed.

SECTION 4 - SYSTEM OPERATION

4.1 Startup

4.1.1 Control Panel System Start

Turn on control power selector switch (SSW-1) to "On" position, the power "On" light (PL-1) will be lit. The alarm circuit will be activated. Press the alarm silence reset pushbutton (PB-9) to silence the alarm horn. Open the main gas valve.

Check the configuration settings in the Partlow ARC-4100 circular chart recorder/controller (Dwg. #D-92-6891-01)

Also check the jumper settings pertaining to the recorder/controller inputs. The settings should be set per drawing #D-92-6891-01.

4.1.2 System Permissives - Process Fan Start

Press the fan restart pushbutton (PB-1) the process fan will start.

Press the Preheat Burner #1 start pushbutton (PB-3). The burner #1 start pushbutton will activate the Honeywell BC7000L Micro-computer Burner Control System.

4.1.3A System Permissives - Preheat Burner #1 Start

Before the Honeywell BC7000L burner control system can be activated, the following system permissives must be satisfied:

a) Process Fan running (M1)
b) High temperature latching relay de-energize
c) Low gas pressure switch open (PSL-4)
d) High gas pressure switch closed (PSH-4)
e) CROSSFLOW outlet high temperature switch (TSH-5) de-energized
f) Customer permissive contact (Jumped or Closed X3-5)
g) Preheat Burner #1 permissive relay opened (CR-1)
h) Process Air Flow

Once the permissives a) through h) are satisfied, the burner permissive relay CR-1 energizes, activating the Honeywell BC7000L, when the burner start pushbutton PB-3 is pressed.

The Honeywell BC7000L burner control system will automatically initiate at programmed startup sequence which will include the following sequence modes.

Pre-purge
Hold
Ignition Trial
Flame On
Run

During the pre-purge sequence the purge On light is energized, (via the BC7000L). During the ignition trial sequence the pilot On light will energize (via the BC7000L) if the ignition trial is successful the main flame relay will energize and activate the main gas flame On light.

4.1.3B System Permissives - Main Burner #2 Start

Before the Honeywell BC7000L Burner #2 control system can be activated, the following system permissives must be satisfied.

a) All a) to h) permissives noted at 4.1.3.A
b) Catalyst outlet high temperature switch (TSH-8)
c) High gas pressure switch closed (PSH-7)
d) Main burner #2 permissive relay open CR-3

Now Honeywell BC7000L Burner #2 control system will automatically initiate at programmed startup sequence as noted in 4.1.3.A.

4.1.4 Burner System Shutdown

To shut down the burner, press the "Burner Off" pushbutton. The "Main Flame ON" light will go out and the alarm circuit will activate. Press "Alarm Silence" reset pushbutton. If Burner #1 shut-down, automatically Burner #2 also gets shut-down.

4.1.5 Emergency Shutdowns - Burner System (Typ. for Both Burners)

The following conditions cause the burner to shut down and the alarm to activate and latch.

a. Loss of any burner permissives which results in the re-energization of the burner permissive relay (CR-1).

4.1.5 Loss of Burner Flame (Gas Valve Closing) (Typ. for Both Burners)

Loss of burner flame. When the flame UV Scanner senses a loss of burner flame, the Honeywell Flame Safeguard Programming Control causes a safety shutdown of the burner to occur as described in the Honeywell Bulletin. The "Main Flame ON" light, will go out and the Red burner "Lockout" light will activate. Depress the burner "Reset" pushbutton until the "Lockout" light goes out.

The following will also actuate alarms and shutdown sequences:

a) Loss of the burner permissive relays
b) Low fire
c) Low air flow switch relay

The devices are directly wired to the BC-7000.

4.2 Miscellaneous Emergency Shutdowns (Typ. for Both Burners)

The following are emergency induced conditions which result in automatic shutdown sequences.

4.2.1 Catalyst Exit High High Temperature

When the temperature downstream of the catalyst exceeds 1050°F, the temperature switch (TSHH-8) closes. The "High Catalyst OUtlet Temperature" light on the oxidizer control panel will activate. The latching relay will also energize. The alarm must be silenced and the TSHH-5 switch reset by pushing the latch reset pushbutton located on the oxidizer control panel.

4.2.2 Low Gas Pressure

Low gas pressure will activate the low gas pressure switch (PSL-4) and energize the low gas pressure light (PL-2) on the oxidizer control panel. THis switch activation will shutdown the burner.

4.2.3 High Gas Pressure (Typ. for Both Burners)

High gas pressure will activate the high gas pressure switch and energize the high gas pressure light on the oxidizer control panel. THis switch activation will shutdown the burner.

4.3 The following conditions cause only an alarm light and/or to activate.

4.3.1 Catalyst Outlet Warning Temperature (TSH-8.1)

When the temperature downstream of the catalyst exceeds 950°F, the temperature switch closes. The "High Catalyst Warning Temperature" will activate.

4.3.2 Low Process Air Flow (DPSL-1)

Insufficient air flow from the vacuum blower will activate the process air low differential pressure switch (DPSL-5) and energize the process air low air flow light on the oxidizer control panel.

4.4 Temperature/Flow Recorder-Controller

The Partlow ARC-4100 Truline circular chart recorder/controller records the outputs from the catalyst inlet thermocouple and the catalyst outlet thermocouple (TE-8 and TE-8.1).

The control output one (1) will control the burner Modutrol Valve (MOV-7).

The alarms configured in the Partlow ARC-4100 is the following:

High catalyst inlet temperature (TSH-8).

4.4.2 Honeywell UDC-300

Honeywell UDC-3000 controls the output from the CROSSFLOW outlet thermocouple (TE-5), and configured as reverse action. The alarm configured in UDC-3000 is as follows:

High CROSSFLOW outlet temp (TSH-5).

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TEST PROTOCOL
HEINZ PET PRODUCTS
PERMIT NO. 19-318-016
CATALYTIC AFTERBURNER SYSTEM

Prepared for:

Heinz Pet Products
Bloomsburg, Pennsylvania

Submitted To:

Pennsylvania Department of
Environmental Resources

August 1993

SCOTT ENVIRONMENTAL TECHNOLOGY
A Division of National Air Network, Inc.
Plumsteadville, Pennsylvania 18949
215-766-7230

TABLE OF CONTENTS

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1.0 INTRODUCTION

Scott Environmental Technology will conduct an emission compliance test program at the Heinz Pet Products facility located in Bloomsburg, Pennsylvania. The purpose of the evaluation will be to demonstrate compliance with applicable state of Pennsylvania Department of Environmental Resources regulations and permit requirements. Emission sampling will be conducted in evaluation of the total non-methane hydrocarbon destruction efficiency of a VOC control device. The Volatile Organic Compound (VOC) capture efficiency shall also be verified in evaluation of the fume control system. The specific parameters to be determined as part of this test program will include the following:

Inlet Outlet Test Locations

Total Hydrocarbons
Methane
Volumetric Flow Rate
Stack Gas Molecular Weight
Stack Gas Moisture

Scott Environmental Technology will be responsible for the performance of all on-site sampling and analysis. Scott Environmental Technology shall coordinate and review all activities while Heinz Pet Products shall maintain an operational log of all pertinent process data. Scott shall be responsible for the preparation and submittal of a final report presenting the test results and detailing the sampling and analytical methods employed.

Prior to the conduct of the compliance test, Scott Environmental Technology will present to the on-site PADER observer a calibration report containing data verifying the accuracy of the test equipment.

An outline of the intended test program is provided herein. Any questions pertaining to this protocol may be addressed to the following:

Mr. Robert McKinney
Manager - Field Services
Scott Environmental Technology
6205 Route 611
P. O. Box 369
Plumsteadville, PA 18949
Phone: 215-766-7230 Fax: 215-766-2051

2.0 PROCESS DESCRIPTION

The emission source under evaluation is a can side stripe surface coating operation consisting of a coating application station, a curing oven and a spray nozzle cleaning station. The coating applied is Valspar 9849-501 consisting of the following volatile organic compounds:

Naptha	4- Methyl,.2- Pentanone
Ethyl benzene	2- Butanone
Dimethyl phenyl	2- Butoxy Ethanol
1- Butanol	2- Propanol
Methyl phenyl	2- (2-Butoxyethoxy) - ethanol
1- Methoxy, 2- Propanol	1- Methoxy - acetate, 2- Propanol
Glycidyl ether phenol	Butyl ester, acetic acid

Fumes from the coating operation are gathered in a collection duct and directed to a CSM Environmental Systems Model 25A Torvex catalytic fume incinerator. Specifications for the afterburner are as follows:

Typical Operation	#1 Burner		150,000 BTU/HR
	#2 Burner		700,000 BTU/HR
	TOTAL	=	850,000 BTU/HR
	MAX	=	3,000,000 BTU/HR
Settings Operation	1# Burner	=	350°F
	#2 Burner	=	810°F
Differential	Across Fan	=	10" W.C.
"	Crossflow	=	1" W.C.
"	Catalyst	=	1" W.C.
Outer Damper		=	45% Open
Inlet SCFM		=	2500

Outlet sampling will be conducted in a horizontal section of ducting 18 inches in diameter. Two ports located in a 90° arc arrangement will be used for sampling and flow measurement. The ports are located 4 feet (2.7 diameters) upstream and 14.5 feet (9.7 diameters) downstream from any flow disturbance.

Inlet flow measurement will be conducted at two locations: the hood exhaust and the outlet of the Flynn curing oven. The hood exhaust test location is situated in a horizontal section of ducting 18 inches in diameter. Two sample ports will be used for all measurements. The ports are located 18 inches (1.0 diameters) upstream

and 5.5 feet (3.7 diameters) downstream from any flow disturbance.

Flow measurement will be performed in a vertical section of ducting 13 inches in diameter. Two sample ports situated 90° opposed will be utilized for pitot tube traverses. The ports are located 6 inches (0.5 diameters) upstream and 2 feet (1.9 diameters) downstream from any flow disturbance.

Inlet sampling for total hydrocarbons and methane will be conducted in a horizontal section of ducting following the combination of the two inlet gas streams. The test location will be before the ID fan for the system.

Blueprints showing the test locations have been enclosed with this protocol submittal.

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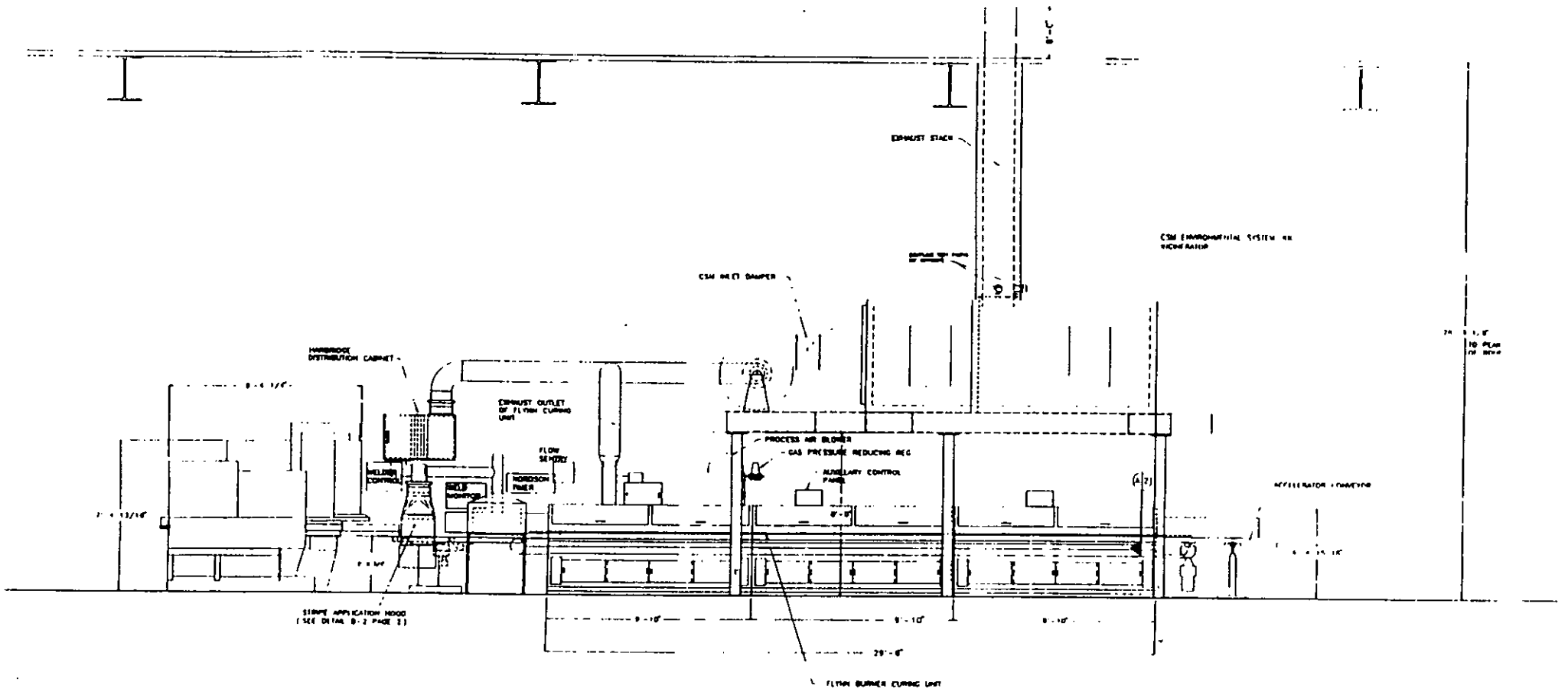
Figure 2-1



3.0 SAMPLING AND ANALYTICAL PROCEDURES

3.1 INTRODUCTION

The procedures to be employed for testing will be as defined in detail in the following US EPA Reference Methods found in the Code of Federal Regulations, Title 40, Part 60, Appendix A (40 CFR 60):

Method 1	-	"Sample and Velocity Traverses for Stationary Sources";
Method 2	-	"Determination of Stack Gas Velocity and Volumetric Flow Rate (Type S Pitot Tube)";
Method 3	-	"Gas Analysis for the Determination of Dry Molecular Weight";
Method 4	-	"Determination of Moisture Content in Stack Gases";
Method 18	-	"Measurement of Gaseous Organic compounds Emissions by Gas Chromatography";
Method 25A	-	"Determination Of Total Gaseous Organic Concentration Using A Flame Ionization Analyzer";

Copies of the test methods may be found in the appendices of this test protocol. The remainder of this section is presented to summarize the test procedures.

3.2 SAMPLING LOCATION

Sampling will be conducted at the inlet and outlet of the catalytic afterburner. Flow measurement will also be conducted at these locations. Scott Environmental Technology will perform a characterization of the flow patterns for each stack port arrangement to ensure the absence of cyclonic flow. This measurement will take place prior to the conduct of the emission compliance test. The results of the flow measurement will be presented to the on-site PADER observer during the compliance evaluation.

3.3 VOLUMETRIC FLOW

The procedures and apparatus employed for flow measurement will be as defined in EPA Methods 1-4. Volumetric stack gas flow will be measured using a type S pitot tube assembly. The pitot tubes to be employed are calibrated using the procedures outlined in Method 2, Section 4.1.2 and meet the construction criteria of Section 4.1. A type K thermocouple will be used for measuring stack gas temperature. The barometric pressure measurement required during the test will be obtained using an aneroid barometer which will be brought in the field by the test crew. The aneroid barometer will be calibrated using a mercury barometer before leaving the office. A diagram depicting the flow measurement apparatus is shown in Figure 3-1.

Gas sampling for determination of dry gas molecular weight will be performed by EPA Reference Method 3 procedures. An Orsat apparatus will be used for the measurement of O_2 and CO_2 concentrations.

Gaseous samples will be extracted from each source at a constant rate. A three-point traverse will be made at locations 16.7%, 50.0% and 83.3% across the stack diameter. A stainless steel probe will be used followed by a teflon sample line. Moisture removal will take place in an ice-cooled coil condenser. After passing through a teflon-lined diaphragm pump, the sample is collected in a leak-free tedlar bag. A portion of the bag sample will be analyzed for CO_2 and O_2 content. Orsat analysis provides for the selective absorption of oxygen in alkaline pyrogallic and carbon dioxide in potassium hydroxide solutions. The difference in gas volume before and after the absorption represents the amount of constituent gas in the sample. Constant temperature and pressure will be maintained during the analysis.

Schematics of the Orsat sampling train and apparatus are presented in Figures 3-2 and 3-3.

Stack gas moisture content will be determined using EPA Reference Method 4 procedures. An impinger sampling train incorporating H_2O and silica gel will be used for moisture capture. The net increase in the weight of the two reagents will be recorded as volume of water collected (1 gram = 1 milliliter).

The dry meter used in the sampling train will be calibrated in accordance with EPA Method 5, Section 7.2.

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Figure 3-1

Flow Measurement Apparatus

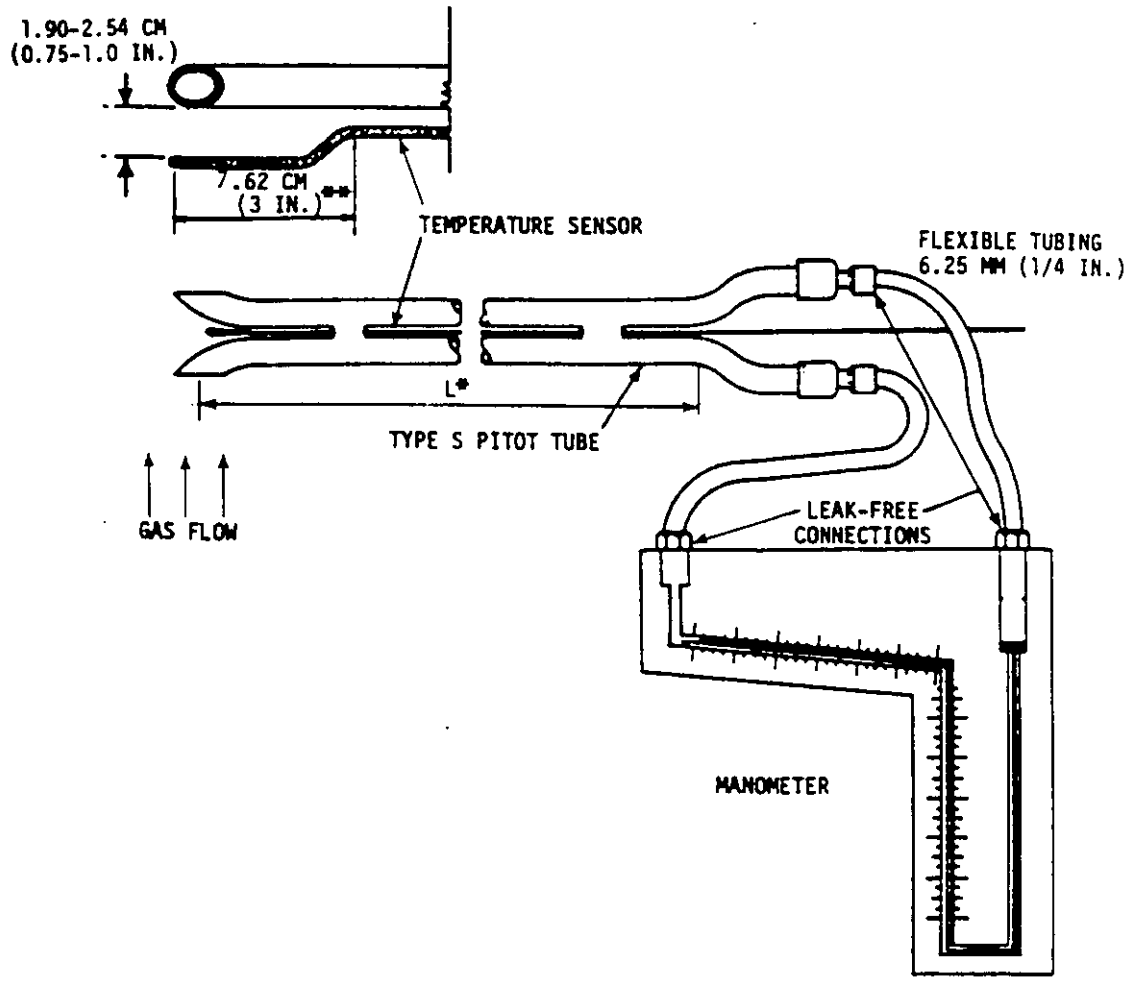

Figure 3-2

Orsat Sampling Train

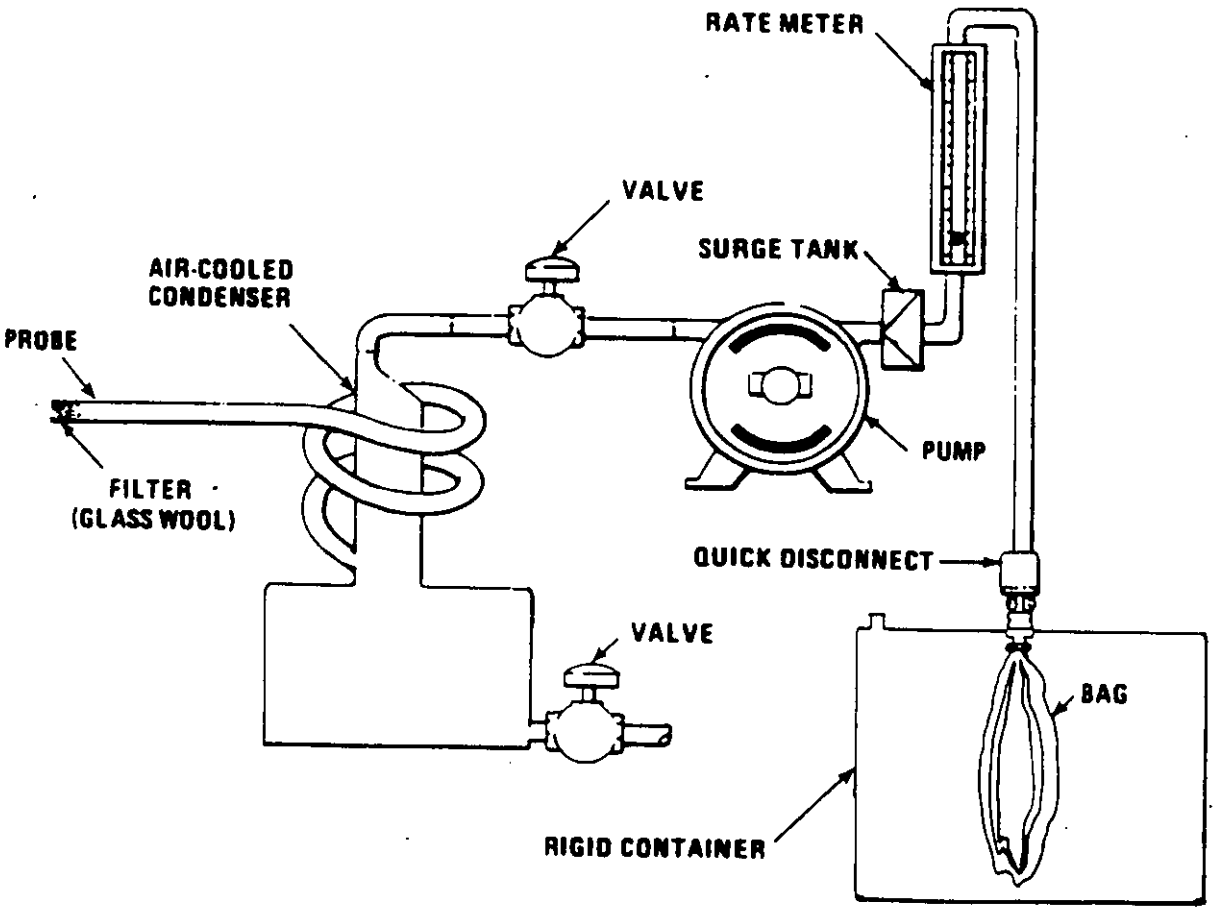

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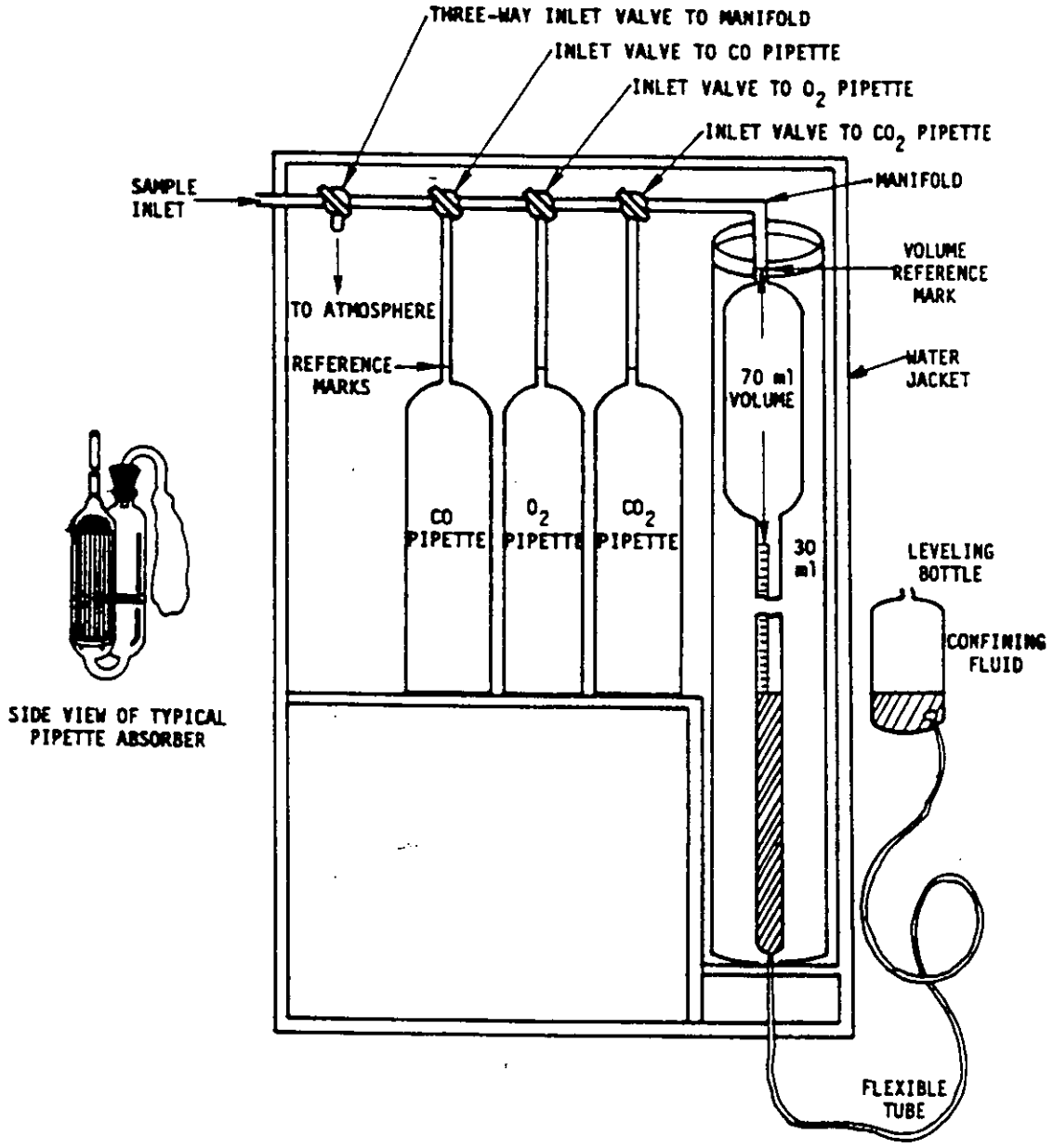
Figure 3-3

Orsat Apparatus



3.4 TOTAL HYDROCARBONS

Total hydrocarbon emissions from each sources inlet and exhaust will be continuously monitored over 3 one-hour periods by a heated Flame Ionization Detector analyzer. The selected instruments will be Ratfisch RS-55, J.U.M. Model 3-100 and VE-7 FIDS. A representative gaseous sample will be withdrawn from the test locations through a sintered metal filter and heated (250°F) sample line. System response time will be minimized by using high capacity sample pumps dedicated to the FID instrument and slip-stream sampling techniques. The gaseous sample is then immediately introduced to the analyzer. The FID operates on the principle that a small electric current is detected when a gas containing carbon atoms is oxidized to carbon dioxide in a hydrogen flame. Measurement of this current provides an indication of concentration for organic compounds present in the gas sample. The instrument will be spanned using primary propane (C_3H_8) standards and zeroed with hydrocarbon free air.

The full scale range of the instrument will be 0-100 ppm (C_3) at the outlet and 0-1000 ppm (C_3) at the inlet. Calibration standards will be provided that correspond to zero, 25-35%, 45-55% and 80-90% of full scale.

A comparison will be made between the inlet loading and outlet mass emission rate for total hydrocarbons to determine the VOC destruction efficiency.

A diagram showing the FID apparatus is shown in Figure 3-4.

3.5 METHANE

The test methodology for methane at the stack inlet and exhaust involves collection of an integrated sample in a tedlar bag by means of an evacuated drum. Samples will be collected by pulling a vacuum on a rigid air tight container containing the tedlar bag. The bag fills though volume displacement within the evacuated canister. An integrated sample will be collected over a 1-hour period at a flow rate of 0.5 ℓ/minute. The inert tedlar bags will be leak checked at inflated and deflated conditions, in accordance with Method 10A Section 4.1, then screened for contamination by analyzing zero air placed in the bag using a gas chromatograph.

A Varian 3400 gas chromatograph with a flame ionization detector will be used for the analysis of methane in the gas stream samples. The GC will be fired with a mixture of pure hydrogen and hydrocarbon free air. Gas chromatography provides for the separation of constituents in a gaseous mixture based on their differences in relative affinity for a given packing material in a separation column. The continuous process of repeated adsorption and desorption steps results in compounds passing though the column at different rates. The gases are analyzed separately at the column exit by the FID detector. The methane analyses will be referenced to the prepared laboratory standards.

Each tedlar bag sample will be analyzed until two successive chromatogram yielded results within 5 percent their average. Each methane standard and sample peak will be plotted using an onboard laboratory computing integrator. The integrator digitizes the analog signal from the Varian chromatograph, detects and integrates the peaks and plots a chromatogram. Data collection is controlled in three ways: timing, peak detection and baseline treatment. Following data treatment, the sample peaks will be compared to a prepared calibration curve plotting the peak area versus the concentration.

A determination of non-methane hydrocarbons will be made by subtracting the methane contribution to the total hydrocarbon concentration.

A diagram showing the sampling apparatus is shown in figure 3-5.

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Figure 3-4

FID Apparatus

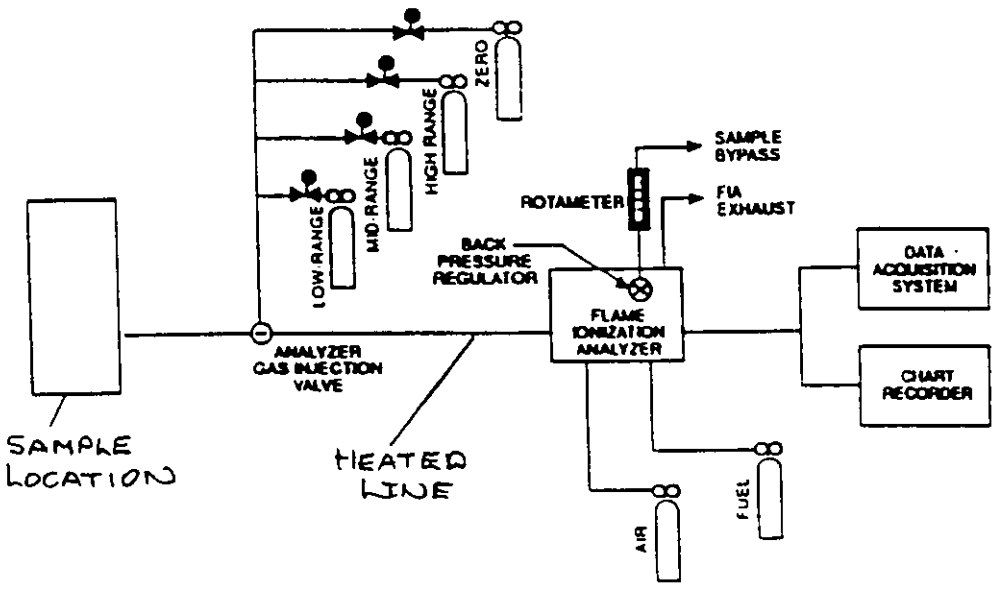

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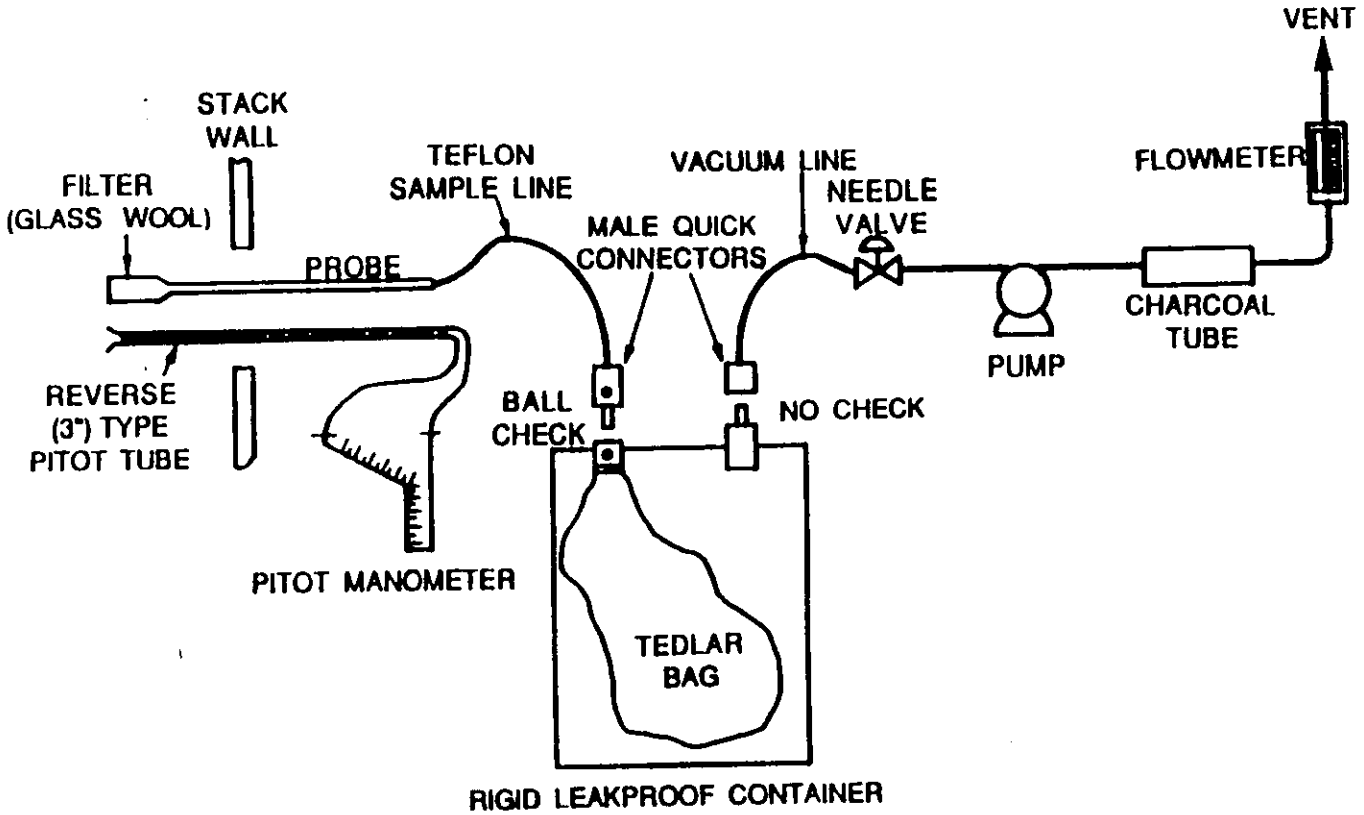
Figure 3-5

Methane Sampling Apparatus



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3.6 VOC CAPTURE EFFICIENCY

The volatile organic compound capture efficiency for coater will be accomplished employing draft EPA Method 30B and coating usage data to determined a liquid/gas mass balance across the system. Heinz Pet Products shall monitor coating usage on the can side stripe surface coating operation over a four hour period of continuous operation. A composite sample of the coating material will be collected during the production run for a determination of solvent content. An alequoit of the coating sample will also be analyzed for total carbon content by Galbraith Laboratories of Knoxville Tennessee. Finally the coating sample will be volatilized and introduced to the flame ionization detector following the procedures in EPA Method 30A. This will allow the calculation of a solvent response factor for comparison with the propane calibration standard.

The gas phase portion of the measurement will be accomplished using a hot flame ionization detector. Three one hour test runs will be conducted during the four hour production run. Sampling will be conducted at the outlet ductwork of coater for total hydrocarbon expressed as propane equivalent. Concurrent volumetric flow and gas stream measurements will be made at this location. The response factor corrected total hydrocarbon mass emission rate will be compared to solvent usage (carbon basis) to determine the VOC capture efficiency of the fume collection system.

APPENDIX A

EPA TEST METHODOLOGY

Sampling Equipment. Environmental Protection Agency. Research Triangle Park, N.C. APTD-0576. March, 1972.

4. Smith, W. S., R. T. Shigehara, and W. F. Todd. A Method of Interpreting Stack Sampling Data. Paper Presented at the 63rd Annual Meeting of the Air Pollution Control Association, St. Louis, Mo. June 14-19, 1970.

5. Smith, W. S., et al., Stack Gas Sampling Improved and Simplified with New Equipment. APCA Paper No. 67-119, 1967.

6. Specifications for Incinerator Testing at Federal Facilities. PHS, NCAPC, 1967.

7. Shigehara, R. T., Adjustments in the EPA Nomograph for Different Pitot Tube Coefficients and Dry Molecular Weights. Stack Sampling News 2:4-11, October, 1974.

8. Vollaro, R. F., A Survey of Commercially Available Instrumentation for the Measurement of Low-Range Gas Velocities. U.S. Environmental Protection Agency, Emission Measurement Branch. Research Triangle Park, N.C. November, 1976 (unpublished paper).

9. Annual Book of ASTM Standards, Part 26. Gaseous Fuels; Coal and Coke; Atmospheric Analysis. American Society for Testing and Materials, Philadelphia, Pa. 1974. pp. 617-622.

10. Vollaro, R. F., Recommended Procedure for Sample Traverses in Ducts Smaller than 12 Inches in Diameter. U.S. Environmental Protection Agency, Emission Measurement Branch. Research Triangle Park, N.C. November, 1976.

Method 18—Measurement of Gaseous Organic Compound Emissions by Gas Chromatography

Introduction

This method should not be attempted by persons unfamiliar with the performance characteristics of gas chromatography, nor by those persons who are unfamiliar with source sampling. Particular care should be exercised in the area of safety concerning choice of equipment and operation in potentially explosive atmospheres.

1. *Applicability and Principle*

1.1 Applicability. This method applies to the analysis of approximately 90 percent of the total gaseous organics emitted from an industrial source. It does not include techniques to identify and measure trace amounts of organic compounds, such as those found in building air and fugitive emission sources.

This method will not determine compounds that (1) are polymeric (high molecular weight), (2) can polymerize before analysis, or (3) have very low vapor pressures at stack or instrument conditions.

1.2 Principle.

The major organic components of a gas mixture are separated by gas chromatography (GC) and individually quantified by flame ionization, photoionization, electron capture, or other appropriate detection principles.

The retention times of each separated component are compared with those of known compounds under identical conditions. Therefore, the analyst confirms the identity and approximate concentrations of the organic emission components beforehand. With this information, the analyst then prepares or purchases commercially available standard mixtures to calibrate the GC under conditions identical to those of the samples. The analyst also determines the need for sample dilution to avoid detector saturation, gas stream filtration to eliminate particulate matter, and prevention of moisture condensation.

2. *Range and Sensitivity*

2.1 Range. The range of this method is from about 1 part per million (ppm) to the upper limit governed by GC detector saturation or column overloading. The upper limit can be extended by diluting the stack gases with an inert gas or by using smaller gas sampling loops.

2.2 Sensitivity. The sensitivity limit for a compound is defined as the minimum detectable concentration of that compound, or the concentration that produces a signal-to-noise ratio of three to one. The minimum detectable concentration is determined during the presurvey calibration for each compound.

3. *Precision and Accuracy*

Gas chromatographic techniques typically provide a precision of 5 to 10 percent relative standard deviation (RSD), but an experienced GC operator with a reliable instrument can readily achieve 5 percent RSD. For this method, the following combined GC/operator values are required.

(a) Precision. Duplicate analyses are within 5 percent of their mean value.

(b) Accuracy. Analysis results of prepared audit samples are within 10 percent of preparation values.

4. *Interferences*

Resolution interferences that may occur can be eliminated by appropriate GC column and detector choice or by shifting the retention times through changes in the column flow rate and the use of temperature programming.

The analytical system is demonstrated to be essentially free from contaminants by periodically analyzing blanks that consist of hydrocarbon-free air or nitrogen.

Sample cross-contamination that occurs when high-level and low-level samples or standards are analyzed alternately, is best

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dealt with by thorough purging of the GC sample loop between samples.

To assure consistent detector response, calibration gases are contained in dry air. To adjust gaseous organic concentrations when water vapor is present in the sample, water vapor concentrations are determined for those samples, and a correction factor is applied.

5. *Presurvey and Presurvey Sampling.*

Perform a presurvey for each source to be tested. Refer to Figure 18-1. Some of the information can be collected from literature surveys and source personnel. Collect gas samples that can be analyzed to confirm the identities and approximate concentrations of the organic emissions.

5.1 Apparatus. This apparatus list also applies to Sections 6 and 7.

5.1.1 Teflon Tubing. (Mention of trade names or specific products does not constitute endorsement by the U.S. Environmental Protection Agency.) Diameter and length determined by connection requirements of cylinder regulators and the GC. Additional tubing is necessary to connect the GC sample loop to the sample.

5.1.2 Gas Chromatograph. GC with suitable detector, columns, temperature-controlled sample loop and valve assembly, and temperature programable oven, if necessary. The GC shall achieve sensitivity requirements for the compounds under study.

5.1.3 Pump. Capable of pumping 100 ml/min. For flushing sample loop.

5.1.4 Flowmeters. To measure flow rates.

5.1.5 Regulators. Used on gas cylinders for GC and for cylinder standards.

5.1.6 Recorder. Recorder with linear strip chart is minimum acceptable. Integrator (optional) is recommended.

5.1.7 Syringes. 0.5-ml, 1.0- and 10-microliter sizes, calibrated, maximum accuracy (gas tight), for preparing calibration standards. Other appropriate sizes can be used.

5.1.8 Tubing Fittings. To plumb GC and gas cylinders.

5.1.9 Septums. For syringe injections.

5.1.10 Glass Jars. If necessary, clean-colored glass jars with Teflon-lined lids for condensate sample collection. Size depends on volume of condensate.

5.1.11 Soap Film Flow Meter. To determine flow rates.

5.1.12 Tedlar Bags. 10- and 50-liter capacity, for preparation of standards.

5.1.13 Dry Gas Meter with Temperature and Pressure Gauges. Accurate to ±2 percent, for perparation of gas standards.

5.1.14 Midget Impinger/Hot Plate Assembly. For preparation of gas standards.

5.1.15 Sample Flasks. For presurvey samples, must have gas-tight seals.

5.1.16 Adsorption Tubes. If necessary, blank tubes filled with necessary adsorbent (charcoal, Tenax, XAD-2, etc.) for presurvey samples.

5.1.17 Personnel Sampling Pump. Calibrated, for collecting adsorbent tube presurvey samples.

5.1.18 Dilution System. Calibrated, the dilution system is to be constructed following the specifications of an acceptable method.

5.1.19 Sample Probes. Pyrex or stainless steel, of sufficient length to reach centroid of stack, or a point no closer to the wall than 1 m.

5.1.20 Barometer. To measure barometric pressure.

5.2 Reagents.

5.2.1 Deionized Distilled Water.

5.2.2 Methylene Dichloride.

5.2.3 Calibration Gases. A series of standards prepared for every compound of interest.

5.2.4 Organic Compound Solutions. Pure (99.9 percent), or as pure as can reasonably be obtained, liquid samples of all the organic compounds needed to prepare calibration standards.

5.2.5 Extraction Solvents. For extraction of adsorbent tube samples in preparation for analysis.

5.2.6 Fuel. As recommended by the manufacturer for operation of the GC.

5.2.7 Carrier Gas. Hydrocarbon free, as recommended by the manufacturer for operation of the detector and compatability with the column.

5.2.8 Zero Gas. Hydrocarbon free air or nitrogen, to be used for dilutions, blank preparation, and standard preparation.

5.3 Sampling.

5.3.1 Collection of Samples with Glass Sampling Flasks. Presurvey samples can be collected in precleaned 250-ml double-ended glass sampling flasks. Teflon stopcocks without grease, are preferred. Flasks should be cleaned as follows: Remove the stopcock from both ends of the flasks, and wipe the parts to remove any grease. Clean the stopcocks, barrels, and receivers with methylene dichloride. Clean all glass parts with a soap solution, then rinse with tap and deionized distilled water. Place the flask in a cool glass annealing furnace and apply heat up to 500° C. Maintain at this temperature for 1 hour. After this time period, shut off and open the furnace to allow the flask to cool. Grease the stopcocks with stopcock grease and return them to the flask receivers. Purge the assembly with high-purity nitrogen for 2 to 5 minutes. Close off the stopcocks after purging to maintain a slight positive nitrogen pressure. Secure the stopcocks with tape.

Presurvey samples can be obtained either by drawing the gases into the previously evacuated flask or by drawing the gases into

and purging the flask with a rubber suction bulb.

5.3.1.1 Evacuated Flask Procedure. Use a high-vacuum pump to evacuate the flask to the capacity of the pump; then close off the stopcock leading to the pump. Attach a 6-mm outside diameter (OD) glass tee to the flask inlet with a short piece of Teflon tubing. Select a 6-mm OD borosilicate sampling probe, enlarged at one end to a 12-mm OD and of sufficient length to reach the centroid of the duct to be sampled. Insert a glass wool plug in the enlarged end of the probe to remove particulate matter. Attach the other end of the probe to the tee with a short piece of Teflon tubing. Connect a rubber suction bulb to the third leg of the tee. Place the filter end of the probe at the centroid of the duct, or at a point no closer to the walls than 1 m, and purge the probe with the rubber suction bulb. After the probe is completely purged and filled with duct gases, open the stopcock to the grab flask until the pressure in the flask reaches duct pressure. Close off the stopcock, and remove the probe from the duct. Remove the tee from the flask and tape the stopcocks to prevent leaks during shipment. Measure and record the duct temperature and pressure.

5.3.1.2 Purged Flask Procedure. Attach one end of the sampling flask to a rubber suction bulb. Attach the other end to a 6-mm OD glass probe as described in Section 5.3.1.1. Place the filter end of the probe at the centroid of the duct, or at a point no closer to the walls than 1 m, and apply suction with the bulb to completely purge the probe and flask. After the flask has been purged, close off the stopcock near the suction bulb, and then close the stopcock near the probe. Remove the probe from the duct, and disconnect both the probe and suction bulb. Tape the stopcocks to prevent leakage during shipment. Measure and record the duct temperature and pressure.

5.3.2 Flexible Bag Procedure. Tedlar or aluminized Mylar bags can also be used to obtain the presurvey sample. Use new bags, and leak check them before field use. In addition, check the bag before use for contamination by filling it with nitrogen or air, and analyzing the gas by GC at high sensitivity. Experience indicates that it is desirable to allow the inert gas to remain in the bag about 24 hours or longer to check for desorption of organics from the bag. Follow the leak check and sample collection procedures given in Section 7.1.

5.3.3 Determination of Moisture Content. For combustion or water-controlled processes, obtain the moisture content from plant personnel or by measurement during the presurvey. If the source is below 59° C, measure the wet bulb and dry bulb temperatures, and calculate the moisture content using a psychrometric chart. At higher temperatures, use Method 4 to determine the moisture content.

5.4 Determination of Static Pressure. Obtain the static pressure from the plant personnel or measurement. If a type S pitot tube and an inclined manometer are used, take care to align the pitot tube 90° from the direction of the flow. Disconnect one of the tubes to the manometer, and read the static pressure; note whether the reading is positive or negative.

5.5 Collection of Presurvey Samples with Adsorption Tube. Follow Section 7.4 for presurvey sampling.

6. *Analysis Development*

6.1 Selection of GC Parameters.

6.1.1 Column Choice. Based on the initial contact with plant personnel concerning the plant process and the anticipated emissions, choose a column that provides good resolution and rapid analysis time. The choice of an appropriate column can be aided by a literature search, contact with manufacturers of GC columns, and discussion with personnel at the emission source.

Most column manufacturers keep excellent records of their products. Their technical service departments may be able to recommend appropriate columns and detector type for separating the anticipated compounds, and they may be able to provide information on interferences, optimum operating conditions, and column limitations.

Plants with analytical laboratories may also be able to provide information on appropriate analytical procedures.

6.1.2 Preliminary GC Adjustment. Using the standards and column obtained in Section 6.1.1, perform initial tests to determine appropriate GC conditions that provide good resolution and minimum analysis time for the compounds of interest.

6.1.3 Preparation of Presurvey Samples. If the samples were collected on an adsorbent, extract the sample as recommended by the manufacturer for removal of the compounds with a solvent suitable to the type of GC analysis. Prepare other samples in an appropriate manner.

6.1.4 Presurvey Sample Analysis. Before analysis, heat the presurvey sample to the duct temperature to vaporize any condensed material. Analyze the samples by the GC procedure, and compare the retention times against those of the calibration samples that contain the components expected to be in the stream. If any compounds cannot be identified with certainty by this procedure, identify them by other means such as GC/mass spectroscopy (GC/MS) or GC/infrared techniques. A GC/MS system is recommended.

Use the GC conditions determined by the procedures of Section 6.1.2 for the first injection. Vary the GC parameters during subsequent injections to determine the opti-

mum settings. Once the optimum settings have been determined, perform repeat injections of the sample to determine the retention time of each compound. To inject a sample, draw sample through the loop at a constant rate (100 ml/min for 30 seconds). Be careful not to pressurize the gas in the loop. Turn off the pump and allow the gas in the sample loop to come to ambient pressure. Activate the sample valve, and record injection time, loop temperature, column temperature, carrier flow rate, chart speed, and attenuator setting. Calculate the retention time of each peak using the distance from injection to the peak maximum divided by the chart speed. Retention times should be repeatable within 0.5 seconds.

If the concentrations are too high for appropriate detector response, a smaller sample loop or dilutions may be used for gas samples, and, for liquid samples, dilution with solvent is appropriate. Use the standard curves (Section 6.3) to obtain an estimate of the concentrations.

Identify all peaks by comparing the known retention times of compounds expected to be in the retention times of peaks in the sample. Identify any remaining unidentified peaks which have areas larger than 5 percent of the total using a GC/MS, or estimation of possible compounds by their retention times compared to known compounds, with confirmation by further GC analysis.

6.2 Calibration Standards. Prepare or obtain enough calibration standards so that there are three different concentrations of each organic compound expected to be measured in the source sample. For each organic compound, select those concentrations that bracket the concentrations expected in the source samples. A calibration standard may contain more than one organic compound. If available, commercial cylinder gases may be used if their concentrations have been certified by direct analysis.

If samples are collected in adsorbent tubes (charcoal, XAD-2, Tenax, etc.), prepare or obtain standards in the same solvent used for the sample extraction procedure. Refer to Section 7.4.3.

Verify the stability of all standards for the time periods they are used. If gas standards are prepared in the laboratory, use one or more of the following procedures.

6.2.1 Preparation of Standards from High Concentration Cylinder Standards. Obtain enough high concentration cylinder standards to represent all the organic compounds expected in the source samples.

Use these high concentration standards prepare lower concentration standards dilution, as shown by Figures 18-5 and 18-

To prepare the diluted calibration sa ples, calibrated rotameters are normal used to meter both the high concentrati calibration gas and the diluent gas. Oth types of flowmeters and commercially ava able dilution systems can also be used.

Calibrate each flowmeter before use placing it between the diluent gas supp and suitably sized bubble meter, spirome or wet test meter. Record all data shown Figure 18-4. While it is desirable to calibra the cylinder gas flowmeter with cylind gas, the available quantity and cost m preclude it. The error introduced by usi the diluent gas for calibration is insigni cant for gas mixtures of up to 1,000 to 2,0 ppm of each organic component.

Once the flowmeters are calibrated, co nect the flowmeters to the calibration a diluent gas supplies using 6-mm Tefl tubing. Connect the outlet side of the flo meters through a connector to a leak-fr Tedlar bag as shown in Figure 18-5. (S Section 7.1 for bag leak-check procedure Adjust the gas flow to provide the desir dilution, and fill the bag with sufficient g for GC calibration. Be careful not to overi and cause the bag to apply additional pr sure on the dilution system. Record the fl rates of both flowmeters, and the laborat ry temperature and atmospheric pressu Calculate the concentration C_s in ppm each organic in the diluted gas as follows:

$$C_s = \frac{10^6 \ (\bar{X} \ q_c)}{q_c + q_d}$$

Eq. 18-

where:

10^6 = Conversion to ppm.

$\bar{X}$ = Mole or volume fraction of the orga in the calibration gas to be diluted.

q_c = Flow rate of the calibration gas to be luted.

q_d = Diluent gas flow rate.

Single-stage dilutions should be used to p pare calibration mixtures up to about 1: dilution factor.

For greater dilutions, a double dilut system is recommended, as shown in Figu 18-6. Fill the Tedlar bag with the dilute g from the second stage. Record the labora ry temperature, barometric pressure, a static pressure readings. Correct the fl reading for temperature and pressure. C culate the concentration C, in ppm of t organic in the final gas mixture as follo

$$C_s = 10^6 \bar{X} \left(\frac{q_{c1}}{q_{c1} + q_{d1}}\right)\left(\frac{q_{c2}}{q_{c2} + q_{d2}}\right)$$

Eq. 18-2

Where:

10^6 = Conversion to ppm.

$\bar{X}$ = Mole or volume fraction of the organic in the calibration gas to be diluted.

q_{c1} = Flow rate of the calibration gas to be diluted in stage 1.

q_{c2} = Flow rate of the calibration gas to be diluted in stage 2.

q_{d1} = Flow rate of diluent gas in stage 1.

q_{d2} = Flow rate of diluent gas in stage 2.

Further details of the calibration methods for flowmeters and the dilution system can be found in Citation 21 in the Bibliography.

6.2.2 Preparation of Standards from Volatile Materials. Record all data shown on Figure 18-3.

6.2.2.1 Gas Injection Technique. This procedure is applicable to organic compounds that exist entirely as a gas at ambient conditions. Evacuate a 10-liter Tedlar bag that has passed a leak-check (see Section 7.1), and meter in 5.0 liters of air or nitrogen through a dry gas meter that has been calibrated in a manner consistent with the procedure described in Section 5.1.1 of Method 5. While the bag is filling use a 0.5-ml syringe to inject a known quantity of "pure" gas of the organic compound through the wall of the bag, or through a septum-capped tee at the bag inlet. Withdraw the syringe needle, and immediately cover the resulting hole with a piece of masking tape. In a like manner, prepare dilutions having other concentrations. Prepare a minimum of three concentrations. Place each bag on a smooth surface, and alternately depress opposite sides of the bag 50 times to mix the gases Record the average meter temperature and pressure, the gas volume and the barometric pressure. Record the syringe temperature and pressure before injection.

Calculate each organic standard concentration C_s in ppm as follows:

$$C_s = \frac{G_v \times 10^6 \frac{293}{T_s} \frac{P_s}{760}}{V_m Y \frac{293}{T_m} \frac{P_m}{760} 1000}$$

$$= \frac{G_v \times 10^3 \frac{P_s}{T_s} \frac{T_m}{P_m}}{V_m Y}$$

Eq. 18-3

where:

G_v = Gas volume or organic compound injected, ml.

10^6 = Conversion to ppm.

P_s = Absolute pressure of syringe before injection, mm Hg.

T_s = Absolute temperature of syringe before injection, °K.

V_m = Gas volume indicated by dry gas meter, liters.

Y = Dry gas meter calibration factor, dimensionless.

P_m = Absolute pressure of dry gas meter, mm Hg.

T_m = Absolute temperature of dry gas meter, °K.

1000 = Conversion factor, ml/liter.

6.2.2.2 Liquid Injection Technique. Use the equipment shown in Figure 18-8. Calibrate the dry gas meter as described in Section 6.2.2.1 with a wet test meter or a spirometer. Use a water manometer for the pressure gauge and glass, Teflon, brass, or stainless steel for all connections. Connect a valve to the inlet of the 50-liter Tedlar bag.

To prepare the standards, assemble the equipment as shown in Figure 18-8, and leak-check the system. Completely evacuate the bag. Fill the bag with hydrocarbon-free air, and evacuate the bag again. Close the inlet valve.

Turn on the hot plate, and allow the water to reach boiling. Connect the bag to the impinger outlet. Record the initial meter reading, open the bag inlet valve, and open the cylinder. Adjust the rate so that the bag will be completely filled in approximately 15 minutes. Record meter pressure and temperature, and local barometric pressure.

Allow the liquid organic to equilibrate to room temperature. Fill the 1.0- or 10-microliter syringe to the desired liquid volume

with the organic. Place the syringe needle into the impinger inlet using the septum provided, and inject the liquid into the flowing air stream. Use a needle of sufficient length to permit injection of the liquid below the air inlet branch of the tee. Remove the syringe.

When the bag is filled, stop the pump, and close the bag inlet valve. Record the final meter reading, temperature, and pressure.

Disconnect the bag from the impinger outlet, and either set it aside for at least 1 hour, or massage the bag to insure complete mixing.

Measure the solvent liquid density a room temperature by accurately weighing known volume of the material on an analyt ical balance to the nearest 1.0 milligram. A ground-glass stoppered 25-ml volumetri flask or a glass-stoppered specific gravit bottle is suitable for weighing. Calculate th result in terms of g/ml. As an alternative literature values of the density of the liqui at 20 °C may be used.

Calculate each organic standard concen tration C, in ppm as follows:

$$C_s = \frac{\frac{L_v \rho}{M}(24.055 \times 10^6)}{V_m Y \frac{293}{T_m}\frac{P_m}{760}1000} = 6.24 \times 10^4 \frac{L_v \rho T_m}{M V_m Y P_m} \quad \text{Eq. 18-4}$$

where:

L_v = Liquid volume of organic injected, µl.
ρ = Liquid organic density as determined, g/ml.
M = Molecular weight of organic, g/g-mole.
24.055 = Ideal gas molar volume at 293 °K and 760 mm Hg, liters/g-mole.
10^6 = Conversion to ppm.
1000 = Conversion factor, µl/ml.

6.3 Preparation of Calibration Curves. Establish proper GC conditions, then flush the sampling loop for 30 seconds at a rate of 100 ml/min. Allow the sample loop pressure to equilibrate to atmospheric pressure, and activate the injection valve. Record the standard concentration, attenuator factor, injection time, chart speed, retention time, peak area, sample loop temperature, column temperature, and carrier gas flow rate. Repeat the standard injection until two consecutive injections give area counts within 5 percent of their average. The average value multipled by the attenuator factor is then the calibration area value for the concentration.

Repeat this procedure for each standard. Prepare a graphical plot of concentration (C_s) versus the calibration area values. Perform a regression analysis, and draw the least squares line.

6.4 Relative Response Factors. The calibration curve generated from the standards for a single organic can usually be related to each of the individual GC response curves that are developed in the laboratory for all the compounds in the source. In the field, standards for that single organic can then be used to "calibrate" the GC for all the organics present. This procedure should first be confirmed in the laboratory by preparing and analyzing calibration standards containing multiple organic compounds.

6.5 Quality Assurance for Laboratory Procedures. Immediately after the preparation of the calibration curves and prior to the presurvey sample analysis, the analyst audit described in 40 CFR Part 61, Appendix C, Procedure 2: "Procedure for Field Auditing GC Analysis," should be performed. The information required to document the analysis of the audit samples has been included on the example data sheets shown in Figures 18-3 and 18-7. The audit analyses should agree with the audit concentrations within 10 percent. When available, the tester may obtain audit cylinders by contacting: U.S. Environmental Protection Agency, Environmental Monitoring Systems Laboratory, Quality Assurance Division (MD-77), Research Triangle Park, North Carolina 27711. Audit cylinders obtained from a commercial gas manufacturer may be used provided that (a) the gas manufacturer certifies the audit cylinder in a manner similar to the procedure described in 40 CFR Part 61, Appendix B, Method 106, Section 5.2.3.1, and (b) the gas manufacturer obtains an independent analysis of the audit cylinders to verify this analysis. Independent analysis is defined as an analysis performed by an individual other than the individual who performs the gas manufacturer's analysis, while using calibration standards and analysis equipment different from those used for the gas manufacturer's analysis. Verification is complete and acceptable when the independent analy-

concentration is within 5 percent of the gas manufacturer's concentration.

7. *Final Sampling and Analysis Procedure*

Considering safety (flame hazards) and the source conditions, select an appropriate sampling and analysis procedure (Section 7.1, 7.2, 7.3, or 7.4). In situations where a hydrogen flame is a hazard and no intrinsically safe GC is suitable, use the flexible bag collection technique or an adsorption technique. If the source temperature is below 100°C, and the organic concentrations are suitable for the detector to be used, use the direct interface method. If the source gases require dilution, use a dilution interface and either the bag sample or adsorption tubes. The choice between these two techniques will depend on the physical layout of the site, the source temperature, and the storage stability of the compounds if collected in the bag. Sample polar compounds by direct interfacing or dilution interfacing to prevent sample loss by adsorption on the bag.

7.1 Integrated Bag Sampling and Analysis.

7.1.1 Evacuated Container Sampling Procedure. In this procedure, the bags are filled by evacuating the rigid air-tight containers that hold the bags. Use a field sample data sheet as shown in Figure 18-10. Collect triplicate sample from each sample location.

7.1.1.1 Apparatus.

7.1.1.1.1 Probe. Stainless steel, Pyrex glass, or Teflon tubing probe, according to the duct temperature, with 6.4-mm OD Teflon tubing of sufficient length to connect to the sample bag. Use stainless steel or Teflon unions to connect probe and sample line.

7.1.1.1.2 Quick Connects. Male (2) and female (2) of stainless steel construction.

7.1.1.1.3 Needle Valve. To control gas flow.

7.1.1.1.4 Pump. Leakless Teflon-coated diaphragm-type pump or equivalent. To deliver at least 1 liter/min.

7.1.1.1.5 Charcoal Adsorption Tube. Tube filled with activated charcoal, with glass wool plugs at each end, to adsorb organic vapors.

7.1.1.1.6 Flowmeter. 0 to 500-ml flow range; with manufacturer's calibration curve.

7.1.1.2 Sampling Procedure. To obtain a sample, assemble the sample train as shown in Figure 18-9. Leak check both the bag and the container. Connect the vacuum line from the needle valve to the Teflon sample line from the probe. Place the end of the probe at the centroid of the stack, or at a point no closer to the walls than 1 m, and start the pump with the needle valve adjusted to yield a flow of 0.5 liter/minute. After allowing sufficient time to purge the line several times, connect the vacuum line to the bag, and evacuate until the rotameter indicates no flow. Then position the sample and vacuum lines for sampling, and begin the actual sampling, keeping the rate proportional to the stack velocity. As a precaution, direct the gas exiting the rotameter away from sampling personnel. At the end of the sample period, shut off the pump, disconnect the sample line from the bag, and disconnect the vacuum line from the bag container. Record the source temperature, barometric pressure, ambient temperature, sampling flow rate, and initial and final sampling time on the data sheet shown in Figure 18-10. Protect the Tedlar bag and its container from sunlight. When possible, perform the analysis within 2 hours of sample collection.

7.1.2 Direct Pump Sampling Procedure. Follow 7.1.1, except place the pump and needle valve between the probe and the bag. Use a pump and needle valve constructed of stainless steel or some other material not affected by the stack gas. Leak check the system, and then purge with stack gas before the connecting to the previously evacuated bag.

7.1.3 Explosion Risk Area Bag Sampling Procedure. Follow 7.1.1 except replace the pump with another evacuated can (see Figure 18-9a). Use this method whenever there is a possibility of an explosion due to pumps, heated probes, or other flame producing equipment.

7.1.4 Other Modified Bag Sampling Procedures. In the event that condensation is observed in the bag while collecting the sample and a direct interface system cannot be used, heat the bag during collection, and maintain it at a suitably elevated temperature during all subsequent operations. (Note: Take care to leak check the system prior to the dilutions so as not to create a potentially explosive atmosphere.) As an alternative, collect the sample gas, and simultaneously dilute it in the Tedlar bag.

In the first procedure, heat the box containing the sample bag to the source temperature, provided the components of the bag and the surrounding box can withstand this temperature. Then transport the bag as rapidly as possible to the analytical area while maintaining the heating, or cover the box with an insulating blanket. In the analytical area, keep the box heated to source temperature until analysis. Be sure that the method of heating the box and the control for the heating circuit are compatible with the safety restrictions required in each area.

To use the second procedure, prefill the Tedlar bag with a known quantity of inert gas. Meter the inert gas into the bag according to the procedure for the preparation of gas concentration standards of volatile liquid materials (Section 6.2.2.2), but eliminate the midget impinger section. Take the partly filled bag to the source, and meter

the source gas into the bag through heated sampling lines and a heated flowmeter, or Teflon positive displacement pump. Verify the dilution factors periodically through dilution and analysis of gases of known concentration.

7.1.5 Analysis of Bag Samples.

7.1.5.1 Apparatus. Same as Section 5. A minimum of three gas standards are required.

7.1.5.2 Procedure. Establish proper GC operating conditions as described in Section 6.3, and record all data listed in Figure 18-7. Prepare the GC so that gas can be drawn through the sample valve. Flush the sample loop with gas from one of the three calibration mixtures, and activate the valve. Obtain at least two chromatograms for the mixture. The results are acceptable when the peak areas from two consecutive injections agree to within 5 percent of their average. If they do not, run additional analyses or correct the analytical techniques until this requirement is met. Then analyze the other two calibration mixtures in the same manner. Prepare a calibration curve as described in the same manner. Prepare a calibration curve as described in Section 6.3.

Analyze the source gas samples by connecting each bag to the sampling valve with a piece of Teflon tubing identified for that bag. Follow the specifications on replicate analyses specified for the calibration gases. Record the data listed in Figure 18-11. If certain items do not apply, use the notation "N.A." After all samples have been analyzed, repeat the analyses of the calibration gas mixtures, and generate a second calibration curve. Use an average of the two curves to determine the sample gas concentrations. If the two calibration curves differ by more than 5 percent from their mean value, then report the final results by comparison to both calibration curves.

7.1.6 Determination of Bag Water Vapor Content. Measure and record the ambient temperature and barometric pressure near the bag. From a water saturation vapor pressure table, determine and record the water vapor content as a decimal figure. (Assume the relative humidity to be 100 percent unless a lesser value is known.) If the bag has been maintained at an elevated temperature as described in Section 7.1.4, determine the stack gas water content by Method 4.

7.1.7 Quality Assurance. Immediately prior to the analysis of the stack gas samples, perform audit analyses as described in Section 6.5. The audit analyses must agree with the audit concentrations within 10 percent. If the results are acceptable, proceed with the analyses of the source samples. If they do not agree within 10 percent, then determine the reason for the discrepancy, and take corrective action before proceeding.

7.1.8 Emission Calculations. From the average calibration curve described in Section 7.1.5., select the value of C_i that corresponds to the peak area. Calculate the concentration C_c in ppm, dry basis, of each organic in the sample as follows:

$$C_c = \frac{C_s P_r T_i F_r}{P_i T_r (1-B_{ws})} \qquad \text{Eq. 18-5}$$

where:

C_i = Concentration of the organic from the calibration curve, ppm.

P_r = Reference pressure, the barometric pressure or absolute sample loop pressure recorded during calibration, mm Hg.

T_i = Sample loop temperature at the time of sample analysis, °K.

F_r = Relative response factor (if applicable, see Section 6.4).

P_i = Barometric or absolute sample loop pressure at time of sample analysis, mm Hg.

T_r = Reference temperature, the termperature of the sample loop recorded during calibration, °K.

B_{ws} = Water vapor content of the bag sample or stack gas, proportion by volume.

7.2 Direct Interface Sampling and Analysis Procedure. The direct interface procedure can be used provided that the moisture content of the gas does not interfere with the analysis procedure, the physical requirements of the equipment can be met at the site, and the source gas concentration is low enough that detector saturation is not a problem. Adhere to all safety requirements with this method.

7.2.1 Apparatus.

7.2.1.1 Probe. Constructed of stainless steel, Pyrex glass, or Teflon tubing as required by duct temperature, 6.4-mm OD, enlarged at duct end to contain glass wool plug. If necessary, heat the probe with heating tape or a special heating unit capable of maintaining duct temperature.

7.2.1.2 Sample Lines. 6.4-mm OD Teflon lines, heat-traced to prevent condensation of material.

7.2.1.3 Quick Connects. To connect sample line to gas sampling valve on GC instrument and to pump unit used to withdraw source gas. Use a quick connect or equivalent on the cylinder or bag containing calibration gas to allow connection of the calibration gas to the gas sampling valve.

7.2.1.4 Thermocouple Readout Device. Potentiometer or digital thermometer, to measure source temperature and probe temperature.

7.2.1.5 Heated Gas Sampling Valve. Of two-position, six-port design, to allow sample loop to be purged with source gas or to direct source gas into the GC instrument.

7.2.1.6 Needle Valve. To control gas sampling rate from the source.

7.2.1.7 Pump. Leakless Teflon-coated diaphragm-type pump or equivalent, capable of at least 1 liter/minute sampling rate.

7.2.1.8 Flowmeter. Of suitable range to measure sampling rate.

7.2.1.9 Charcoal Adsorber. To adsorb organic vapor collected from the source to prevent exposure of personnel to source gas.

7.2.1.10 Gas Cylinders. Carrier gas (helium or nitrogen), and oxygen and hydrogen for a flame ionization detector (FID) if one is used.

7.2.1.11 Gas Chromatograph. Capable of being moved into the field, with detector, heated gas sampling valve, column required to complete separation of desired componenta, and option for temperature programming.

7.2.1.12 Recorder/Integrator. To record results.

7.2.2 Procedure. To obtain a sample, assemble the sampling system as shown in Figure 18-12. Make sure all connections are tight. Turn on the probe and sample line heaters. As the temperature of the probe and heated line approaches the source temperature as indicated on the thermocouple readout device, control the heating to maintain a temperature of 0 to 3°C above the source temperature. While the probe and heated line are being heated, disconnect the sample line from the gas sampling valve, and attach the line from the calibration gas mixture. Flush the sample loop with calibration gas and analyze a portion of that gas. Record the results. After the calibration gas sample has been flushed into the GC instrument, turn the gas sampling valve to flush position, then reconnect the probe sample line to the valve. Place the inlet of the probe at the centroid of the duct, or at a point no closer to the walls than 1 m, and draw source gas into the probe, heated line, and sample loop. After thorough flushing, analyze the sample using the same conditions as for the calibration gas mixture. Repeat the analysis on an additional sample. Measure the peak areas for the two samples, and if they do not agree to within 5 percent of their mean value, analyze additional samples until two consecutive analyses meet this criteria. Record the data. After consistent results are obtained, remove the probe from the source and analyze a second calibration gas mixture. Record this calibration data and the other required data on the data sheet shown in Figure 18-11, deleting the dilution gas information.

(NOTE: Take care to draw all samples, calibration mixtures, and audits through the sample loop at the same pressure.)

7.2.3 Determination of Stack Gas Moisture Content. Use Method 4 to measure the stack gas moisture content.

7.2.4 Quality Assurance. Same as Section 7.1.7. Introduce the audit gases in the sample line immediately following the probe.

7.2.5 Emission Calculations. Same as Section 7.1.8.

7.3 Dilution Interface Sampling and Analysis Procedure. Source samples that contain a high concentration of organic materials may require dilution prior to analysis to prevent saturating the GC detector. The apparatus required for this direct interface procedure is basically the same as that described in the Section 7.2, except a dilution system is added between the heated sample line and the gas sampling valve. The apparatus is arranged so that either a 10:1 or 100:1 dilution of the source gas can be directed to the chromatograph. A pump of larger capacity is also required, and this pump must be heated and placed in the system between the sample line and the dilution apparatus.

7.3.1 Apparatus. The equipment required in addition to that specified for the direct interface system is as follows:

7.3.1.1 Sample Pump. Leakless Teflon-coated diaphragm-type that can withstand being heated to 120°C and deliver 1.5 liters/minute.

7.3.1.2 Dilution Pumps. Two Model A-150 Komhyr Teflon positive displacement type delivering 150 cc/minute, or equivalent. As an option, calibrated flowmeters can be used in conjunction with Teflon-coated diaphragm pumps.

7.3.1.3 Valves. Two Teflon three-way valves, suitable for connecting to 6.4-mm OD Teflon tubing.

7.3.1.4 Flowmeters. Two, for measurement of diluent gas, expected delivery flow rate to be 1,350 cc/min.

7.3.1.5 Diluent Gas with Cylinders and Regulators. Gas can be nitrogen or clean dry air, depending on the nature of the source gases.

7.3.1.6 Heated Box. Suitable for being heated to 120°C, to contain the three pumps, three-way valves, and associated connections. The box should be equipped with quick connect fittings to facilitate connection of: (1) The heated sample line from the probe, (2) the gas sampling valve, (3) the calibration gas mixtures, and (4) diluent gas lines. A schematic diagram of the components and connections is shown in Figure 18-13.

(NOTE: Care must be taken to leak check the system prior to the dilutions so as not to create a potentially explosive atmosphere.)

The heated box shown in Figure 18-13 is designed to receive a heated line from the

probe. An optional design is to build a probe unit that attaches directly to the heated box. In this way, the heated box contains the controls for the probe heaters, or, if the box is placed against the duct being sampled, it may be possible to eliminate the probe heaters. In either case, a heated Teflon line is used to connect the heated box to the gas sampling valve on the chromatograph.

7.3.2 Procedure. Assemble the apparatus by connecting the heated box, shown in Figure 18-13, between the heated sample line from the probe and the gas sampling valve on the chromatograph. Vent the source gas from the gas sampling valve directly to the charcoal filter, eliminating the pump and rotameter. Heat the sample probe, sample line, and heated box. Insert the probe and source thermocouple to the centroid of the duct, or to a point no closer to the walls than 1 m. Measure the source temperature, and adjust all heating units to a temperature 0 to 3°C above this temperature. If this temperature is above the safe operating temperature of the Teflon components, adjust the heating to maintain a temperature high enough to prevent condensation of water and organic compounds. Verify the operation of the dilution system by analyzing a high concentration gas of known composition through either the 10:1 or 100:1 dilution stages, as appropriate. (If necessary, vary the flow of the diluent gas to obtain other dilution ratios.) Determine the concentration of the diluted calibration gas using the dilution factor and the calibration curves prepared in the laboratory. Record the pertinent data on the data sheet shown in Figure 18-11. If the data on the diluted calibration gas are not within 10 percent of the expected values, determine whether the chromatograph or the dilution system is in error, and correct it. Verify the GC operation using a low concentration standard by diverting the gas into the sample loop, bypassing the dilution system. If these analyses are not within acceptable limits, correct the dilution system to provide the desired dilution factors. Make this correction by diluting a high-concentration standard gas mixture to adjust the dilution ratio as required.

Once the dilution system and GC operations are satisfactory, proceed with the analysis of source gas, maintaining the same dilution settings as used for the standards. Repeat the analyses until two consecutive values do not vary by more than 5 percent from their mean value are obtained.

Repeat the analysis of the calibration gas mixtures to verify equipment operation. Analyze the two field audit samples using either the dilution system, or directly connect to the gas sampling valve as required. Record all data and report the results to the audit supervisor.

7.3.3 Determination of Stack Gas Moisture Content. Same as Section 7.2.3.

7.3.4 Quality Assurance. Same as Section 7.2.4.

7.3.5 Emission Calculations. Same as Section 7.2.5, with the dilution factor applied.

7.4 Adsorption Tube Procedure (Alternative Procedure). It is suggested that the tester refer to the National Institute of Occupational Safety and Health (NIOSH) method for the particular organics to be sampled. The principal interferent will be water vapor. If water vapor is present at concentrations above 3 percent, silica gel should be used in front of the charcoal. Where more than one compound is present in the emissions, then develop relative adsorptive capacity information.

7.4.1 Additional Apparatus. In addition to the equipment listed in the NIOSH method for the particular organic(s) to be sampled, the following items (or equivalent) are suggested.

7.4.1.1 Probe (Optional). Borosilicate glass or stainless steel, approximately 6-mm ID, with a heating system if water condensation is a problem, and a filter (either in-stack or out-stack heated to stack temperature) to remove particulate matter. In most instances, a plug of glass wool is a satisfactory filter.

7.4.1.2 Flexible Tubing. To connect probe to adsorption tubes. Use a material that exhibits minimal sample adsorption.

7.4.1.3 Leakless Sample Pump. Flow controlled, constant rate pump, with a set of limiting (sonic) orifices to provide pumping rates from approximately 10 to 100 cc/min.

7.4.1.4 Bubble-Tube Flowmeter. Volume accuracy within ± 1 percent, to calibrate pump.

7.4.1.5 Stopwatch. To time sampling and pump rate calibration.

7.4.1.6 Adsorption Tubes. Similar to ones specified by NIOSH, except the amounts of adsorbent per primary/backup sections are 800/200 mg for charcoal tubes and 1040/260 mg for silica gel tubes. As an alternative the tubes may contain a porous polymer adsorbent such as Tenax GC or XAD-2.

7.4.1.7 Barometer. Accurate to 5 mm Hg to measure atmospheric pressure during sampling and pump calibration.

7.4.1.8 Rotameter. 0 to 100 cc/min. to detect changes in flow rate during sampling.

7.4.2 Sampling and Analysis. It is suggested that the tester follow the sampling and analysis portion of the respective NIOSH method section entitled "Procedure." Calibrate the pump and limiting orifice flow rate through adsorption tubes with the bubble tube flowmeter before sampling. The sample system can be operated as a "recirculating loop" for this operation. Record the ambient temperature and barometric pressure. Then, during sampling, use the ro

tameter to verify that the pump and orifice sampling rate remains constant.

Use a sample probe, if required, to obtain the sample at the centroid of the duct, or at a point no closer to the walls than 1 m. Minimize the length of flexible tubing between the probe and adsorption tubes. Several adsorption tubes can be connected in series, if the extra adsorptive capacity is needed. Provide the gas sample to the sample system at a pressure sufficient for the limiting orifice to function as a sonic orifice. Record the total time and sample flow rate (or the number of pump strokes), the barometric pressure, and ambient temperature. Obtain a total sample volume commensurate with the expected concentration(s) of the volatile organic(s) present, and recommended sample loading factors (weight sample per weight adsorption media). Laboratory tests prior to actual sampling may be necessary to predetermine this volume. When more than one organic is present in the emissions, then develop relative adsorptive capacity information. If water vapor is present in the sample at concentrations above 2 to 3 percent, the adsorptive capacity may be severely reduced. Operate the gas chromatograph according to the manufacture's instructions. After establishing optimum conditions, verify and document these conditions during all operations. Analyze the audit samples (see Section 7.4.4.3), then the emission samples. Repeat the analysis of each sample until the relative deviation of two consecutive injections does not exceed 5 percent.

7.4.3 Standards and Calibration. The standards can be prepared according to the respective NIOSH method. Use a minimum of three different standards; select the concentrations to bracket the expected average sample concentration. Perform the calibration before and after each day's sample analyses. Prepare the calibration curve by using the least squares method.

7.4.4 Quality Assurance.

7.4.4.1 Determination of Desorption Efficiency. During the testing program, determine the desorption efficiency in the expected sample concentration range for each batch of adsorption media to be used. Use an internal standard. A minimum desorption efficiency of 50 percent shall be obtained. Repeat the desorption determination until the relative deviation of two consecutive determinations does not exceed 5 percent. Use the average desorption efficiency of these two consecutive determinations for the correction specified in Section 7.4.4.5. If the desorption efficiency of the compound(s) of interest is questionable under actual sampling conditions, use of the Method of Standard Additions may be helpful to determine this value.

7.4.4.2 Determination of Sample Collection Efficiency. For the source samples, analyze the primary and backup portions of the adsorption tubes separately. If the backup portion exceeds 10 percent of the total amount (primary and backup), repeat the sampling with a larger sampling portion.

7.4.4.3 Analysis Audit. Immediately before the sample analyses, analyze the two audits in accordance with Section 7.4.2. The analysis audit shall agree with the audit concentration within 10 percent.

7.4.4.4 Pump Leak Checks and Volume Flow Rate Checks. Perform both of these checks immediately after sampling with all sampling train components in place. Perform all leak checks according to the manufacturer's instructions, and record the results. Use the bubble-tube flowmeter to measure the pump volume flow rate with the orifice used in the test sampling, and the result. If it has changed by more than 5 but less than 20 percent, calculate an average flow rate for the test. If the flow rate has changed by more than 20 percent, recalibrate the pump and repeat the sampling.

7.4.4.5 Calculations. All calculations can be performed according to the respective NIOSH method. Correct all sample volumes to standard conditions. If a sample dilution system has been used, multiply the results by the appropriate dilution ratio. Correct all results by dividing by the desorption efficiency (decimal value). Report results as ppm by volume, dry basis.

7.5 Reporting of Results. At the completion of the field analysis portion of the study, ensure that the data sheets shown in Figure 18-11 have been completed. Summarize this data on the data sheets shown in Figure 18-15.

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I. Name of company _____ Date _____

Address _____

_____

Contacts _____ Phone _____

_____ _____

Process to be sampled _____

_____

_____

Duct or vent to be sampled _____

_____

II. Process description _____

_____

_____

_____

_____

Raw material _____

_____

_____

Products _____

_____

_____

Operating cycle

Check: Batch _____ Continuous _____ Cyclic _____

Timing of batch or cycle _____

Best time to test _____

Figure 18-1. Preliminary survey data sheet.

III. Sampling site

A. Description

Site description _____

Duct shape and size _____

Material _____

Wall thickness _____ inches

Upstream distance _____ inches _____ diameter

Downstream distance _____ inches _____ diameter

Size of port _____

Size of access area _____

Hazards _____ Ambient temp. _____ °F

B. Properties of gas stream

Temperature _____ °C _____ °F, Data source _____

Velocity _____, Data source _____

Static pressure ___ inches H_2O, Data source _____

Moisture content _____ %, Data source _____

Particulate content _____, Data source _____

Gaseous components

N_2	_____ %	Hydrocarbons	_____ ppm
O_2	_____ %	_____	_____
CO	_____ %	_____	_____
CO_2	_____ %	_____	_____
SO_2	_____ %	_____	_____

Hydrocarbon components

_____	_____ ppm
_____	_____ ppm
_____	_____ ppm
_____	_____ ppm
_____	_____ ppm
_____	_____ ppm

Figure 18-1 (continued). Preliminary survey data sheet.

C. Sampling considerations

Location to set up GC _____

_____

Special hazards to be considered _____

_____

Power available at duct _____

Power available for GC _____

Plant safety requirements _____

_____

Vehicle traffic rules _____

_____

Plant entry requirements _____

_____

Security agreements _____

_____

Potential problems _____

_____

D. Site diagrams. (Attach additional sheets if required).

Figure 18-1 (continued). Preliminary survey data sheet.

Components to be analyzed	Expected concentration

Suggested chromatographic column _____

_____

Column flow rate ____ml/min Head pressure____ mm

Column temperature:

Isothermal _____°C

Programmed from _____°C to ____°C at ____°C/mi

Injection port/sample loop temperature _____°C

Detector temperature _____°C

Detector flow rates: Hydrogen _____ml/min.

head pressure____ mm

Air/Oxygen _____ml/min,

head pressure____ mm

Chart speed _____ inches/minute

Compound data:

Compound	Retention time	Attenuation

Figure 18-2. Chromatographic conditions data sheet.

Preparation of Standards in Tedlar Bags and Calibration Curve

Standards Preparation Data:	Standards Mixture #1	Standards Mixture #2	Standards Mixture #3
Organic: _____			
Bag number or identification			
Dry gas meter calibration factor			
Final meter reading (liters)			
Initial meter reading (liters)			
Metered volume (liters)			
Average meter temperature (°K)			
Average meter pressure, gauge (mm Hg)			
Average atmospheric pressure (mm Hg)			
Average meter pressure, absolute (mm Hg)			
Syringe temperature (°K) (Section 6.2.2.1)			
Syringe pressure, absolute (mm Hg) (Section 6.2.2.1)			
Volume of gas in syringe (ml) (Section 6.2.2.1)			
Density of liquid organic (g/ml) (Section 6.2.2.2)			
Volume of liquid in syringe (µl) (Section 6.2.2.2)			
GC Operating Conditions:			
Sample loop volume (ml)			
Sample loop temperature (°C)			
Carrier gas flow rate (ml/min)			
Column temperature			
Initial (°C)			
Rate change (°C/min)			
Final (°C)			
Organic Peak Identification and Calculated Concentrations:			
Injection time (24-hr clock)			
Distance to peak (cm)			
Chart speed (cm/min)			
Organic retention time (min)			
Attenuation factor			
Peak height (mm)			
Peak area (mm^2)			
Peak area x attenuation factor (mm^2)			
Calculated concentration (ppm) (Equation 18-3 or 18-4)			

Plot peak area x attenuation factor against calculated concentration to obtain calibration curve.

Figure 18-3. Standards prepared in Tedlar bags and calibration curve.

Flowmeter Calibration

Flowmeter number or identification _____
Flowmeter type _____
Calibration device (x): Bubble meter___ Spirometer___ Wet test meter___
Readings at laboratory conditions:
Laboratory temperature (T_{lab}) _____ °K
Laboratory barometric pressure (P_{lab}) _____ mm Hg
Flow data:

Flowmeter			Calibration device		
reading (as marked)	temp. (°K)	pressure (absolute)	Time (min)	gas volume[a]	flow rate[b]

a = Volume of gas measured by calibration device, corrected to standard conditions (liters).

b = Calibration device gas volume/time.

Plot flowmeter reading against flow rate (standard conditions), and draw a smooth curve. If the flowmeter being calibrated is a rotameter or other flow device that is viscosity dependent, it may be necessary to generate a "family" of calibration curves that cover the operating pressure and temperature ranges of the flowmeter.

While the following technique should be verified before application, it may be possible to calculate flow rate readings for rotameters at standard conditions Q_{std} as follows:

$$Q_{std} = Q_{lab}\left(\frac{760 \times T_{lab}}{P_{lab} \times 293}\right)^{1/2}$$

Flow rate (laboratory conditions)	Flow rate (standard conditions)

Figure 18-4. Flowmeter calibration.

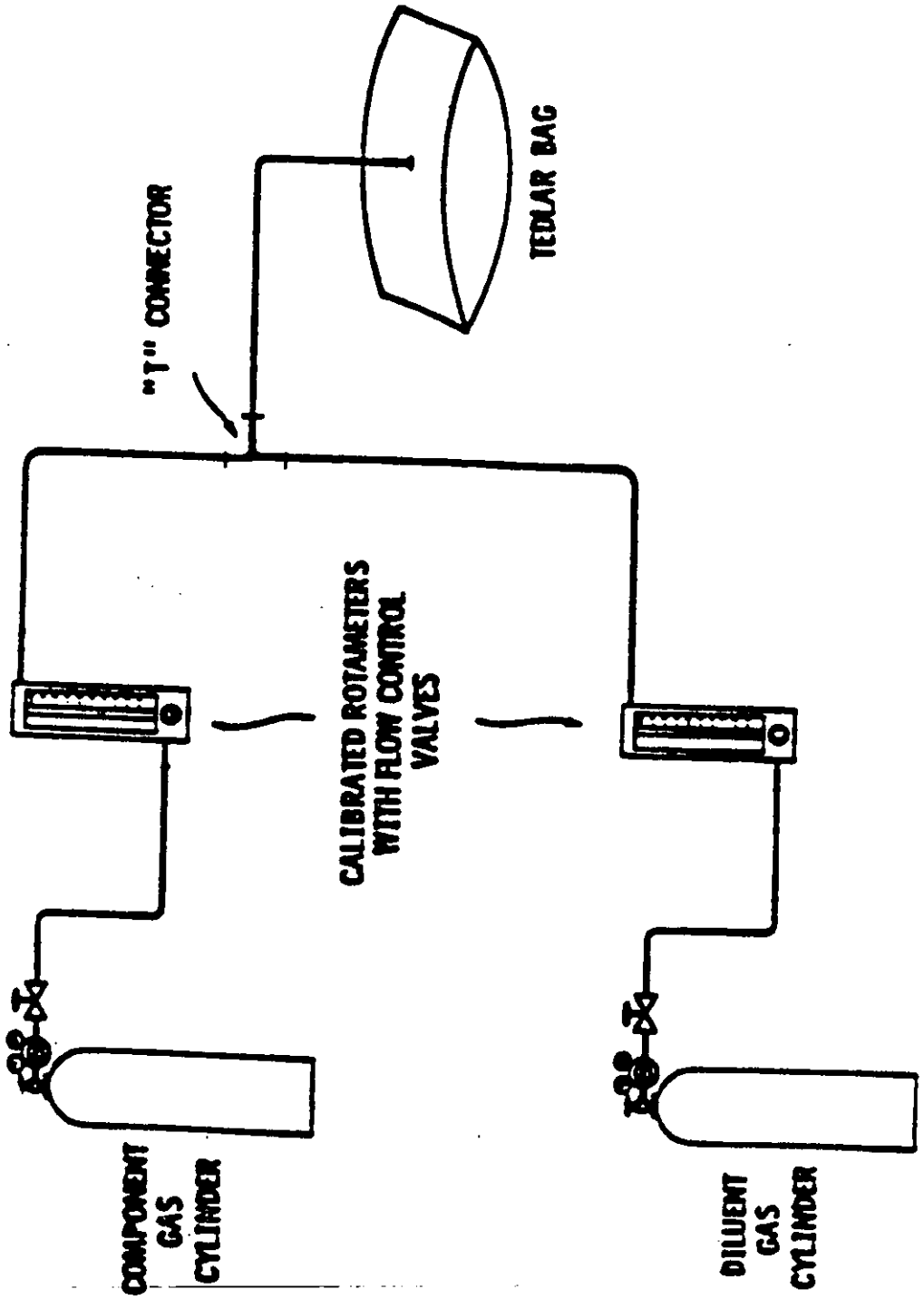

Figure 18-5. Single-stage calibration gas dilution system.

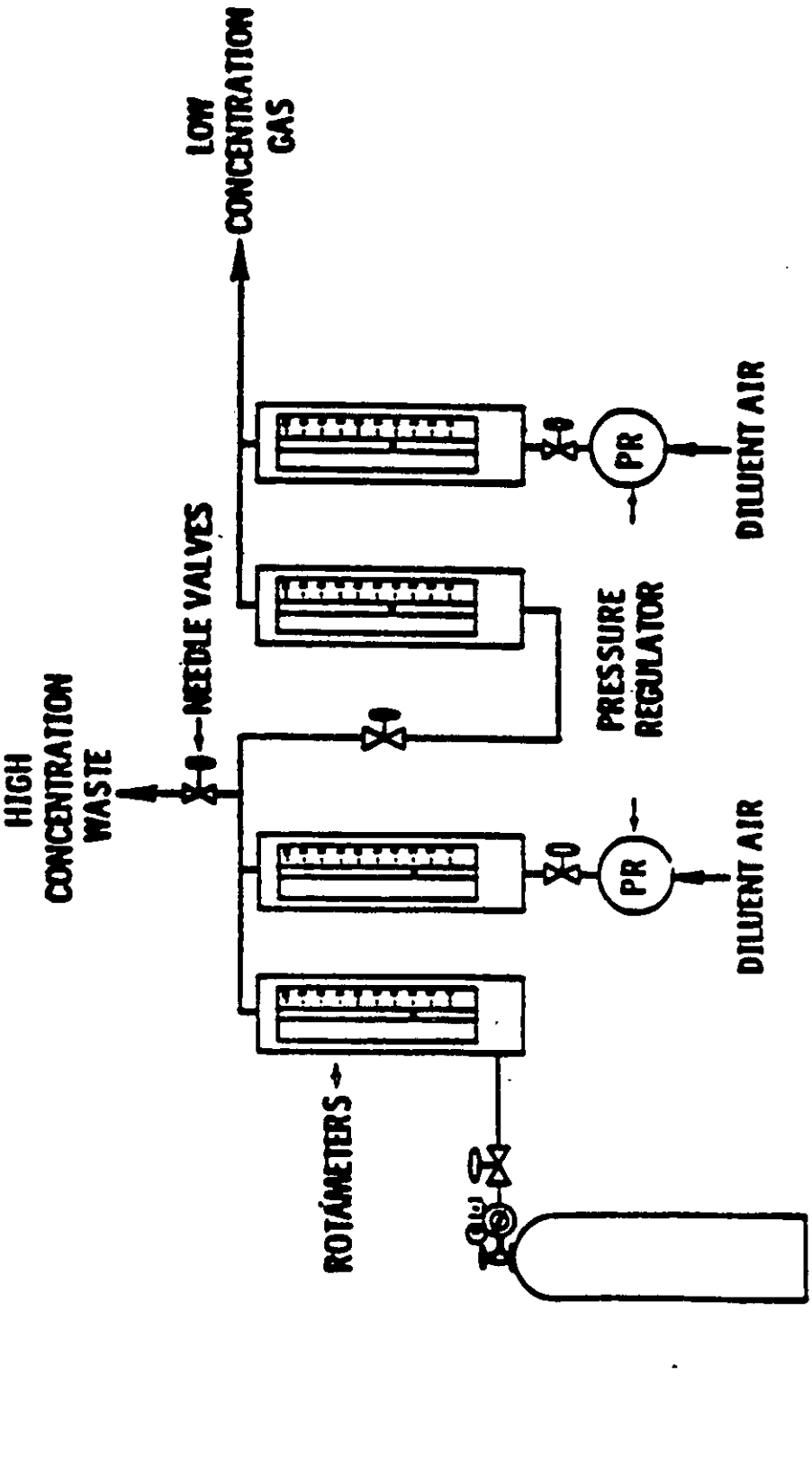

Figure 18-6 Two-stage dilution apparatus

National Grain and Feed Association

December 19, 1996

Mr. Dallas Safriet
Environmental Engineer
Emission Factor and Inventory Group
U.S. Environmental Protection Agency
Research Triangle Park, NC 27711

Dear Mr. Safriet:

As per your request, the National Grain and Feed Association (NGFA) has reviewed the study submitted by the National Cattleman's Beef Association (NCBA) entitled, "Emission Factors for Grain Receiving & Feed Loading Operations at Feed Mills." Although NGFA is encouraged that the data on emissions from hopper truck unloading confirm findings similar to those in the recently completed National Grain and Feed Foundation (NGFF) research project, we have some concerns with some aspects of the NCBA report which are discussed below.

The NGFA is the national nonprofit trade association of more than 1,000 grain, feed and processing firms comprising 5,000 facilities that store, handle, merchandise, mill, process and export more than two-thirds of all U.S. grains and oilseeds utilized in domestic and export markets.

The NCBA report presents data on both TSP and PM-10 emission when unloading grain from hopper trucks at feed mills associated with cattle feed yards. Much like the NGFF research, these data also confirm that emissions from grain unloading and handling are much lower than the data relied on in the past to establish emission factors.

However, as we will discuss below, the NCBA report contains several problems which severely diminish its usefulness and accuracy beyond cattle feed yards.

I. General Comments

A. Facility Equipment and Operating Characteristics

The NCBA report states that the typical grain handling capacity at a country elevator is 10,000 bu/hr, whereas the typical grain handling capacity of the facilities tested by Texas A&M ranged from 3,000 to 6,000 bu/hr. We do not believe that this broad characterization of the handling capacity found at the typical country grain elevator is correct. In reality, our members report that the range of leg sizes found at country elevators can and often do include the sizes found at the facilities discussed in the NCBA report.

The NCBA report also states that, because country grain elevators are "seasonal"

operations, the average particulate emission rate per unit time will be significantly higher at grain elevators than feed mills. There are two problems with NCBA's comparison between country grain elevators and feed mills. First, this characterization assumes that domestic feed mills do not increase truck receipts during harvest to take advantage of attractive raw material pricing and storage premiums associated with storage. In fact, increasing receipts during harvest season is a common business practice at feed mills as it is at country grain elevators. Second, it projects the image that feed mills only operate as feed mills and never as country grain elevators. In reality, many feed mills have an elevator associated with them which is used not only to receive raw material but also to function as a grain elevator to receive, condition and ship grain during harvest and non-harvest periods.

It is also important to recognize that grain receipts at country elevators during the non-harvest periods do not arrive in a relatively steady daily stream as implied in the case with the facilities in the NCBA report. Rather, grain receipts at country grain elevators on a per unit time basis during non-harvest periods tend to be sporadic and very low. As a result, the emission rate on a per unit time basis at grain elevators during the non-harvest periods can be either lower than or similar to those at feed mills depending on relative size and market conditions. Thus, the annual average emission rate on a per unit time basis at country elevators is not necessarily different from feed mills.

B. Choke Unloading

We believe the NCBA report makes two mistakes when it states that "it is likely that the unloading operation at country elevators do not encounter choke flow" when unloading hopper bottom trucks.

First, the Texas A&M researchers are mistaken when they improperly characterize receiving pits at feed mills as "typically" smaller than those at country elevators. In fact, country elevators can and often do have receiving pits similar in size to those mentioned in the NCBA report.

Furthermore, we think the NCBA report leaves the misconception that country elevators only receive grain in hopper bottom trucks. In reality, country elevators typically receive grain directly from producers in the same size and type of trucks unloaded at feed facilities.

Second, we believe the NCBA report is in error when it states that choke flow conditions are not encountered when unloading hopper bottom trucks at country grain elevators. In addition to the fact that the pit sizes and leg capacity at country elevators can be comparable to those discussed in the NCBA report, the recently completed NGFF research project found that unloading hopper trucks at