

Report of a...

Relative Accuracy Test Audit

performed for the...

Hillman Power Company
Hillman, Michigan

on the

Wood Fired Boiler

August 15, 2019

130.35

Network Environmental, Inc.
Grand Rapids, MI

Performed for:

Hillman Power Company
750 Progress Street
Hillman, MI 48746
Contact: Robert Havermahl
Telephone: (989) 742-4571
Fax: (989) 742-3723
E-mail: bob@hillmanpowerllc.com

Performed by:

Network Environmental, Inc.
2629 Remico Street, Suite B
Grand Rapids, MI 49519
Contact: David D. Engelhardt
Telephone: (616) 530-6330
Fax: (616) 530-0001
E-mail: netenviro@aol.com

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I. INTRODUCTION

Network Environmental, Inc. was retained by the Hillman Power Company of Hillman, Michigan to perform a Relative Accuracy Test Audit (RATA) on the Continuous Emissions Monitoring System (CEMS) that services their wood fired boiler. The CEMS is for oxides of nitrogen (NO_x), carbon monoxide (CO), sulfur dioxide (SO₂) and oxygen (O₂).

In addition, the opacity monitor was audited per Performance Specification 1 and the U.S. EPA Technical Assistance Document EPA 450/4-92-010 "Performance Audit Procedures for Opacity Monitors". Exhaust gas flow rates were also quantified to calculate mass emission rates for the boiler.

The RATA was performed on August 15, 2019. The opacity audit was performed on August 15, 2018. Stephan K. Byrd and David D. Engelhardt of Network Environmental, Inc. conducted the RATA in accordance with 40 CFR Part 60 Appendix B Performance Specifications 2 for NO_x and SO₂, 3 for O₂ and 4 for CO. Exhaust gas flow rates were determined using EPA Methods 1-4.

Assisting with the RATA were Mr. Robert Havermahl of Hillman Power and the operating staff of the facility.

II. PRESENTATION OF RESULTS

II.1 TABLE 1
NO_x RELATIVE ACCURACY TEST RESULTS (PPM @ 7% O₂)
WOOD FIRED BOILER
HILLMAN POWER COMPANY
HILLMAN, MICHIGAN
AUGUST 15, 2019

Run #	Time	RM	CEM	DIFF
		NO _x ⁽¹⁾	NO _x ⁽¹⁾	
1 ⁽²⁾	09:59-10:24	108.3	92.8	15.5
2 ⁽²⁾	11:50-12:15	112.0	114.2	-2.2
3	13:31-13:56	110.3	111.2	-0.9
4	14:22-14:47	111.7	113.2	-1.5
5	15:09-15:34	110.7	112.6	-1.9
6	15:52-16:17	108.6	111.6	-3.0
7	16:38-17:03	108.7	110.8	-2.1
8	17:22-17:47	118.9	121.9	-3.0
9	18:08-18:33	121.1	124.2	-3.1
10	18:48-19:13	120.2	122.8	-2.6
11	19:29-19:54	121.7	123.7	-2.0

Mean Reference Value = 114.6667

Absolute Value of the Mean of the Difference = 2.2333

Standard Deviation = 0.7550

Confidence Co-efficient = 0.5803

Relative Accuracy = 2.45% of the mean of the reference method

(1) Concentration in terms of PPM by volume on a dry basis corrected to 7% O₂

(2) Not used in relative accuracy calculation

II.2 TABLE 2
NO_x RELATIVE ACCURACY TEST RESULTS (LBS/HR)
WOOD FIRED BOILER
HILLMAN POWER COMPANY
HILLMAN, MICHIGAN
AUGUST 15, 2019

Run #	Time	RM	CEM	DIFF
		NO _x ⁽¹⁾	NO _x ⁽¹⁾	
1 ⁽²⁾	09:59-10:24	43.01	37.39	5.62
2 ⁽²⁾	11:50-12:15	44.81	46.73	-1.92
3	13:31-13:56	43.81	45.29	-1.48
4	14:22-14:47	44.69	46.08	-1.39
5	15:09-15:34	44.98	46.11	-1.13
6	15:52-16:17	44.10	45.40	-1.30
7	16:38-17:03	44.52	45.30	-0.78
8	17:22-17:47	47.63	49.69	-2.06
9	18:08-18:33	48.13	50.67	-2.54
10	18:48-19:13	49.25	49.79	-0.54
11	19:29-19:54	49.85	50.26	-0.41

Mean Reference Value = 46.3289

Absolute Value of the Mean of the Difference = 1.2922

Standard Deviation = 0.6914

Confidence Co-efficient = 0.5314

Relative Accuracy = 3.94% of the mean of the reference method

(1) Pounds Per Hour (Lbs/Hr)

(2) Not used in relative accuracy calculation

II.3 TABLE 3
CO RELATIVE ACCURACY TEST RESULTS (PPM @ 7% O₂)
WOOD FIRED BOILER
HILLMAN POWER COMPANY
HILLMAN, MICHIGAN
AUGUST 15, 2019

Run #	Time	RM	CEM	DIFF
		CO ⁽¹⁾	CO ⁽¹⁾	
1 ⁽²⁾	09:59-10:24	139.6	150.6	-11.0
2 ⁽²⁾	11:50-12:15	127.6	131.2	-3.6
3	13:31-13:56	129.0	141.5	-12.5
4	14:22-14:47	156.2	167.9	-11.7
5	15:09-15:34	108.7	126.4	-17.7
6	15:52-16:17	145.1	159.5	-14.4
7	16:38-17:03	160.7	174.7	-14.0
8	17:22-17:47	132.9	152.4	-19.5
9	18:08-18:33	124.2	138.6	-14.4
10	18:48-19:13	135.2	149.5	-14.3
11	19:29-19:54	134.3	148.8	-14.5

Mean Reference Value = 136.3

Absolute Value of the Mean of the Difference = 14.7778

Standard Deviation = 2.4160

Confidence Co-efficient = 1.8571

Relative Accuracy = 3.68% of the Emission Limit (452.0 PPM)

(1) Concentration in terms of PPM by volume on a dry basis corrected to 7% O₂

(2) Not used in relative accuracy calculation

II.4 TABLE 4
CO RELATIVE ACCURACY TEST RESULTS (LBS/HR)
WOOD FIRED BOILER
HILLMAN POWER COMPANY
HILLMAN, MICHIGAN
AUGUST 15, 2019

Run #	Time	RM	CEM	DIFF
		CO ⁽¹⁾	CO ⁽¹⁾	
1 ⁽²⁾	09:59-10:24	33.73	68.99	-35.26
2 ⁽²⁾	11:50-12:15	31.06	32.58	-1.52
3	13:31-13:56	31.16	35.02	-3.86
4	14:22-14:47	38.04	41.42	-3.38
5	15:09-15:34	26.88	31.41	-4.53
6	15:52-16:17	35.87	39.22	-3.35
7	16:38-17:03	40.09	43.31	-3.22
8	17:22-17:47	32.40	37.56	-5.16
9	18:08-18:33	30.05	34.38	-4.33
10	18:48-19:13	33.72	36.75	-3.03
11	19:29-19:54	33.50	36.68	-3.18

Mean Reference Value = 33.52

Absolute Value of the Mean of the Difference = 3.7822

Standard Deviation = 0.7380

Confidence Co-efficient = 0.5673

Relative Accuracy = 3.62% of the Emission Limit (120 LBS/HR)

(1) Pounds Per Hour (Lbs/Hr)

(2) Not used in relative accuracy calculation

II.5 TABLE 5
SO₂ RELATIVE ACCURACY TEST RESULTS (PPM @ 7% O₂)
WOOD FIRED BOILER
HILLMAN POWER COMPANY
HILLMAN, MICHIGAN
AUGUST 15, 2019

Run #	Time	RM	CEM	DIFF
		SO ₂ ⁽¹⁾	SO ₂ ⁽¹⁾	
1 ⁽²⁾	09:59-10:24	39.8	23.1	16.7
2 ⁽²⁾	11:50-12:15	48.2	54.9	-6.7
3	13:31-13:56	54.4	44.4	10.0
4	14:22-14:47	47.8	40.6	7.2
5	15:09-15:34	65.3	56.6	8.7
6	15:52-16:17	42.4	36.9	5.5
7	16:38-17:03	60.0	52.0	8.0
8	17:22-17:47	47.9	42.4	5.5
9	18:08-18:33	42.0	38.2	3.8
10	18:48-19:13	34.2	31.3	2.9
11	19:29-19:54	41.0	37.3	3.7

Mean Reference Value = 48.3333

Absolute Value of the Mean of the Difference = 6.1444

Standard Deviation = 2.4694

Confidence Co-efficient = 1.8981

Relative Accuracy = 8.04% of the emission limit (100 PPM @ 7% O₂)

(1) Concentration in terms of PPM by volume on a dry basis corrected to 7% O₂

(2) Not used in relative accuracy calculation

II.6 TABLE 6
SO₂ RELATIVE ACCURACY TEST RESULTS (LBS/HR)
WOOD FIRED BOILER
HILLMAN POWER COMPANY
HILLMAN, MICHIGAN
AUGUST 15, 2019

Run #	Time	RM	CEM	DIFF
		SO ₂ ⁽¹⁾	SO ₂ ⁽¹⁾	
1 ⁽²⁾	09:59-10:24	22.01	12.97	9.04
2 ⁽²⁾	11:50-12:15	26.80	31.43	-4.63
3	13:31-13:56	30.04	25.24	4.80
4	14:22-14:47	26.61	22.93	3.68
5	15:09-15:34	36.94	32.22	4.72
6	15:52-16:17	23.94	20.96	2.98
7	16:38-17:03	34.22	29.79	4.43
8	17:22-17:47	26.72	24.07	2.65
9	18:08-18:33	23.23	21.61	1.62
10	18:48-19:13	19.48	17.63	1.85
11	19:29-19:54	23.39	21.10	2.29

Mean Reference Value = 27.1744

Absolute Value of the Mean of the Difference = 3.2244

Standard Deviation = 1.2302

Confidence Co-efficient = 0.9456

Relative Accuracy = 8.34% of the emission limit (50.0 Lbs/Hr)

(1) Pounds Per Hour (Lbs/Hr)

(2) Not used in relative accuracy calculation

III. DISCUSSION OF RESULTS

III.1 NO_x RATA - The results of the NO_x RATA's can be found in Tables 1 and 2 (Sections II.1 & II.2). The relative accuracy calculations were performed in terms of PPMV corrected to 7% O₂ and Lbs/Hr. Eleven (11), twenty five (25) minute runs were collected from the boiler exhaust. Only nine (9) of the sample runs were used for the relative accuracy calculations. Four (4) flow rate measurements and moisture determinations (1 for every set of 3 gas samples) were also performed. All reference method PPM data was calibration corrected using U.S. EPA Equation 7E-5.

The relative accuracy for the NO_x CEMS was 2.45% of the mean of the reference method samples for the PPMV @ 7% O₂ RATA and 3.94% of the mean of the reference method samples for the Lbs/Hr RATA.

According to Performance Specification 2 in 40 CFR Part 60 Appendix B, "The relative accuracy (RA) of the CEMS shall be no greater than 20 percent of the mean value of the reference method test data in terms of the units of the emission standard or 10 percent of the applicable standard, whichever is greater."

III.2 CO RATA - The results of the CO RATA's can be found in Tables 3 and 4 (Section II.3 & II.4). The relative accuracy calculations were performed in terms of PPMV and Lbs/Hr. Eleven (11), twenty five (25) minute runs were collected from the boiler exhaust. Only nine (9) of the sample runs were used for the relative accuracy calculations. Four (4) flow rate measurements and moisture determinations (1 for every set of 3 gas samples) were also performed. All reference method PPM data was calibration corrected using U.S. EPA Equation 7E-5.

The relative accuracy for the CO CEMS was 3.68% of the emission limit (452.0 PPM) for the PPMV @ 7% O₂ RATA and 3.62% of the emission limit (120 Lbs/Hr) for the Lbs/Hr RATA.

According to Performance Specification 4 in 40 CFR Part 60 Appendix B, "The relative accuracy (RA) of the CEMS shall be no greater than 10 percent of the mean value of the reference method test data in terms of the units of the emission standard or 5 percent of the applicable standard, whichever is greater." This applies to the PPMV RATA.

According to Performance Specification 6 in 40 CFR Part 60 Appendix B, "The relative accuracy (RA)

of the CEMS shall be no greater than 20 percent of the mean value of the reference method test data in terms of the units of the emission standard or 10 percent of the applicable standard, whichever is greater." This applies to the Lbs/Hr RATA.

III.3 SO₂ RATA - The results of the SO₂ RATA's can be found in Tables 5 and 6 (Sections II.5 & II.6). The relative accuracy calculations were performed in terms of PPMV corrected to 7% O₂ and Lbs/Hr. Eleven (11), twenty five (25) minute runs were collected from the boiler exhaust. Only nine (9) of the sample runs were used for the relative accuracy calculations. Four (4) flow rate measurements and moisture determinations (1 for every set of 3 gas samples) were also performed. All reference method PPM data was calibration corrected using U.S. EPA Equation 7E-5.

The relative accuracy for the SO₂ CEMS was 8.04% of the emission limit (100 PPMV @ 7 % O₂) for the PPMV @ 7% O₂ RATA and 8.34% of the emission limit (50.0 Lbs/Hr) for the Lbs/Hr RATA.

According to Performance Specification 2 in 40 CFR Part 60 Appendix B, "The relative accuracy (RA) of the CEMS shall be no greater than 20 percent of the mean value of the reference method test data in terms of the units of the emission standard or 10 percent of the applicable standard, whichever is greater."

III.4 Opacity Audit - The results of the opacity audit can be found in Appendix C. The calibration errors were as follows:

Filter	Calibration Error
Low	0.16%
Mid	0.21%
High	0.65%

According to Performance Specification 1 in 40 CFR Part 60 Appendix B, the calibration error of the monitor should be less than or equal to 3% opacity.

IV. SOURCE DESCRIPTION

CEMS services a wood fired boiler. The exhaust is controlled by an electrostatic precipitator. The boiler was operated above the minimum 50% of load requirement during the testing period.

V. CEMS DESCRIPTION

The NO_x monitor is a AMETEK, Model 9900, Serial # ZD-9900-10859-1. The monitor records data on a dry basis. The span is 0-500 PPM.

The SO₂ monitor is a AMETEK, Model 9900, Serial # ZD-9900-10859-1. The monitor records data on a dry basis. The span is 0-500 PPM.

The CO monitor is a California Analytical Model 601, Serial # Z07004-M. The monitor records data on a dry basis. The span range is 0-1000 PPM.

The O₂ monitor is a Brand Gaus Model 4705, Serial # 10970. The monitor records data on a dry basis. The span range is 0-25 %.

The opacity monitor is a Durag Model D-R 290 (AW2-USEPA), Serial # 1226727. The span range is 0-100 %.

VI. SAMPLING AND ANALYTICAL PROTOCOL

The RATA was performed in accordance with 40 CFR Part 60 Appendix B Performance Specifications 2 for NO_x and SO₂, 3 for O₂ and 4 for CO. In addition, the opacity monitor was audited per Performance Specification 1 and the U.S. EPA Technical Assistance Document EPA450/4-92-010 "Performance Audit Procedures for Opacity Monitors". The sampling was conducted on the 72 inch I.D. exhaust stack at a location that exceeds 8 duct diameters downstream and 2 duct diameters upstream from the nearest disturbances (U.S. EPA Reference Method 1 requirement).

The RATA was performed in accordance with the protocol approved by the EGLE – Air Quality Division.

The sampling methods used for the reference method determinations were as follows:

VI.1 Oxides of Nitrogen

The NO_x sampling was conducted in accordance with U.S. EPA Reference Method 7E. A Thermo Environmental Model 42H gas analyzer was used to monitor the boiler exhaust. Sample gas was extracted through a heated probe. A heated teflon sample line was used to transport the exhaust gases to a gas conditioner to remove moisture and reduce the temperature. From the gas conditioner stack gases were passed to the analyzer. The analyzer produces instantaneous readouts of the NO_x concentrations (PPM).

The analyzer was calibrated by direct injection prior to the testing. A span gas of 250.1 PPM was used to establish the initial instrument calibration. Calibration gases of 53.2 PPM and 124.0 PPM were used to determine the calibration error of the analyzer. A 50.8 PPM NO₂ gas was direct injected to determine the conversion efficiency of the analyzer (93.90%). The sampling system (from the back of the stack probe to the analyzer) was injected using the 124.0 PPM gas to determine the system bias. After each sample, a system zero and system injection of 124.0 PPM were performed to establish system drift and system bias during the test period. All calibration gases were EPA Protocol 1 Certified.

The analyzer was calibrated to the output of the data acquisition system (DAS) used to collect the data from the boiler.

VI.2 Carbon Monoxide

The CO sampling was conducted in accordance with U.S. EPA Reference Method 10. A Thermo Environmental Model 48C gas analyzer was used to monitor the boiler exhaust. Sample gas was extracted through a heated probe. A heated teflon sample line was used to transport the exhaust gases to a gas conditioner to remove moisture and reduce the temperature. From the gas conditioner stack gases were passed to the analyzer. The analyzer produces instantaneous readouts of the CO concentrations (PPM).

The analyzer was calibrated by direct injection prior to the testing. A span gas of 998.0 PPM was used to establish the initial instrument calibration. Calibration gases of 254.0 PPM and 498.0 PPM were used to determine the calibration error of the analyzer. The sampling system (from the back of the stack probe to the analyzer) was injected using the 254.0 PPM gas to determine the system bias. After each sample, a system zero and system injection of 254.0 PPM were performed to

establish system drift and system bias during the test period. All calibration gases were EPA Protocol 1 Certified.

The analyzer was calibrated to the output of the data acquisition system (DAS) used to collect the data from the boiler.

VI.3 Sulfur Dioxide

The SO₂ sampling was conducted in accordance with U.S. EPA Reference Method 6C. A Bivar Model 721M gas analyzer was used to monitor the boiler exhaust. Sample gas was extracted through a heated probe. A heated teflon sample line was used to transport the exhaust gases to a gas conditioner to remove moisture and reduce the temperature. From the gas conditioner stack gases were passed to the analyzer. The analyzer produces instantaneous readouts of the SO₂ concentrations (PPM).

The analyzer was calibrated by direct injection prior to the testing. A span gas of 254.2 PPM was used to establish the initial instrument calibration. Calibration gases of 95.2 PPM and 147.9 PPM were used to determine the calibration error of the analyzer. The sampling system (from the back of the stack probe to the analyzer) was injected using the 95.2 PPM gas to determine the system bias. After each sample, a system zero and system injection of 95.2 PPM were performed to establish system drift and system bias during the test period. All calibration gases were EPA Protocol 1 Certified.

The analyzer was calibrated to the output of the data acquisition system (DAS) used to collect the data from the boiler.

VI.4 Oxygen & Carbon Dioxide

The O₂ & CO₂ sampling was conducted in accordance with U.S. EPA Reference Method 3A. Servomex Model 1400M portable stack gas analyzers were used to monitor the boiler exhaust. Sample gas was extracted through a heated probe. A heated teflon sample line was used to transport the exhaust gases to a gas conditioner to remove moisture and reduce the temperature. From the gas conditioner stack gases were passed to the analyzers. The analyzers produce instantaneous readouts of the O₂ & CO₂ concentrations (%).

The analyzers were calibrated by direct injection prior to the testing. Span gases of 21.0% O₂ and

21.04% CO₂ were used to establish the initial instrument calibrations. Calibration gases of 5.96% O₂ / 11.8% CO₂ and 12.0% O₂ / 6.01% CO₂ were used to determine the calibration error of the analyzers. The sampling system (from the back of the stack probe to the analyzer) was injected using the 5.96% O₂ / 11.8% CO₂ gas to determine the system bias. After each sample, a system zero and system injection of 5.96% O₂ / 11.8% CO₂ were performed to establish system drift and system bias during the test period. All calibration gases were EPA Protocol 1 Certified.

The analyzers were calibrated to the output of the data acquisition system (DAS) used to collect the data from the boiler.

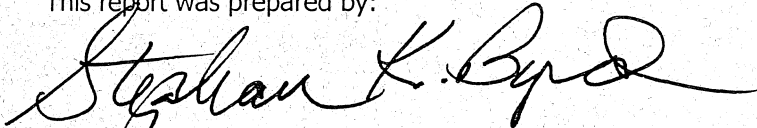
VI.5 Opacity

The opacity audit was conducted in accordance with Performance Specification 1 and the U.S. EPA Technical Assistance Document EPA450/4-92-010 "Performance Audit Procedures for Opacity Monitors". A three-point calibration error test of the opacity monitor was conducted. Three (3) neutral density filters, meeting the requirements of PS-1, were placed in the light beam path five consecutive times and the monitor responses were recorded. The calibration error of the monitor was calculated in accordance with Section 8.0 of Performance Specification 1.

VI.6 Exhaust Gas Parameters

The exhaust gas parameters (air flow rate, temperature, moisture and density) were determined by employing U.S. EPA Reference Methods 1 through 4. All the quality assurance and quality control procedures listed in the methods were incorporated in the sampling analysis.

This report was prepared by:



Stephan K. Byrd
President

This report was reviewed by:



David D. Engelhardt
Vice President

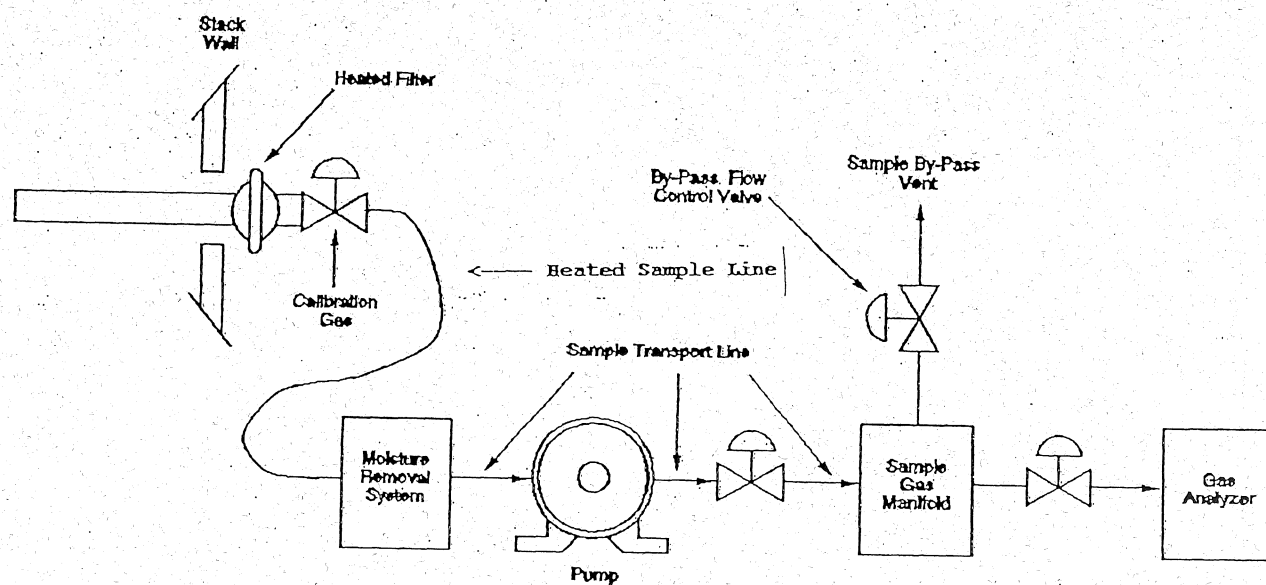


Figure 1

NO_x, CO, SO₂ & O₂ Sampling Train

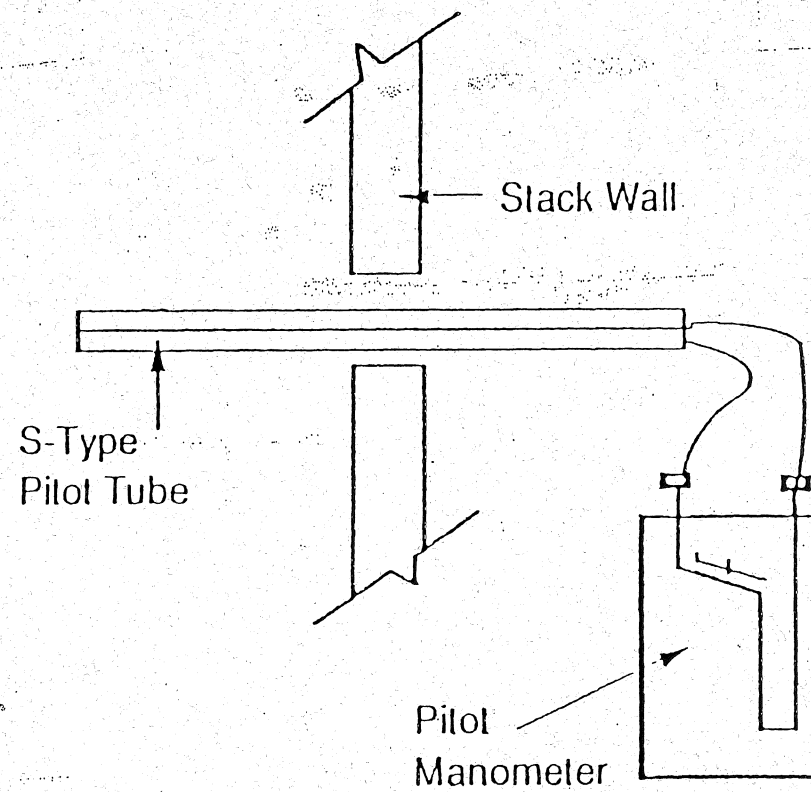


Figure 2
Air Flow Sampling Train

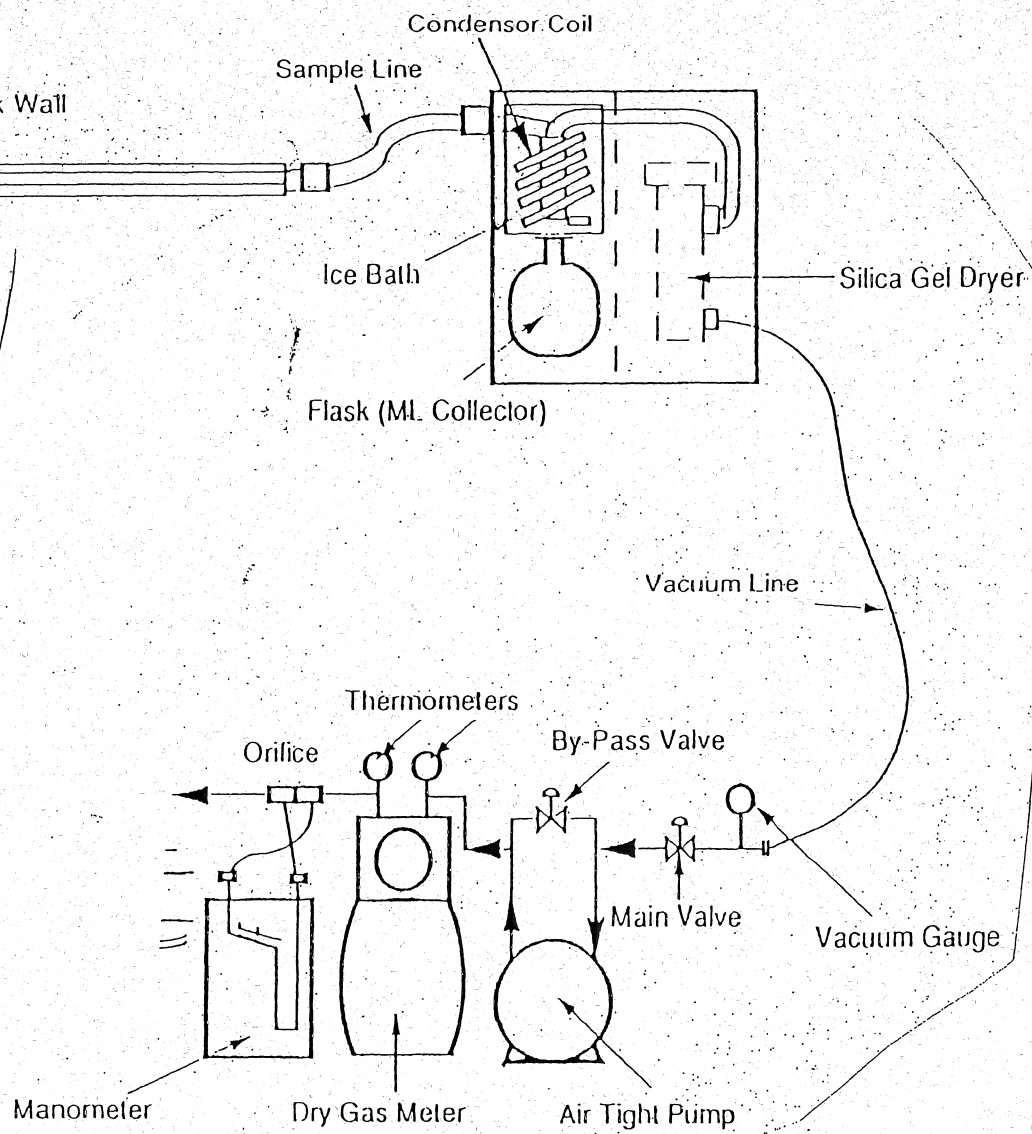


Figure 3
Moisture Sampling Train