Custom Stack Analysis, LLC.

1-800-824-4274

ReConserve of Michigan, Inc.
170 Angell Street
Battle Creek, Michigan 49016

Report

Performed Velocity, Moisture, Temperature, Volumetric Flow Rate, Particulate, PM_{10}, $PM_{2.5}$, Condensable Particulate Matter, Volatile Organic Compounds, Oxygen, Formaldehyde and Carbon Dioxide Emissions Testing

Sampling performed on the Regenerative Thermal Oxidizer Inlet & Outlet

Battle Creek, MI

Test Date: 7/28/16 & 7/29/16

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9/16/2016

X

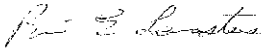
Signed by: Custom Stack Analysis, LLC.

Brian E. Lemasters
Custom Stack Analysis, LLC.

REPORT CERTIFICATION

Custom Stack Analysis, LLC. has used its professional experience and best professional efforts in performing this compliance test. I have reviewed the results of these tests and to the best of my knowledge and belief they are true and correct.

9/16/2016

X 

Signed by: Custom Stack Analysis, LLC.
Brian E. Lemasters

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EXECUTIVE SUMMARY

Custom Stack Analysis, LLC. conducted emissions sampling using USEPA Methods 1-5, 3A, 323, 25A, 201A and 202. Testing was conducted on the EU-DRYING Inlet & Outlet on July 28th & 29th, 2016 for compliance purposes. The Custom Stack Analysis, LLC. test crew consisted of Mr. James Gray, Mr. Jordan Smith, Mr. Kevin Ketchum and Mr. Brian Lemasters. The testing procedures were coordinated by Mr. Don Sturch of ReConserve of Michigan, Inc. All testing procedures were witnessed by reprensentatives of the Michigan Department of Environmental Quality Office.

Pollutant	Emission Limitations	Test Result Average	Compliance Demonstrated
Volatile Organic Compounds	17.08 lbs/hr 95% destruction efficiency	0.38 lbs/hr 98.6% destruction efficiency	Yes Yes
PM	0.006 lb / 1,000 lb of dry exhaust gas	0.003 lb / 1,000 lb of dry exhaust gas	Yes
PM_{10}	0.84 lbs/hr	0.26 lbs/hr	Yes
$PM_{2.5}$	0.14 lbs/hr	0.13 lbs/hr	Yes
Formaldehyde	0.04 lbs/hr	.004 lbs/hr	Yes

A description of the testing protocol is included on pages 6-12. All testing calculations are located on pages 22-36. Appendix 1 includes field test data. Appendix 2 contains laboratory data from Custom Stack Analysis, LLC. and ALS Environmental. Appendix 3 contains calibration data for the equipment used on test day. Appendix 4 contains monitoring data. Test results are located on pages 2-5.

Test Results

ReConserve of Michigan, Inc. - EU-DRYING Inlet
7/29/2016
Methods 1-4, 3A & 25A

	Run #1	Run #2	Run #3	Avg.
Stack Gas Velocity (ft/sec)	55.98	55.24	55.81	55.68
Standard Cubic Feet an Hour	1,928,275	1,880,939	1,857,964	1,889,059
Actual Cubic Feet per Minute	42,206	41,653	42,082	41,980
Moisture %	10.46%	11.47%	13.11%	11.68%
Carbon Dioxide %	0.51%	0.59%	0.57%	0.56%
Oxygen %	19.49%	19.51%	19.39%	19.46%
Nitrogen %	80.00%	79.90%	80.04%	79.98%
Inlet				
VOC* (ppm)	145.87	168.19	158.99	157.69
(lbs/hr Carbon)	26.31	29.59	27.63	27.85
Outlet				
VOC (ppm)**	2.19	1.82	1.19	1.73
(lbs/hr Carbon)	0.48	0.39	0.27	0.38
Destruction Efficiency (%)	98.18%	98.67%	99.04%	98.64%

* VOC concentration dry

** VOC concentration with the Methane removed and Dry.

Test Results

Reconserve of Michigan, Inc. - EU-DRYING Outlet
7/28/2016 & 7/29/2016
Methods 1-5, 3A, 25A

		Run #1	Run #2	Run #3	Run #4	Avg.
Stack Gas Velocity (ft/sec)		48.49	47.25	49.53	50.58	48.96
Standard Cubic Feet an Hour		2,316,583	2,339,862	2,316,573	2,393,054	2,341,518
Actual Cubic Feet per Minute		57,130	55,661	58,351	59,590	57,683
Stack Temperature (F)		251	223	260	254	247
Moisture % (Measured)		6.70%	7.09%	7.49%	7.29%	7.14%
Isokinicity %		98.2%	101.5%	102.8%	101.6%	101.05%
Carbon Dioxide %		0.20%	0.20%	0.50%	0.50%	0.35%
Oxygen %		19.80%	19.80%	19.80%	19.80%	19.80%
Nitrogen %		80.00%	80.00%	79.70%	79.70%	79.85%
1,000 lb of dry exhaust gas		173.74	175.49	173.74		174.3254
Particulate	(lbs/hr)	0.4719	0.4646	0.4820		0.4728
	(gr/dscf)	0.00143	0.00139	0.00146		0.00142
	(lbs/dscf)	2.04E-07	1.99E-07	2.08E-07		2.03E-07
	(lb / 1,000 lb of dry exhaust gas)	0.0027	0.0026	0.0028		0.0027
CH_2O	(lbs/hr)	2.50E-03	2.46E-03	5.59E-03		3.52E-03
	(lbs/dscf)	1.08E-09	1.05E-09	2.41E-09		1.51E-09
VOC	(ppm)	0	2.19	1.82	1.19	1.73
	(lbs/hr carbon)	0	0.4791	0.3945	0.2661	0.3799
	(lbs/hr propane)	0	0.5860	0.4825	0.3255	0.4647

Test Results

ReConserve of Michigan, Inc. - EU-DRYING Outlet
7/28/2016 & 7/29/2016
Methods 1-4, 201A & 202

		Run #1	Run #2	Run #3	Avg.
Stack Gas Velocity (ft/sec)		48.37	53.86	50.23	50.82
Standard Cubic Feet an Hour		2,359,018	2,629,658	2,431,677	2,473,451
Actual Cubic Feet per Minute		56,986	63,453	59,175	59,871
Stack Temperature (F)		241	238	241	240
Moisture % (Measured)		6.20%	6.51%	6.84%	6.52%
Isokinicity %		115.54%	97.07%	103.13%	105.25%
Carbon Dioxide %		0.20%	0.20%	0.50%	0.30%
Oxygen %		19.80%	19.80%	19.80%	19.80%
Nitrogen %		80.00%	80.00%	79.70%	79.90%
Cont. #1, ≤ $PM_{2.5}$					
Particulate	(lbs/hr)	7.56E-02	7.63E-02	9.05E-02	8.08E-02
Particulate	(gr/dscf)	2.24E-04	2.03E-04	2.61E-04	2.29E-04
Particulate	(lbs/dscf)	3.20E-08	2.90E-08	3.72E-08	3.28E-08
Cont. #2, > PM_{10}					
Particulate	(lbs/hr)	1.95E-01	1.80E-01	2.23E-01	1.99E-01
Particulate	(gr/dscf)	5.80E-04	4.80E-04	6.42E-04	5.67E-04
Particulate	(lbs/dscf)	8.28E-08	6.86E-08	9.17E-08	8.10E-08
Cont. #3, ≤ PM_{10} and > $PM_{2.5}$					
Particulate	(lbs/hr)	1.13E-01	1.11E-01	1.46E-01	1.24E-01
Particulate	(gr/dscf)	3.37E-04	2.95E-04	4.21E-04	3.51E-04
Particulate	(lbs/dscf)	4.81E-08	4.22E-08	6.02E-08	5.01E-08
Cont. #4, ≤ $PM_{2.5}$					
Particulate	(lbs/hr)	4.41E-02	6.24E-02	4.88E-02	5.18E-02
Particulate	(gr/dscf)	1.31E-04	1.66E-04	1.40E-04	1.46E-04
Particulate	(lbs/dscf)	1.87E-08	2.37E-08	2.01E-08	2.08E-08
Totals					
Particulate	(lbs/hr)	4.28E-01	4.30E-01	5.08E-01	4.56E-01
Particulate	(gr/dscf)	1.27E-03	1.14E-03	1.46E-03	1.29E-03
Particulate	(lbs/dscf)	1.82E-07	1.63E-07	2.09E-07	1.85E-07
Condensable Particulate Matter	(lbs/hr)	3.91E-01	4.16E-01	4.14E-01	4.07E-01
Condensable Particulate Matter	(gr/dscf)	1.16E-03	1.11E-03	1.10E-03	1.12E-03
Condensable Particulate Matter	(lbs/dscf)	1.66E-07	1.58E-07	1.70E-07	1.65E-07

Test Results

ReConserve of Michigan, Inc. - EU-DRYING Outlet

Method $PM_{2.5}$ - 12/15/2011

		Run #1	Run #2	Run #3	Avg.
Cont. #1, ≤ $PM_{2.5}$					
Particulate	(lbs/hr)	7.56E-02	7.63E-02	9.05E-02	8.08E-02
Particulate	(gr/dscf)	2.24E-04	2.03E-04	2.61E-04	2.29E-04
Particulate	(lbs/dscf)	3.20E-08	2.90E-08	3.72E-08	3.28E-08
Cont. #4, ≤ $PM_{2.5}$					
Particulate	(lbs/hr)	4.41E-02	6.24E-02	4.88E-02	5.18E-02
Particulate	(gr/dscf)	1.31E-04	1.66E-04	1.40E-04	1.46E-04
Particulate	(lbs/dscf)	1.87E-08	2.37E-08	2.01E-08	2.08E-08
Total $PM_{2.5}$					
Particulate	(lbs/hr)	1.20E-01	1.39E-01	1.39E-01	1.33E-01
Particulate	(gr/dscf)	3.55E-04	3.69E-04	4.01E-04	3.75E-04
Particulate	(lbs/dscf)	5.07E-08	5.27E-08	5.73E-08	5.36E-08
D_{50} $PM_{2.5}$		2.156	2.323	2.366	2.282

Test Results

ReConserve of Michigan, Inc. - EU-DRYING Outlet

Method PM_{10} - 12/15/2011

		Run #1	Run #2	Run #3	Avg.
Cont. #1, ≤ $PM_{2.5}$					
Particulate	(lbs/hr)	7.56E-02	7.63E-02	9.05E-02	8.08E-02
Particulate	(gr/dscf)	2.24E-04	2.03E-04	2.61E-04	2.29E-04
Particulate	(lbs/dscf)	3.20E-08	2.90E-08	3.72E-08	3.28E-08
Cont. #3, ≤ PM_{10} and > $PM_{2.5}$					
Particulate	(lbs/hr)	1.13E-01	1.11E-01	1.46E-01	1.24E-01
Particulate	(gr/dscf)	3.37E-04	2.95E-04	4.21E-04	3.51E-04
Particulate	(lbs/dscf)	4.81E-08	4.22E-08	6.02E-08	5.01E-08
Cont. #4, ≤ $PM_{2.5}$					
Particulate	(lbs/hr)	4.41E-02	6.24E-02	4.88E-02	5.18E-02
Particulate	(gr/dscf)	1.31E-04	1.66E-04	1.40E-04	1.46E-04
Particulate	(lbs/dscf)	1.87E-08	2.37E-08	2.01E-08	2.08E-08
Total PM_{10}					
Particulate	(lbs/hr)	0.23312	0.24962	0.28558	0.25611
Particulate	(gr/dscf)	0.00069	0.00066	0.00082	0.00073
Particulate	(lbs/dscf)	9.88E-08	9.49E-08	1.17E-07	1.04E-07
D_{50} PM_{10}		9.845	10.280	10.378	10.168

METHOD 1

Sample and velocity traverses for stationary sources.

To aid in the representative measurement of pollutant emissions and/ or total volumetric flow rate from a stationary source, a measurement site where the effluent stream is flowing in a known direction is selected, and the cross-section of the stack is divided into a number of equal areas. A traverse point is then located within each of these equal areas.

METHOD 2

Determination of stack gas velocity and volumetric flow rate.

The average gas velocity in a stack is determined from the gas density and from measurement of the average velocity head with a Type S (Stausscheibe or reverse type) pitot tube.

METHOD 3

Gas analysis for the determination of dry molecular weight.

This method is applicable for determining carbon dioxide and oxygen concentrations and dry molecular weight of a sample from a gas stream of a fossil-fuel combustion process.

METHOD 4

Determination of moisture content in stack gases.

A gas sample is extracted at a constant rate from the source. It is determined either volumetrically or gravimetrically.

METHOD 3A TESTING DESCRIPTION

A gas sample is continuously extracted from the stack, and a portion of the sample is conveyed to an instrumental analyzer for determination of O2 gas concentration. The gases pass through a heated sampling probe and filter to prevent condensation. The gases then pass through a calibration valve to a heated sampling line. After the heated sampling line is a Universal Analyzers Model 530 air cooled single sample thermoelectric water condenser with a perostolic pump for moisture removal. The sample is then passed through to a California Analytical Instruments Model 100F for O2 concentrations. Before the testing procedures commence the analyzer is left to warm up for a 90 minute period. It is then calibrated according to Method 7E specifications. To the extent practicable, the measured emissions should be between 20 to 100 percent of the selected calibration span. Three calibration gases are selected. The High-Level gas concentrations shall be equivalent to 20 to 100 percent of the calibration span. Mid-Level concentrations shall be equivalent to 40 to 60 percent of the calibration span. The Low-Level Gas concentrations of less than 20 percent of the span. Before the first run an analyzer calibration error check is conducted. If the low-level, mid, or high cal gases expected concentrations differ by more than +-2% of the span then the procedure needs to be repeated until an acceptable 3 point calibration is obtained. After the analyzer calibration check the upscale and low level calibration gases are introduced to the sampling calibration valve and recorded. System bias calibration must be within 5.0% of the analyzer calibration span for low-scale and upscale calibration gases. At the conclusion of each of the test runs the low-level gas and an upscale gas closest to the concentrations are introduced to the calibration valve assembly. If either the low-level or upscale value exceeds +-3% of the span, then the run is considered invalid.

METHOD 5 TESTING DESCRIPTION

Particulate samples were collected following EPA Methods 1-5. The equipment used for testing consisted of a Custom Stack Analysis Stack Train Sampler (EPA type). A type "S" pitot and a heated sampling probe were used with the sampling train. All equipment was calibrated in the laboratory prior to the test. The sampling nozzle and the pitot tubes were measured on the day of the test. All calibrations can be found in the appendix. The dust laden gases are passed through a heated pyrex probe and a heated glass four inch filter holder containing Gelman Type A-E fiberglass filter media. The gases leaving the filter were collected in a series of four impingers packed in ice. The first, third, and fourth impingers were the modified Greenburg-Smith type and the second one was a standard Greenburg-Smith type. The first and second impinger contained 100 ml of distilled water. After leaving the third and fourth empty impingers the gases passed through a "Drierite" column containing about 500 grams of indicating silica gel to remove any remaining water vapor. The dry gas then passed through the hose portion of the umbilical cord to a Custom Stack Analysis Model #3000 "Stacksampler" module. In the module the gas was moved through the system by a leakless air pump to a Rockwell 175-S dry test meter. The dry test meter exhausted to a calibrated orifice to measure the flow rate of the gases passing through the sampling apparatus. A type "S" pitot tube was attached to the sheath of the heated probe and nozzle. The orifice pressure taps and the pitot tube were connected to a Dwyer duel 10 inch combination inclined-well type manometer. One half of the manometer measured the orifice differential pressure (^H) and the other half measured the flue gas velocity head (^P). The temperature of the flue gas was measured by a type "K" thermocouple connected to a Marlin Digital Temperature controller. The $C0_2$ and 0_2 levels were analyzed using a Method 3A analyzer.

METHOD 25A TESTING DESCRIPTION

This method will be used to measure the total VOC concentration expressed in terms of ppm propane. A gas sample is extracted from the source through a stainless steel probe, through a heated sample line (teflon), to a flame ionization analyzer. The main components of Method 25A are the same as Method 204B with the exception of a non heated sample probe.

The sampling system is heated up to the proper operating temperature. Within two hours of the start of the test the FIA is calibrated. The calibration range or span is selected to be from 1.5 to 2.5 times the expected concentration. Three calibration ranges are then selected as follows: Low level 25-35% of the span, Mid level 45-55% of the span, and a High level 80-90% of the span. A zero and a high level calibration gas is then injected a the valve assembly and the FIA is adjusted to these levels. Then all four gases are introduced into the analyzer and recorded. If the responses are within 5% of the expected values then the analyzer is responding correctly. The sample probe is located in the center of the stack and sealed in place and the test is started. The test lasts for 60 minutes. At the end of the test run a drift check is ran. The zero gas and the mid level calibration gas is injected at the valve assembly. The analyzer responses are then recorded. The drift check is acceptable if the results are within 3% of the span value. These checks are performed before and after each test run.

METHOD 201A TESTING DESCRIPTION

This method applies to the in-stack measurement of particulate matter (PM) emissions equal to or less than aerodynamic diameter of nominally 2.5 um ($PM_{2.5}$) and 10 um (PM_{10}) from stationary sources. A gas sample is extracted at a constant flow rate through an in-stack sizing, which separates PM greater than PM_{10}. Variations from isokinetic sampling conditions are maintained within well defined limits. The particulate mass is determined gravimetrically after removal of uncombined water. Container # 1 consists of the in stack filter, that is less than or equal to $PM_{2.5}$ micrometer particulate matter. Container #2 is optional and consists of greater than PM_{10} micrometer particulate matter catch that is collected from the interior surfaces of the nozzle and cyclone, excluding the "turn around" cup and the interior surfaces of the exit tube. Container #3 consists of the filterable particulate matter less than PM_{10} and greater than $PM_{2.5}$ that is recovered from the cyclone exit to the front half of the in stack filter holder, including the "turn around" cup inside the cyclone and the interior surfaces of the exit tube. Container #4 consists of less than or equal to $PM_{2.5}$ that is recovered from the acetone rinse of the exit tube of cyclone and front half of the filter holder.

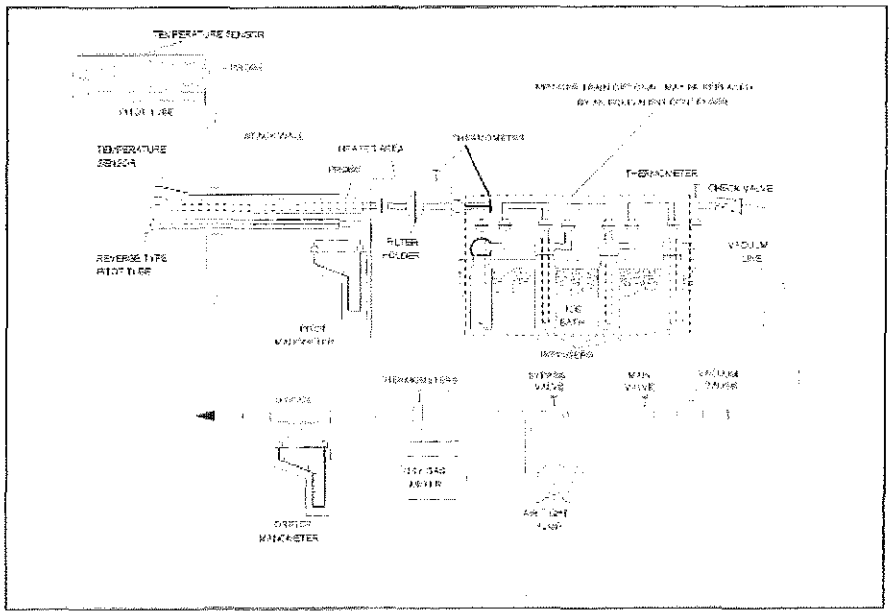
METHOD 202 TESTING DESCRIPTION

Particulate and condensable samples were collected following EPA Method 202. Three 90 minute test repetitions were performed. The equipment used for testing consisted of a Custom Stack Analysis Stack Train Sampler (EPA type). A type "S" pitot and a heated sampling probe were used with the sampling train. All equipment was calibrated in the laboratory prior to the test. The sampling nozzle and the pitot tubes were measured on the day of the test. All calibrations can be found in the appendix. The dust laden gases are passed through a heated Pyrex probe and a heated glass elbow to a condenser, two knock out impingers that are left dry, CPM filter between second and third impinger. The First and second impinger are immersed in a cold water bath while the third and fourth are in a ice water bath. The second, third and forth impingers were the modified Greenburg-Smith type and the first impinger was a short modified Greenburg-Smith type. The first and second impinger are empty. The third contains 100 ml water. The fourth empty impinger contains a "Drierite" column containing about 500 grams of indicating silica gel to remove any remaining water vapor. The dry gas then passed through the hose portion of the umbilical cord to a Custom Stack Analysis Model #3000 "Stacksampler" module. In the module the gas was moved through the system by a leakless air pump to a Rockwell 175-S dry test meter. The dry test meter exhausted to a calibrated orifice to measure the flow rate of the gases passing through the sampling apparatus. A type "S" pitot tube was attached to the sheath of the heated probe and nozzle. The orifice pressure taps and the pitot tube were connected to a Dwyer duel 10 inch combination inclined-well type manometer. One half of the manometer measured the orifice differential pressure (^H) and the other half measured the flue gas velocity head (^P). The temperature of the flue gas was measured by a type "K" thermocouple connected to a Marlin Digital Temperature controller. The $C0_2$ and 0_2 levels were analyzed using a Bacharach Fyrite. All the sampling train glassware was cleaned prior to the test with soap and tap water, and rinsed using tap water, acetone, and finally, Hexane. All the silicone grease was removed from the train. At the conclusion of the test run the post-test nitrogen purge was ran at 14 liters/min. During sample recovery the impinger contents are measured to within 1ml and placed in a container labeled CPM No. 1. The impingers including probe extensions are then rinsed twice with water and placed in container CPM No. 1. The impingers including probe extensions are then rinsed with acetone once and Hexane twice and placed in container No. 2. CPM container contains the CPM filter. CPM container #4 contains cold impinger water. CPM container No. 6 contains the acetone blank with acetone 150 ml. Container No. 7 will have 150 ml of water placed in it as a blank. The sample are then determined for the organic and inorganic fractions.

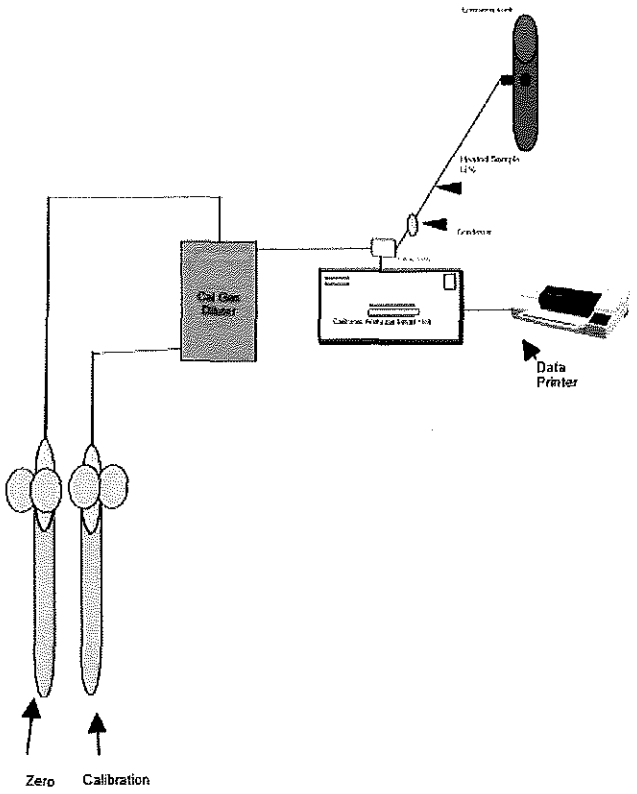
METHOD 323 TESTING DESCRIPTION

An emission sample from the combustion exhaust is drawn through a midget impinger train containing chilled reagent water to absorb formaldehyde. The formaldehyde concentration in the impinger is determined by reaction with acetyl acetone to form a colored derivative which is measured colorimetrically. The first impinger is initially dry. The second impinger contained 20 ml of reagent water, and the third impinger contained silica gel that is added before the impinger was weighed. Each prepared impinger was weighed and the pre-sample weight is recorded to the nearest 0.5 gm. Ice was packed around the impingers during sampling in order to keep them cold during the collection. A small amount of water was added to the ice to improve thermal transfer. The sample flow rate was set between 0.2-0.4 L/min, depending upon the anticipated concentration of formaldehyde in the engine exhaust. At the conclusion of the test run the sample probe and sample line was rinsed with reagent water. The impinger contents and rinse were transferred to an amber 40 ml VOA bottle. The sample bottles were kept on ice until analyzed at the laboratory.

5 Sampling System



3A Sampling System



Method 201A Train

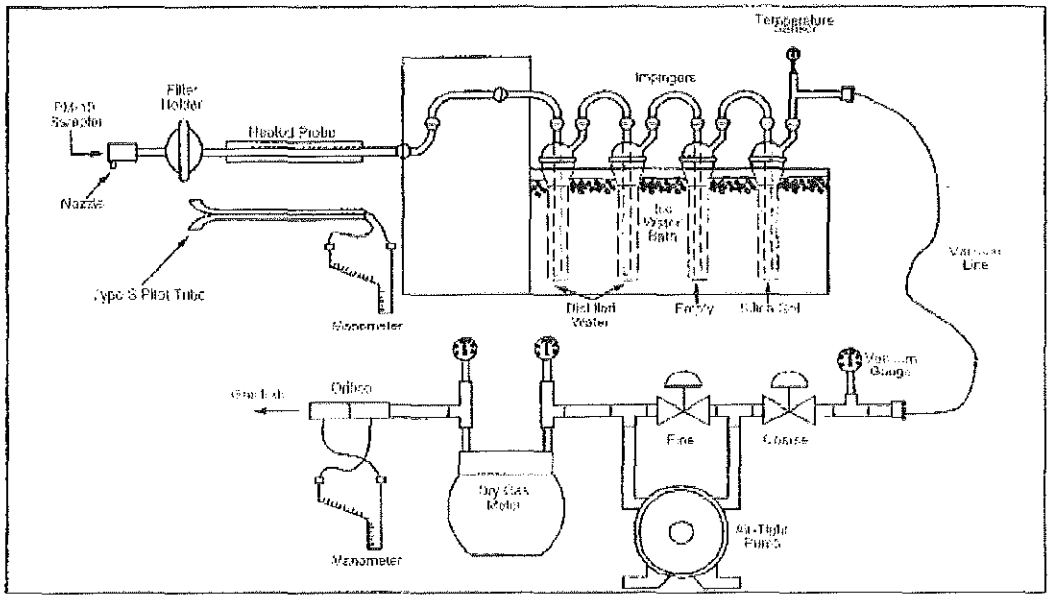


Figure 1. Method 201A Sampling Train