

## 1.0 INTRODUCTION

### 1.1 Summary of Test Program

Gerdau Monroe Mill, located in Monroe, Michigan contracted Air Compliance Testing, Inc. of Cleveland, Ohio to conduct compliance stack emission testing of an Electric Arc Furnace (EAF) (EUEAF), two (2) Vacuum Tank Degassers (VTD) (EUVTD) and a Ladle Metallurgy Furnace (LMF) (EULMF). Testing was performed to satisfy emissions testing requirements pursuant to Michigan Department of Environmental Quality (MDEQ) Permit-to-Install (PTI) No. 102-12A. The testing was performed on February 25-26, 2016.

Simultaneous sampling and opacity observations were performed at the EAF/VTD SVBH01 Exhaust and LMF SVBHLMF Exhaust to determine the emissions of filterable particulate matter (PM), sulfur dioxide (SO<sub>2</sub>), nitrogen oxide (NO<sub>x</sub>) (as NO<sub>2</sub>), carbon monoxide (CO), and total gaseous organics (TGO), lead (Pb), mercury (Hg), PM under 2.5- $\mu$ m (PM<sub>2.5</sub>), and PM under 10- $\mu$ m (PM<sub>10</sub>). Testing was conducted while the EAF, VTD, and LMF were operating at maximum rated capacity. During this test, emissions from the EAF and VTD were controlled by a direct evacuation control (DEC) unit and the DVBAGHOUSE-01 baghouse, and emissions from the LMF were controlled by the DVLMFBAGHOUSE baghouse.

In addition to the testing above, opacity observations were performed at the EAF Meltshop Roofline, and verification of air flow was performed at each natural draft opening (NDO) into the non-fugitive enclosure of the EAF Building.

The test methods that were conducted during this test were EPA Methods 1, 2, 3, 3A, 4, 5, 6C, 7E, 9, 10, 25A, 29, 201A, 202, and Modified 204.

### 1.2 Key Personnel

The key personnel who coordinated this test program (and their phone numbers) were:

Craig Metzger, Environmental Manager, Gerdau Monroe Mill, 734-243-3468

Anna Maiuri, Member, Dickinson Wright PLLC, 248-433-7558

Karen Kajiya-Mills, TPU Supervisor, Air Quality Division, Michigan Department of Environmental Quality (MDEQ), 517-284-6780

Mark Dziadosz, Environmental Quality, Analyst, Air Quality Division, MDEQ, 586-753-3745

Robert Lisy QI, District Manager, Air Compliance Testing, Inc., 800-372-2471

Peter Becker QI, Project Manager, Air Compliance Testing, Inc., 800-372-2471

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## 2.0 SUMMARY AND DISCUSSION OF TEST RESULTS

### 2.1 Objectives and Test Matrix

The purpose of this test was to determine the emissions of filterable PM, SO<sub>2</sub>, NO<sub>x</sub> (as NO<sub>2</sub>), CO, TGO, Pb, Hg, PM<sub>2.5</sub>, and PM<sub>10</sub> and percent opacity of VEs at the EAF/VTD SVBH01 Exhaust and LMF SVBHLMF Exhaust while the EAF, VTD, and LMF were operating at maximum rated capacity. The purpose of the test was also to verify inward flow to the EAF Building and percent opacity of VEs at the EAF Meltshop Roofline while EAF, VTD, and LMF were operating a maximum rated capacity. Testing was performed to satisfy the emissions testing requirements pursuant to MDEQ Permit-to-Install No. 102-12A.

#### The specific test objectives for this test are as follows:

Simultaneously measure the concentrations of filterable PM, oxygen (O<sub>2</sub>), carbon dioxide (CO<sub>2</sub>), SO<sub>2</sub>, NO<sub>x</sub>, CO, TGO, Pb, Hg, filterable PM<sub>2.5</sub> and PM<sub>10</sub>, and condensible PM (CPM) at the EAF/VTD SVBH01 Exhaust and LMF SVBHLMF Exhaust.

Simultaneously measure the dry standard and actual volumetric flow rate of the stack gas at the EAF/VTD SVBH01 Exhaust and LMF SVBHLMF Exhaust.

Utilize the above variables to determine the emissions of filterable PM, SO<sub>2</sub>, NO<sub>x</sub> (as NO<sub>2</sub>), CO, TGO, Pb, Hg, PM<sub>2.5</sub>, and PM<sub>10</sub> at the EAF/VTD SVBH01 Exhaust and LMF SVBHLMF Exhaust while the EAF, VTD, and LMF were operating at maximum rated capacity.

Determine VEs (as % opacity) at the EAF/VTD SVBH01 Exhaust and LMF SVBHLMF Exhaust.

Verify the direction of air flow at each NDO into the non-fugitive enclosure of the EAF Building.

Determine the VEs (as % opacity) from the EAF Building at the Meltshop Roofline.

Tables 2.1.1 - 2.1.3 present the sampling and analytical matrix log for this test.

### 2.2 Field Test Changes and Problems

No field test changes or problems occurred during the performance of this test that would bias the accuracy of the results of this test.

### **2.3 Presentation of Results**

Three (3) sampling trains were utilized during each run at the EAF/VTD SVBH01 Exhaust and LMF SVBHLMF Exhaust to determine the emissions of filterable PM, SO<sub>2</sub>, NO<sub>x</sub> (as NO<sub>2</sub>), CO, TGO, Pb, Hg, PM<sub>2.5</sub>, and PM<sub>10</sub>. At each location, one sampling train measured stack gas volumetric flow rate, dry molecular weight, moisture content, and the concentrations of filterable PM, Pb, and Hg. A second sampling train measured stack gas volumetric flow rate, moisture content, and filterable PM<sub>2.5</sub>, filterable PM<sub>10</sub>, and condensible PM, while a third sampling train measured the concentrations of O<sub>2</sub>, CO<sub>2</sub>, SO<sub>2</sub>, NO<sub>x</sub>, CO, and TGO.

Table 2.2.1 displays the emissions of filterable PM, Pb, and Hg measured at the EAF/VTD SVBH01 Exhaust and LMF SVBHLMF Exhaust while the EAF, VTD, and LMF were operating at maximum rated capacity.

Table 2.2.1 also displays the maximum 6-minute average of opacity measured at the EAF/VTD SVBH01 Exhaust and LMF SVBHLMF Exhaust while the EAF, VTD, and LMF were operating at maximum rated capacity.

Table 2.2.2 displays the emissions of PM<sub>2.5</sub> and PM<sub>10</sub> measured at the EAF/VTD SVBH01 Exhaust and LMF SVBHLMF Exhaust while the EAF, VTD, and LMF were operating at maximum rated capacity.

Table 2.2.3 displays the emissions of SO<sub>2</sub>, NO<sub>x</sub> (as NO<sub>2</sub>), CO, and TGO measured at the EAF/VTD SVBH01 Exhaust and LMF SVBHLMF Exhaust while the EAF, VTD, and LMF were operating at maximum rated capacity.

Table 2.2.4 displays the combined emissions of filterable PM, PM<sub>2.5</sub>, PM<sub>10</sub>, Pb, Hg, SO<sub>2</sub>, NO<sub>x</sub> (as NO<sub>2</sub>), CO, and TGO measured at the EAF SVBH01 Exhaust and LMF SVBHLMF Exhaust while the EAF, VTD, and LMF were operating at maximum rated capacity.

Table 2.3 summarizes the measured results for the VE readings performed at the EAF Meltshop Roofline while the EAF, VTD, and LMF were operating at maximum rated capacity.

Table 2.3 also displays the verification of the direction of air flow of each NDO to the non-fugitive enclosure of the EAF Building while the EAF, VTD, and LMF were operating at maximum rated capacity.

Table 2.4 displays the measured results for the VE readings performed at EAF Meltshop Roofline for Run 1. The data displays the minimum, maximum, and maximum six-minute average opacity readings while the EAF, VTD, and LMF were operating at maximum rated capacity.

Concentration values in Tables 2.2.1 - 2.2.4 denoted with a '<' were measured to be below the minimum detection limit (MDL) of the applicable analytical method.

The graphs that present the raw, uncorrected concentration data measured in the field by the EPA Method 3A, 6C, 7E, 10, and 25A sampling systems at the EAF/VTD SVBH01 Exhaust and LMF SVBHLMF Exhaust are located in the Field Data section of the Appendix.

			EPA TEST METHODS UTILIZED					
			M1/M2 (Flow)	M3 (Dry Mol. Wt.)	M4 (%H <sub>2</sub> O)	M5 (Filterable PM)	M29 (Metals)	M9 (VEs)
Date	Run No.	Sampling Location	Sampling Time / Duration (min)	Sampling Time / Duration (min)	Sampling Time / Duration (min)	Sampling Time / Duration (min)	Sampling Time / Duration (min)	Sampling Time / Duration (min)
2/25/2016	1	EAf/VTD SVBH01 Exhaust	9:55 - 15:22 288	9:55 - 15:22 288	9:55 - 15:22 288	9:55 - 15:22 288	9:55 - 15:22 288	9:55 - 15:22 278
2/26/2016	2	EAf/VTD SVBH01 Exhaust	7:34 - 12:57 288	7:34 - 12:57 288	7:34 - 12:57 288	7:34 - 12:57 288	7:34 - 12:57 288	7:33 - 8:33 60
2/26/2016	3	EAf/VTD SVBH01 Exhaust	15:51 - 20:50 288	15:51 - 20:50 288	15:51 - 20:50 288	15:51 - 20:50 288	15:51 - 20:50 288	15:50 - 16:50 60
2/25/2016	1	LMF SVBHLMF Exhaust	9:55 - 15:22 288	9:55 - 15:22 288	9:55 - 15:22 288	9:55 - 15:22 288	9:55 - 15:22 288	9:55 - 15:22 278
2/26/2016	2	LMF SVBHLMF Exhaust	7:33 - 12:55 288	7:33 - 12:55 288	7:33 - 12:55 288	7:33 - 12:55 288	7:33 - 12:55 288	7:33 - 8:33 60
2/26/2016	3	LMF SVBHLMF Exhaust	15:50 - 20:47 288	15:50 - 20:47 288	15:50 - 20:47 288	15:50 - 20:47 288	15:50 - 20:47 288	15:50 - 18:50 60

All times are Eastern Standard Time.

Table 2.1.1 - Sampling and Analytical Matrix

			EPA TEST METHODS UTILIZED			
			M1/M2 (Flow)	M4 (%H <sub>2</sub> O)	201A (Filterable PM <sub>2.5</sub> /PM <sub>10</sub> )	202 (CPM)
Date	Run No.	Sampling Location	Sampling Time / Duration (min)	Sampling Time / Duration (min)	Sampling Time / Duration (min)	Sampling Time / Duration (min)
2/25/2016	1	EAF/VTD SVBH01 Exhaust	13:44 - 15:45 57.7	13:44 - 15:45 57.7	13:44 - 15:45 57.7	13:44 - 15:45 57.7
2/26/2016	2	EAF/VTD SVBH01 Exhaust	9:09 - 10:28 59.0	9:09 - 10:28 59.0	9:09 - 10:28 59.0	9:09 - 10:28 59.0
2/26/2016	3	EAF/VTD SVBH01 Exhaust	12:24 - 15:38 59.0	12:24 - 15:38 59.0	12:24 - 15:38 59.0	12:24 - 15:38 59.0
2/25/2016	1	LMF SVBHLMF Exhaust	13:40 - 15:43 59.5	13:40 - 15:43 59.5	13:40 - 15:43 59.5	13:40 - 15:43 59.5
2/26/2016	2	LMF SVBHLMF Exhaust	9:07 - 10:26 57.7	9:07 - 10:26 57.7	9:07 - 10:26 57.7	9:07 - 10:26 57.7
2/26/2016	3	LMF SVBHLMF Exhaust	12:21 - 15:36 58.9	12:21 - 15:36 58.9	12:21 - 15:36 58.9	12:21 - 15:36 58.9

All times are Eastern Standard Time.

Table 2.1.2 - Sampling and Analytical Matrix

			EPA TEST METHODS UTILIZED				
			M3A (O <sub>2</sub> & CO <sub>2</sub> )	M6C (SO <sub>2</sub> )	M7E (NO <sub>x</sub> )	M10 (CO)	M25A (TGO)
Date	Run No.	Sampling Location	Sampling Time / Duration (min)	Sampling Time / Duration (min)	Sampling Time / Duration (min)	Sampling Time / Duration (min)	Sampling Time / Duration (min)
2/25/2016	1	EAF/VTD SVBH01 Exhaust	13:40 - 14:55 60	13:40 - 14:55 60	13:40 - 14:55 60	13:40 - 14:55 60	13:40 - 14:55 60
2/26/2016	2	EAF/VTD SVBH01 Exhaust	9:07 - 10:24 60	9:07 - 10:24 60	9:07 - 10:24 60	9:07 - 10:24 60	9:07 - 10:24 60
2/26/2016	3	EAF/VTD SVBH01 Exhaust	12:21 - 15:39 60	12:21 - 15:39 60	12:21 - 15:39 60	12:21 - 15:39 60	12:21 - 15:39 60
2/25/2016	1	LMF SVBHLMF Exhaust	13:40 - 14:59 60	13:40 - 14:59 60	13:40 - 14:59 60	13:40 - 14:59 60	13:40 - 14:59 60
2/26/2016	2	LMF SVBHLMF Exhaust	9:07 - 10:24 60	9:07 - 10:24 60	9:07 - 10:24 60	9:07 - 10:24 60	9:07 - 10:24 60
2/26/2016	3	LMF SVBHLMF Exhaust	12:21 - 15:39 60	12:21 - 15:39 60	12:21 - 15:39 60	12:21 - 15:39 60	12:21 - 15:39 60

All times are Eastern Standard Time.

**Table 2.1.3 - Sampling and Analytical Matrix**

	EAF/VTD SVBH01 Exhaust				LMF SVBHLMF Exhaust			
	Run 1	Run 2	Run 3	Average	Run 1	Run 2	Run 3	Average
Filterable Particulate Matter Emissions (lb/hr)	2.31	0.94	1.71	1.65	1.09	0.55	0.56	0.73
Filterable Particulate Matter Concentration (grains/dscf)	0.00071	0.00028	0.00053	0.00050	0.00046	0.00024	0.00024	0.00032
Lead Emissions (lb/hr)	0.0014	0.00049	0.0010	0.00097	0.00024	0.00011	0.00013	0.00016
Lead Concentration (grains/dscf)	4.35E-07	1.46E-07	3.09E-07	2.97E-07	1.01E-07	4.81E-08	5.83E-08	6.90E-08
Mercury Emissions (lb/hr)	<0.00049	<0.0015	<0.0022	<0.0014	<0.000085	<0.00012	<0.000064	<0.000088
Mercury Concentration (grains/dscf)	1.51E-07	4.53E-07	6.94E-07	4.33E-07	3.58E-08	5.18E-08	2.79E-08	3.85E-08
Maximum Six-Minute Average of Visible Emissions (% opacity)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Stack Gas Average Flow Rate (acfm)	442,810	445,719	431,511	440,013	301,294	277,326	281,119	286,580
Stack Gas Average Flow Rate (scfm)	384,993	399,282	381,834	388,703	278,294	264,698	267,050	270,014
Stack Gas Average Flow Rate (dscfm)	380,287	394,378	376,770	383,812	276,324	263,688	265,815	268,609
Stack Gas Average Velocity (fpm)	4,458	4,487	4,344	4,430	4,607	4,241	4,299	4,382
Stack Gas Average Static Pressure (in-H <sub>2</sub> O)	-1.10	-1.00	-0.92	-1.01	-0.95	-1.32	-1.25	-1.17
Stack Gas Average Temperature (°F)	121	117	126	121	87	82	84	84
Stack Gas Percent by Volume Moisture (%H <sub>2</sub> O)	1.22	1.23	1.33	1.26	0.71	0.38	0.46	0.52
Measured Stack Inner Diameter (in)†	134.8 X 135.1	134.8 X 135.1	134.8 X 135.1	134.8 X 135.1	109.5	109.5	109.5	109.5
Percent by Volume Carbon Dioxide in Stack Gas (%-dry)	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Percent by Volume Oxygen in Stack Gas (%-dry)	20.67	20.83	20.67	20.72	20.50	20.83	20.83	20.72
Percent by Volume Nitrogen in Stack Gas (%-dry)	79.33	79.17	79.33	79.28	79.50	79.17	79.17	79.28

\* The "<" symbol indicates that the pollutant was not present in quantities above the Minimum Detection Limit (MDL) of the analytical method in at least one sample fraction.

† The EAF/VTD SVBH01 Exhaust was elliptical in shape.

Table 2.2.1 - Emission Results

	EAF/VTD SVBH01 Exhaust				LMF SVBHLMF Exhaust			
	Run 1	Run 2	Run 3	Average	Run 1	Run 2	Run 3	Average
PM <sub>2.5</sub> Emissions (lb/hr)*	<11.3	<8.60	<8.65	<9.52	<5.82	<3.20	<5.80	<4.94
PM <sub>2.5</sub> Concentration (gr/dscf)*	<0.00356	<0.00268	<0.00270	<0.00298	<0.00269	<0.00147	<0.00273	<0.00229
PM <sub>10</sub> Emission Rate (lb/hr)*	<11.5	<8.79	<8.84	<9.71	<5.94	<3.33	<5.93	<5.07
PM <sub>10</sub> Concentration (gr/dscf)*	<0.00362	<0.00274	<0.00275	<0.00304	<0.00274	<0.00153	<0.00279	<0.00235
Stack Gas Average Flow Rate (acfm)	435,924	424,397	421,857	427,392	273,626	268,398	262,531	268,185
Stack Gas Average Flow Rate (scfm)	376,898	377,973	379,207	378,026	255,212	255,919	249,538	253,556
Stack Gas Average Flow Rate (dscfm)	370,145	374,426	374,526	373,032	252,980	254,609	248,284	251,958
Stack Gas Average Velocity (fpm)	4,389	4,273	4,247	4,303	4,184	4,104	4,014	4,101
Stack Gas Average Static Pressure (in-H <sub>2</sub> O)	-1.10	-1.00	-1.00	-1.03	-0.85	-1.20	-1.40	-1.15
Stack Gas Average Temperature (°F)	125	121	116	121	82	82	84	83
Stack Gas Percent by Volume Moisture (%H <sub>2</sub> O)	1.79	0.94	1.23	1.32	0.87	0.51	0.50	0.63
Measured Stack Inner Diameter (in)†	134.8 X 135.1	134.8 X 135.1	134.8 X 135.1	134.8 X 135.1	109.5	109.5	109.5	109.5
Percent by Volume Carbon Dioxide in Stack Gas (%-dry)	0.51	0.56	0.52	0.53	0.16	0.26	0.12	0.18
Percent by Volume Oxygen in Stack Gas (%-dry)	20.67	20.63	20.58	20.62	21.05	21.01	21.12	21.06
Percent by Volume Nitrogen in Stack Gas (%-dry)	78.82	78.81	78.90	78.84	78.79	78.73	78.75	78.76

\* The "<" symbol indicates that the pollutant was not present in quantities above the Minimum Detection Limit (MDL) of the analytical method in at least one sample fraction.

† The EAF/VTD SVBH01 Exhaust was elliptical in shape.

Table 2.2.2 - Emission Results



	EAF/VTD SVBH01 Exhaust				LMF SVBHLMF Exhaust			
	Run 1	Run 2	Run 3	Average	Run 1	Run 2	Run 3	Average
Sulfur Dioxide Emissions (lb/hr)*	7.71	10.8	5.62	8.05	<0.87	<1.91	5.27	<2.68
Sulfur Dioxide Concentration (ppmvd)*	2.09	2.89	1.50	2.16	<1.00	<1.00	2.13	<1.38
Nitrogen Oxides Emissions (as NO <sub>2</sub> ) (lb/hr)*	20.9	24.8	25.1	23.6	<1.64	<1.55	<1.42	<1.54
Nitrogen Oxides Concentration (as NO <sub>2</sub> ) (ppmvd)*	7.86	9.23	9.37	8.82	<1.00	<1.00	<1.00	<1.00
Carbon Monoxide Emissions (lb/hr)	110	179	118	136	9.33	22.8	9.47	13.9
Carbon Monoxide Concentration (ppmvd)	68.3	110	72.5	83.5	8.46	20.6	8.74	12.6
Total Gaseous Organic Emissions (lb/hr as propane)	8.36	10.9	7.37	8.87	7.16	10.4	10.5	9.34
Total Gaseous Organic Concentration (ppmvw as propane)	3.23	4.19	2.83	3.42	4.09	5.91	6.11	5.37
Stack Gas Average Flow Rate (acfm)	435,924	424,397	421,857	427,392	273,626	268,398	262,531	268,185
Stack Gas Average Flow Rate (scfm)	376,898	377,973	379,207	378,026	255,212	255,919	249,538	253,556
Stack Gas Average Flow Rate (dscfm)	370,145	374,426	374,526	373,032	252,980	254,609	248,284	251,958
Stack Gas Average Velocity (fpm)	4,389	4,273	4,247	4,303	4,184	4,104	4,014	4,101
Stack Gas Average Static Pressure (in-H <sub>2</sub> O)	-1.10	-1.00	-1.00	-1.03	-0.85	-1.20	-1.40	-1.15
Stack Gas Average Temperature (°F)	125	121	116	121	82	82	84	83
Stack Gas Percent by Volume Moisture (%H <sub>2</sub> O)	1.79	0.94	1.23	1.32	0.87	0.51	0.50	0.63
Measured Stack Inner Diameter (in)†	134.8 X 135.1	134.8 X 135.1	134.8 X 135.1	134.8 X 135.1	109.5	109.5	109.5	109.5
Percent by Volume Carbon Dioxide in Stack Gas (%-dry)	0.51	0.56	0.52	0.53	0.16	0.26	0.12	0.18
Percent by Volume Oxygen in Stack Gas (%-dry)	20.67	20.63	20.58	20.62	21.05	21.01	21.12	21.06
Percent by Volume Nitrogen in Stack Gas (%-dry)	78.82	78.81	78.90	78.84	78.79	78.73	78.75	78.76

\* The "<" symbol indicates that compound was not present in quantities above the Minimum Detection Limit (MDL) of the analytical method.

† The EAF/VTD SVBH01 Exhaust was elliptical in shape.

**Table 2.2.3 - Emission Results**

	Combined EAF/VTD/LMF Exhaust			
	Run 1	Run 2	Run 3	Average
Liquid Steel Produced (ton)*	499	495	496	497
Rate of Liquid Steel Produced (ton/hr)*	93	73	91	86
PM <sub>2.5</sub> Emissions (lb/ton-liquid steel)†	<0.18	<0.16	<0.16	<0.17
PM <sub>2.5</sub> Emissions (lb/hr)†	<17.1	<11.8	<14.5	<14.5
PM <sub>10</sub> Emissions (lb/hr)†	<17.4	<12.1	<14.8	<14.8
Filterable Particulate Matter Emissions (lb/hr)	3.4	1.5	2.3	2.4
Lead Emissions (lb/hr)	0.0017	0.0006	0.0011	0.0011
Mercury Emissions (lb/hr)†	<0.00058	<0.0016	<0.0023	<0.0015
Sulfur Dioxide Emissions (lb/ton-liquid steel)	<0.09	<0.17	<0.12	<0.129
Sulfur Dioxide Emissions (lb/hr)†	<8.6	<12.7	10.9	<10.7
Nitrogen Oxides Emissions (lb/ton liquid steel) (as NO <sub>2</sub> )	<0.24	<0.36	<0.29	<0.298
Nitrogen Oxides Emissions (lb/hr) (as NO <sub>2</sub> )†	<22.5	<26.3	<26.6	<25.1
Carbon Monoxide Emissions (lb/ton-liquid steel)	1.28	2.77	1.41	1.82
Carbon Monoxide Emissions (lb/hr)	120	202	128	150
Total Gaseous Organic Emissions (lb/ton-liquid steel)	0.17	0.29	0.20	0.22
Total Gaseous Organic Emissions (lb/hr as propane)	15.52	21.26	17.84	18.21

\* Process Data provided by Gerdau Monroe Mill personnel.

† The "<" symbol indicates that compound was not present in quantities above the Minimum Detection Limit (MDL) of the analytical method.

**Table 2.2.4 - Combined Emission Results**

Emission Point	Run No.	Date	Sampling Location	Test Run Start Time (hr:min)	Test Run Stop Time (hr:min)	Test Run Duration (min)	Minimum Reading (%-opacity)	Maximum Reading (%-opacity)	Highest Six-Minute Average (%-opacity)
1	1	2/26/2016	EAF Meltshop Roofline	9:07	10:07	60	0.0	15.0	2.92
	2	2/26/2016	EAF Meltshop Roofline	16:51	17:51	60	0.0	0.0	0.0

Date	NDO	Test Run Start Time (hr:min)	Test Run Stop Time (hr:min)	Test Run Duration (min)	Inward Flow Verified with Smoke Bomb (yes/no)
2/26/2016	EAF-Building North Elevation Man Door (East)	10:55	11:00	5	Yes
2/26/2016	EAF-Building North Elevation Man Door (West)	10:55	11:00	5	Yes

All times are Eastern Standard Time.

**Table 2.3 - Visible Emissions Summary and Verification of Inward Flow**

Max 6 min average		2.92
Minimum Reading		0
Maximum Reading		15.00
Start Time	8:10	
End Time	9:10	

Sec.	0	15	30	45	Six minute averages:			
Min.								
0	0	5	10	10	2.92	2.92	2.71	2.29
1	5	15	10	5	1.88	1.67	1.04	0.63
2	5	5	0	0	0.42	0.21	-	-
3	0	0	0	0	-	-	-	-
4	0	0	0	0	-	-	-	-
5	0	0	0	0	-	-	-	-
6	0	0	0	0	-	-	-	-
7	0	0	0	0	-	-	-	-
8	0	0	0	0	-	-	-	-
9	0	0	0	0	-	-	0.21	0.21
10	0	0	0	0	0.42	0.83	1.25	1.46
11	0	0	0	0	1.46	1.46	1.46	1.46
12	0	0	0	0	1.46	1.46	1.46	1.46
13	0	0	0	0	1.46	1.46	1.46	1.46
14	0	0	0	0	1.46	1.67	1.67	1.67
15	0	5	0	5	1.67	1.67	1.46	1.46
16	10	10	5	0	1.25	0.83	0.63	0.42
17	0	0	0	0	0.42	0.42	0.42	0.42
18	0	0	0	0	0.42	0.42	0.42	0.42
19	0	0	0	0	0.42	0.42	0.42	0.42
20	5	0	0	0	0.42	0.21	0.21	0.21
21	0	0	0	0	0.21	0.21	0.21	0.21
22	0	5	0	0	0.21	0.21	-	-
23	0	0	0	0	-	-	-	-
24	0	0	0	0	-	-	-	-
25	0	0	0	0	-	-	-	-
26	0	0	0	0	-	-	-	-
27	0	0	0	0	-	-	-	-
28	0	0	0	0	-	-	-	-
29	0	0	0	0	-	-	-	-
30	0	0	0	0	-	-	-	-
31	0	0	0	0	-	-	-	-
32	0	0	0	0	-	-	-	-
33	0	0	0	0	-	-	-	-
34	0	0	0	0	-	-	-	-
35	0	0	0	0	-	-	-	-
36	0	0	0	0	-	-	-	-
37	0	0	0	0	-	-	-	-
38	0	0	0	0	-	-	-	-
39	0	0	0	0	-	-	-	-
40	0	0	0	0	-	-	-	-
41	0	0	0	0	-	-	-	-
42	0	0	0	0	-	-	-	-
43	0	0	0	0	-	-	-	-
44	0	0	0	0	-	-	-	-
45	0	0	0	0	-	-	-	-
46	0	0	0	0	-	-	-	-
47	0	0	0	0	-	-	-	-
48	0	0	0	0	-	-	-	-
49	0	0	0	0	-	-	-	-
50	0	0	0	0	-	-	-	-
51	0	0	0	0	-	-	-	-
52	0	0	0	0	-	-	-	-
53	0	0	0	0	-	-	-	-
54	0	0	0	0	-	-	-	-
55	0	0	0	0	-	-	-	-
56	0	0	0	0	-	-	-	-
57	0	0	0	0	-	-	-	-
58	0	0	0	0	-	-	-	-
59	0	0	0	0	-	-	-	-

Table 2.4 - Visible Emissions - EAF Meltshop Roofline - Run 1

### 3.0 PLANT AND SAMPLING LOCATION DESCRIPTIONS

#### 3.1 Process Description and Operation

Gerdau is a producer of Special Bar Quality (SBQ) Steel. The steel melting process utilizes Electric Arc Furnace Technology (EAF), a Ladle Metallurgy System (LMF) and Vacuum Tank Degasser (VTD). The EAF is a refractory lined cylindrical vessel made of steel plates and having a bowl-shaped hearth and a dome-shaped roof. Water-cooled panels are used for the shell and roof to reduce refractory costs. Three (3) electrodes, powered by a transformer, are mounted on a superstructure above the furnace and are lowered and raised through ports in the furnace roof. The electrodes convey the energy for melting the steel scrap. Supplemental energy is provided by six (6) oxy-fuel burners. The furnace is mounted on curved rockers, which allow tilting for slagging and bottom tapping.

The EAF melts scrap metal in a batch operation referred to as a heat (each heat is considered a batch operation). The EAF operators primarily follow Standard Operating Procedures (SOPs) to make individual heats and use customized touch screen software to assist them with individual tasks. In addition, there is an arc regulation system, which assist the operators in the steel making process and also minimizes energy consumption. An EAF melting cycle, or heat, consists of three (3) phases: 1. scrap preparation and charging, 2. scrap meltdown, and 3. molten steel tapping. On average, each heat is charged with approximately 134.6 tons of scrap steel, and an average of 9.9 tons of additives alloys and fluxes are also added. Emissions from heat to heat are expected to be relatively consistent. The rated capacity of the process is 850,000 liquid steel tons per year.

The LMF is a complete ladle metallurgy system which includes arc reheating, alloy additions, powder injections, and stirring. The VTD uses mechanical pumps to create a vacuum which removes gases such as O<sub>2</sub> and hydrogen (H<sub>2</sub>) from the molten steel at the LMF/EAF. The EAF, VTD, and LMF were in operation for this test event.

Table 3.1 displays the process data. Figure 3.1 depicts the process and sampling location schematic.

#### 3.2 Control Equipment Description

During this test, emissions from the EAF and VTD were controlled by a direct evacuation control (DEC) unit and the DVBAGHOUSE-01 baghouse, and emissions from the LMF were controlled by the DVLMFBAGHOUSE

The DEC consists of a CO and volatile organic carbon (VOC) combustion chamber, and a water quench system to cool the gases exhausting from the DEC to DVBAGHOUSE-01.

DVBAGHOUSE-01 is a positive pressure baghouse with reverse cleaning to control particulate emissions. The emissions are evacuated using three (3) main exhaust fans and one (1) DEC fan with a single stack emission point where CO and VOC is combusted in a DEC combustion chamber which then vents to DVBAGHOUSE-01. To dispose of the accumulated dust, the reverse air cleaning system of the baghouse utilizes hopper screw conveyors to a pneumatic conveying system to transport the dust into a storage silo. The emissions from the DVBAGHOUSE-01 exhaust to stack SVBH01.

The baghouse that controls LMF emissions, DVLMFBAGHOUSE, utilizes removable covers or decks to control particulate emissions. These covers are located over the ladle while the process is operating. The emissions from the DVLMFBAGHOUSE exhaust to stack SVBHLMF.

### **3.3 Flue Gas Sampling Locations**

#### **3.3.1 EAF/VTD SVBH01 Exhaust**

The EAF/VTD SVBH01 Exhaust was elliptical in shape with measured inner diameters of 134.8-inches and 135.1-inches, was oriented in the vertical plane, and accessed from a permanent platform. Four (4) 6.0-inch I.D. sampling ports were located 90° apart from one another at a location that met EPA Method 1, Section 11.1.1 criteria. Prior to emissions testing, the stack was traversed to verify the absence of cyclonic flow. An average yaw angle of 3.1° was measured. Therefore, the sampling location EPA Method 1, Section 11.4.2 criteria. During emissions sampling the stack was traversed for stack gas volumetric flowrate, dry molecular weight, moisture content, and filterable PM, Pb, Hg, filterable PM<sub>2.5</sub>, filterable PM<sub>10</sub>, condensible PM, O<sub>2</sub>, CO<sub>2</sub>, SO<sub>2</sub>, NO<sub>x</sub>, CO, and TGO concentrations.

#### **3.3.2 LMF SVBHLMF Exhaust**

The LMF SVBHLMF Exhaust had a measured inner diameter of 109.5-inches, was oriented in the vertical plane, and accessed from a permanent platform. One (1) 5.5-inch I.D., one (1) 5.7-inch I.D., one (1) 5.9-inch I.D., and one (1) 5.8-inch I.D. sampling port were each located 90° apart from one another at a location that met EPA Method 1, Section 11.1.1 criteria. Prior to emissions testing, the stack was traversed to verify the absence of cyclonic flow. An average yaw angle of 3.1° was measured. Therefore, the sampling location EPA Method 1, Section 11.4.2 criteria. During emissions sampling the stack was traversed for stack gas volumetric flow rate, dry molecular weight, moisture content, and filterable PM, Pb, Hg, filterable PM<sub>2.5</sub>, filterable PM<sub>10</sub>, condensible PM, O<sub>2</sub>, CO<sub>2</sub>, SO<sub>2</sub>, NO<sub>x</sub>, CO, and TGO concentrations.

Figures 3.2 - 3.4 schematically illustrate the traverse point and sample port locations utilized.

### **3.4 Process Sampling Location**

The EPA Reference Test Methods performed did not specifically require that process samples were to be taken during the performance of this testing event. It is in the best knowledge of Air Compliance Testing that no process samples were obtained and therefore no process sampling location was identified in this report.

Date	Run No.	Emission Unit	Heat No.	Start Time	End Time	Duration (hr)	Production (ton)	Production (ton/hr)
2/25/2016	1	EAF	75062345	9:09	10:10	1.0	128.5	126.4
			75062346	10:41	12:26	1.8	122.7	70.1
			75062347	12:28	13:37	1.2	127.0	109.3
			75062348	14:19	15:45	1.4	121.2	84.6
		LMF	75062343	9:57	11:21	1.4	127.0	90.2
			75062344	11:21	13:31	2.2	121.0	55.7
			75062345	13:31	14:54	1.4	126.0	91.5
			75062346	14:54	16:05	1.2	121.0	101.8
2/26/2016	2	EAF	75062360	6:48	7:57	1.2	117.6	101.1
			75062361	9:20	10:18	1.0	125.3	129.6
			75062362	10:19	11:21	1.0	124.7	120.7
			75062363	11:23	14:59	3.6	127.0	35.3
		LMF	75062358	7:27	9:03	1.6	125.0	78.6
			75062359	9:03	10:18	1.3	127.0	100.7
			75062360	10:18	12:19	2.0	124.0	61.6
			75062361	12:19	15:30	3.2	124.0	39.0
2/26/2016	3	EAF	75062364	15:57	16:44	0.8	124.0	158.3
			75062365	17:15	18:59	1.7	127.5	73.6
			75062366	19:00	19:59	1.0	123.4	126.1
			75062367	20:28	22:27	2.0	121.3	61.2
		LMF	75062363	15:30	16:57	1.5	128.0	88.0
			75062364	16:57	18:40	1.7	123.0	71.3
			75062365	18:40	19:51	1.2	121.0	102.1
			75062366	19:51	21:53	2.0	127.0	62.7

Table 3.1 - EUEAF and EULMF Process Data

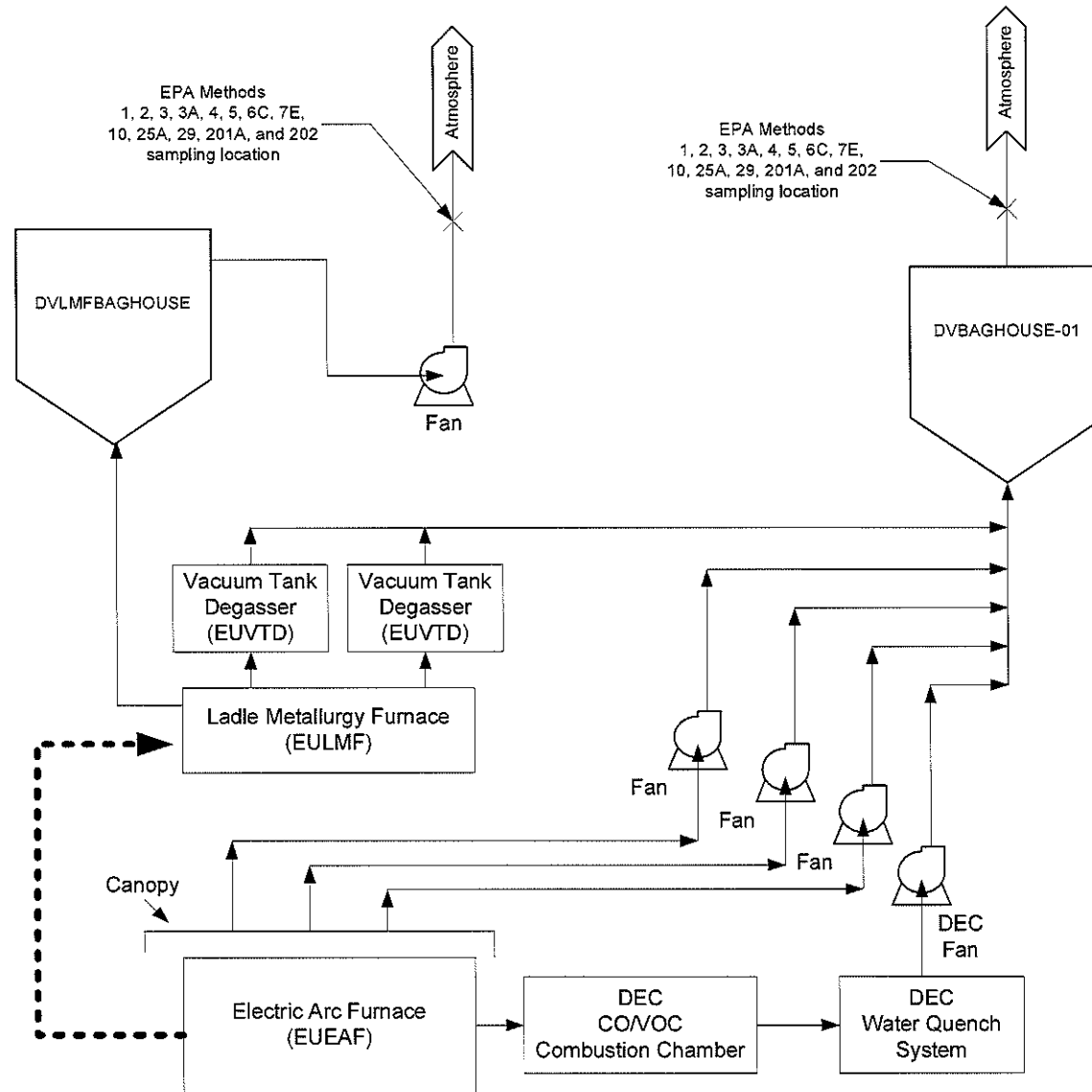


Figure 3.1 - EAF, LMF, and VTD Process and Sampling Location Schematic



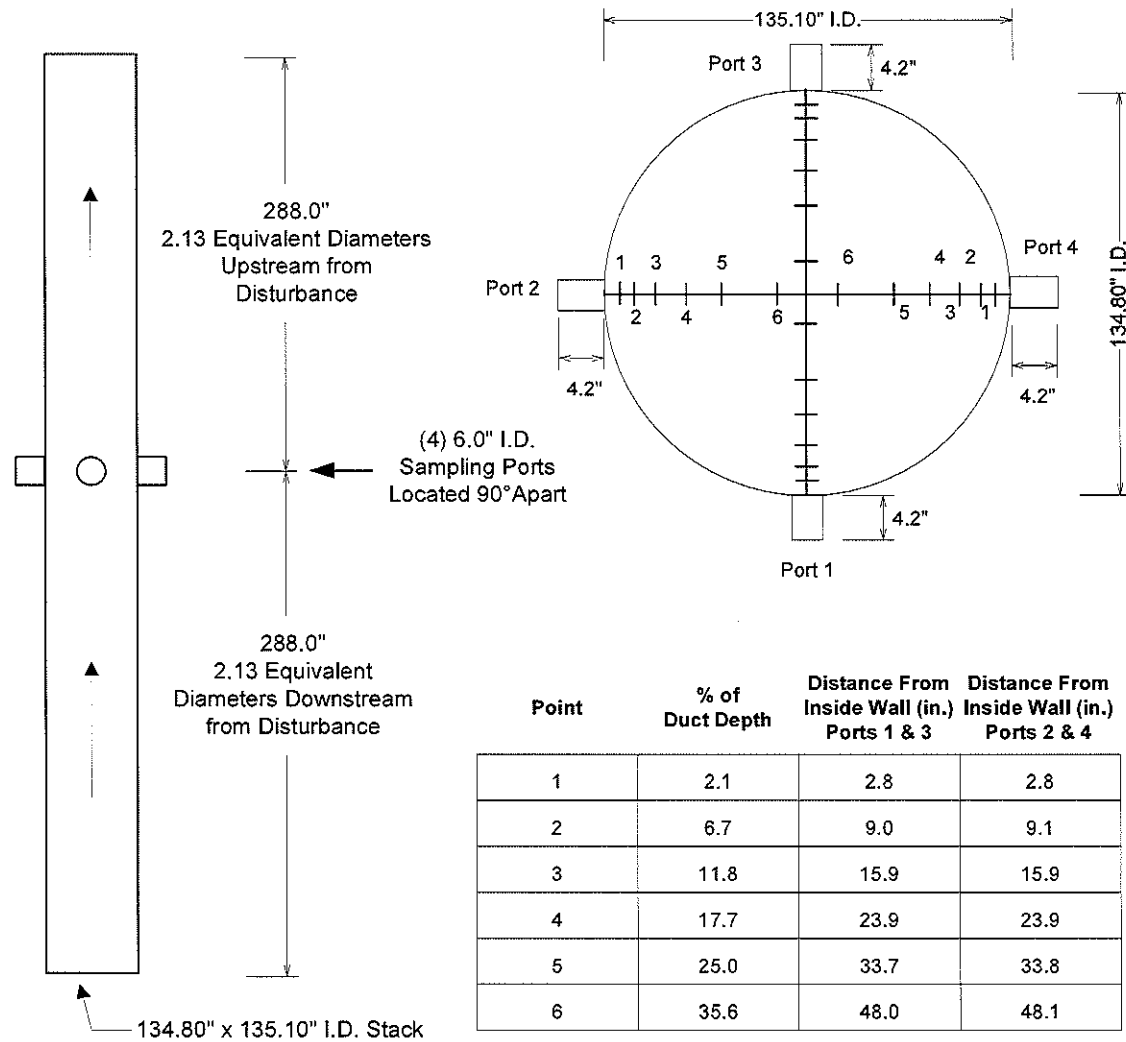


Figure 3.2 - EAF/VTD SVBH01 Exhaust EPA Method 5/29 Traverse Point Location Drawing

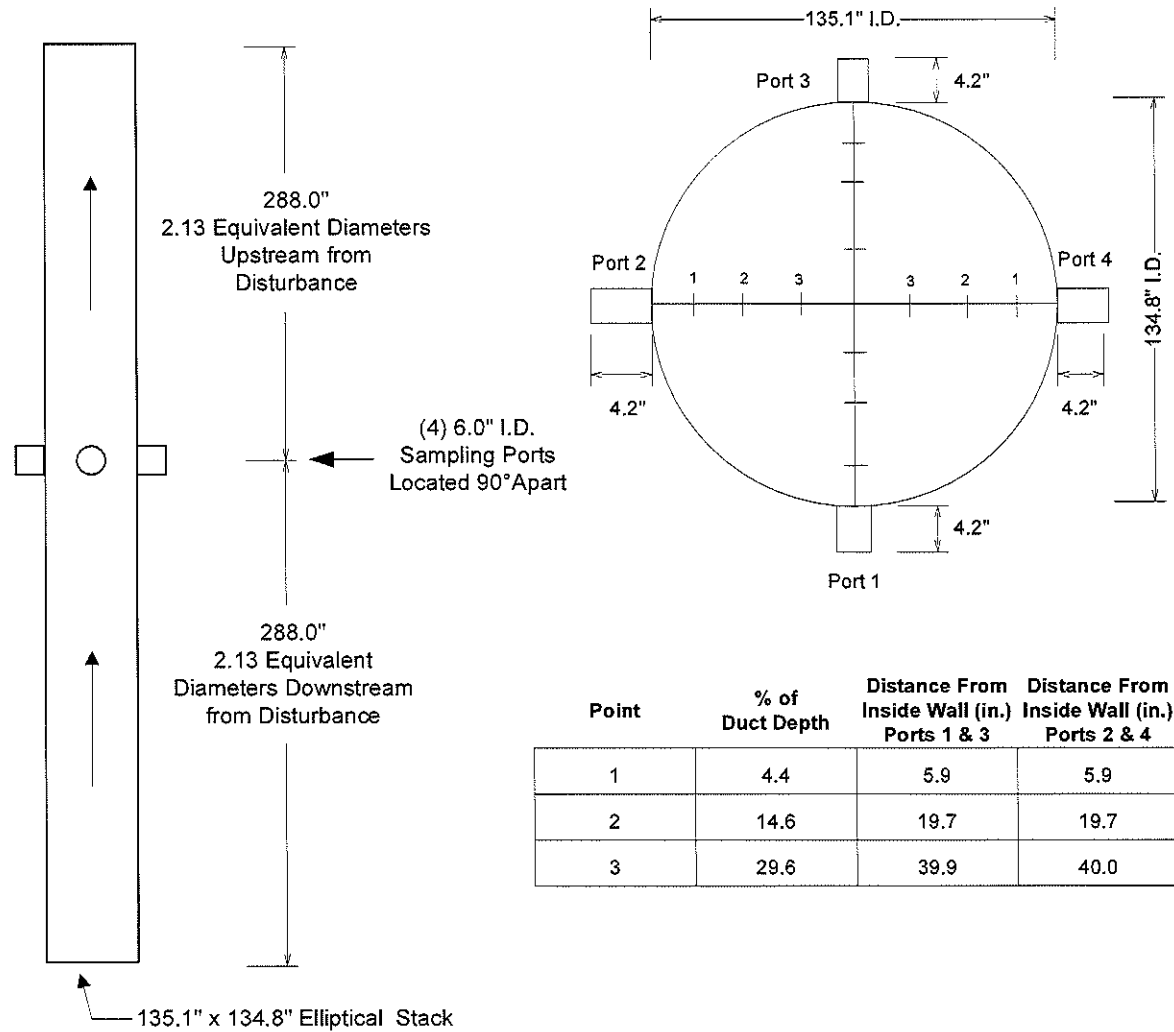


Figure 3.3 - EAF/VTD SVBH01 Exhaust EPA Method 201A Traverse Point Location Drawing

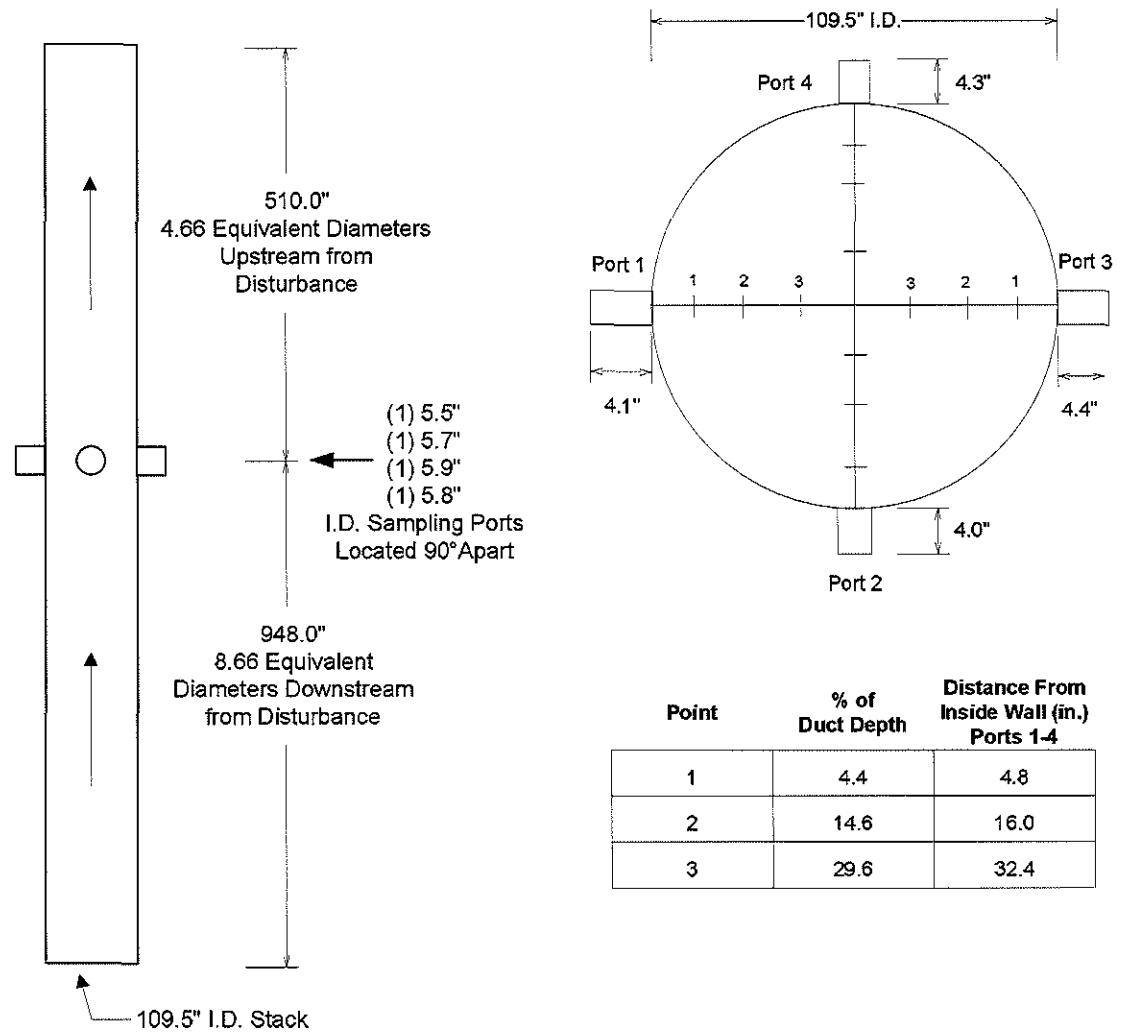


Figure 3.4 - LMF SVBHLMF Exhaust Traverse Point Location Drawing

## 4.0 SAMPLING AND ANALYTICAL PROCEDURES

### 4.1 Test Methods

#### 4.1.1 EPA Method 1: *"Sample and Velocity Traverses for Stationary Sources"*

Principle: 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. This method was utilized in its entirety as per the procedures outlined in 40 CFR Part 60, Appendix A.

#### 4.1.2 EPA Method 2: *"Determination of Stack Gas Velocity and Volumetric Flow Rate (Type S)"*

Principle: 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. This method was utilized in its entirety as per the procedures outlined in 40 CFR Part 60, Appendix A.

#### 4.1.3 EPA Method 3: *"Gas Analysis for the Determination of Dry Molecular Weight"*

Principle: A gas sample is extracted from a stack by one of the following methods: (1) single-point, grab sampling; (2) single-point, integrated sampling; or (3) multi-point, integrated sampling. The gas sample is analyzed for percent CO<sub>2</sub>, percent O<sub>2</sub>, and if necessary, for percent CO. For dry molecular weight determination a Fyrite analyzer is used for the analysis. This method was utilized in its entirety as per the procedures outlined in 40 CFR Part 60, Appendix A.

#### 4.1.4 EPA Method 3A: *"Determination of Oxygen and / or Carbon Dioxide Concentrations in Emissions from Stationary Sources (Instrumental Analyzer Procedure)"*

Principle: A gas sample is continuously extracted from the effluent stream. A portion of the sample stream is conveyed to an instrumental analyzer(s) for determination of O<sub>2</sub> and CO<sub>2</sub> concentration(s). This method was utilized in its entirety as per the procedures outlined in 40 CFR Part 60, Appendix A.

#### 4.1.5 EPA Method 4: *"Determination of Moisture Content in Stack Gases"*

Principle: A gas sample is extracted at a constant rate from the source; moisture is removed from the sample stream and determined either volumetrically or gravimetrically. This method was utilized in its entirety as per the procedures outlined in 40 CFR Part 60, Appendix A.

#### 4.1.6 EPA Method 5: *"Determination of Particulate Emissions from Stationary Sources (Filterable PM only)"*

Principle: Particulate matter is withdrawn isokinetically from the source and collected on a glass fiber filter maintained at a temperature of 120 ± 14°C (248 ± 25°F) or such other temperature as specified by an applicable subpart of the standards or approved by the Administrator for a particular application. The PM mass, which includes any material that condenses at or above the filtration temperature, is determined gravimetrically after the removal of uncombined water. This method was utilized in its entirety as per the procedures outlined in 40 CFR Part 60, Appendix A.

4.1.7 EPA Method 6C: *"Determination of Sulfur Dioxide Emissions from Stationary Sources (Instrumental Analyzer Procedure) (Concentrations assumed less than 10,000 ppm)"*

Principle: A gas sample is continuously extracted from a stack and a portion of the sample is conveyed to an instrumental analyzer for determination of SO<sub>2</sub> gas concentration using an ultraviolet (UV), nondispersive infrared (NDIR) or fluorescence analyzer. This method was utilized in its entirety as per the procedures outlined in 40 CFR Part 60, Appendix A.

4.1.8 EPA Method 7E: *"Determination of Nitrogen Oxides Emissions from Stationary Sources (Instrumental Analyzer Procedure) (Concentrations assumed less than 2,000ppm)"*

Principle: A sample is continuously extracted from the effluent stream; a portion of the sample stream is conveyed to an instrumental chemiluminescent analyzer for determination of NO<sub>x</sub> concentration. Performance specifications and test procedures are provided to ensure reliable data. This method was utilized in its entirety as per the procedures outlined in 40 CFR Part 60, Appendix A.

4.1.9 EPA Method 10: *"Determination of Carbon Monoxide Emissions from Stationary Sources (Concentrations assumed less than 10,000 ppm)"*

Principle: An integrated or continuous gas sample is extracted from a sampling point and analyzed for carbon monoxide (CO) content using a Luft-type nondispersive infrared analyzer (NDIR) or equivalent. This method was utilized in its entirety as per the procedures outlined in 40 CFR Part 60, Appendix A.

4.1.10 EPA Method 25A: *"Determination of Total Gaseous Organic Concentration Using a Flame Ionization Analyzer (Concentrations assumed less than 10,000 ppm, Propane/Nitrogen Calibration Gases)"*

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. This method was utilized in its entirety as per the procedures outlined in 40 CFR Part 60, Appendix A.

4.1.11 EPA Method 29: *"Determination of Metals Emissions from Stationary Sources"*

Principle: A stack sample is withdrawn isokinetically from the source, particulate emissions are collected in the probe and on a heated filter, and gaseous emissions are then collected in an aqueous acidic solution of hydrogen peroxide (analyzed for all metals including Hg) and an aqueous acidic solution of potassium permanganate (analyzed only for Hg). The recovered samples are digested, and appropriate fractions are analyzed for Hg by cold vapor atomic absorption spectroscopy (CVAAS) and for Sb, As, Ba, Be, Cd, Cr, Co, Cu, Pb, Mn, Ni, P, Se, Ag, Tl, and Zn by inductively coupled argon plasma emission spectroscopy (ICAP) or atomic absorption spectroscopy (AAS). Graphite furnace atomic absorption spectroscopy (GFAAS) is used for analysis of Sb, As, Cd, Co, Pb, Se, and Tl if these elements require greater analytical sensitivity than can be obtained by ICAP. Additionally, if desired, the tester may use AAS for analysis of all listed metals if the resulting in-stack method detection limits meet the goal of the testing program. This method was utilized in its entirety as per the procedures outlined in 40 CFR Part 60, Appendix A.

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**4.1.12 EPA Method 201A: "Determination of PM<sub>10</sub> and PM<sub>2.5</sub> Emissions (Constant Sampling Rate Procedure)"**

Principle: A gas sample is extracted at a constant flow rate through an in-stack sizing device, which separates PM greater than PM<sub>10</sub>. Variations from isokinetic sampling conditions are maintained within well-defined limits. The particulate mass is determined gravimetrically after removal of uncombined water. This method was utilized in its entirety as per the procedures outlined in 40 CFR Part 51, Appendix M.

**4.1.13 EPA Method 202: "Determination of Condensible Particulate Emissions from Stationary Sources"**

Principle: The CPM is collected in dry impingers after filterable PM has been collected on a filter maintained as specified in either Method 5 of appendix A-3 to part 60, Method 17 of appendix A-6 to part 60, or Method 201A of appendix M to this part. The organic and aqueous fractions of the impingers and an out-of-stack CPM filter are then taken to dryness and weighed. The total of the impinger fractions and the CPM filter represents the CPM. Compared to the version of Method 202 that was promulgated on December 17, 1991, this method eliminates the use of water as the collection media in impingers and includes the addition of a condenser followed by a water dropout impinger immediately after the final in-stack or heated filter. This method also includes the addition of one modified Greenburg Smith impinger (backup impinger) and a CPM filter following the water dropout impinger. This method was utilized in its entirety as per the procedures outlined in 40 CFR Part 51, Appendix M.

**4.1.14 EPA Method 9: "Visual Determination of the Opacity of Emissions from Stationary Sources"**

Principle: The opacity of emissions from stationary sources is determined visually by a qualified observer. This method was utilized in its entirety as per the procedures outlined in 40 CFR Part 60, Appendix A.

**4.1.15 Modified EPA Method 204: "Criteria for and Verification of a Permanent or Temporary Total Enclosure"**

Principle: An enclosure is evaluated against a set of criteria. If the criteria are met and if all the exhaust gases from the enclosure are ducted to a control device, then the volatile organic compounds (VOC) capture efficiency (CE) is assumed to be 100 percent, and the CE need not be measured. However, if part of the exhaust gas stream is not ducted to a control device, CE must be determined. This method was modified to only verify the air flow through an NDO using a smoke bomb.

The sampling trains utilized during this testing project are depicted in Figures 4.1 - 4.3.

**4.2 Procedures for Obtaining Process Data**

Process data was recorded by Gerdau Monroe Mill personnel utilizing their typical record keeping procedures. Recorded process data was provided to Air Compliance Testing, Inc. personnel at the conclusion of this test event. The process data is located in Tables 2.2.4 and 3.1 and in the Process Data section of the Appendix.

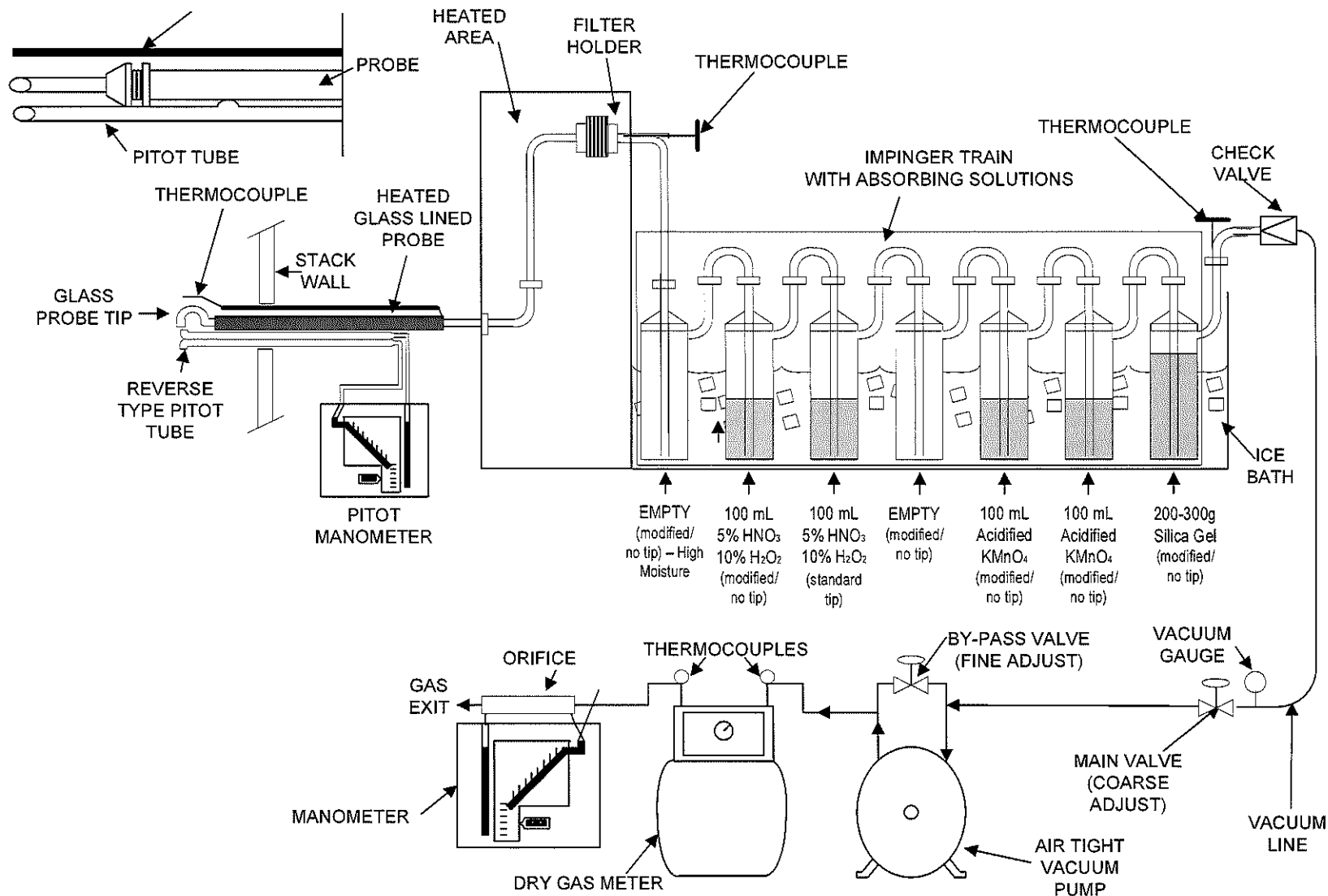


Figure 4.1 - EPA Method 5/29 Sampling Train Schematic

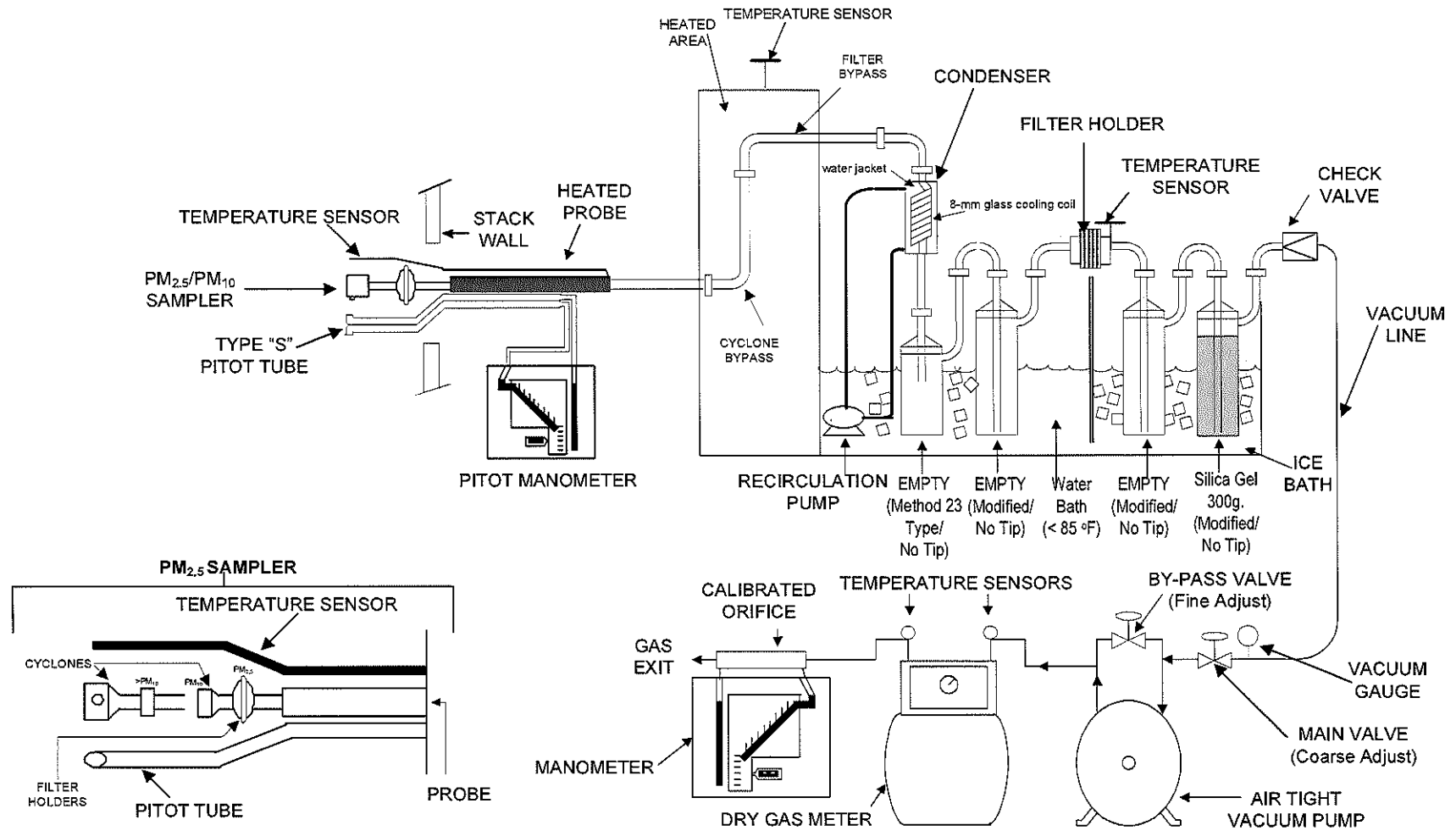


Figure 4.2 - EPA Method 201A/202 Sampling Train Schematic



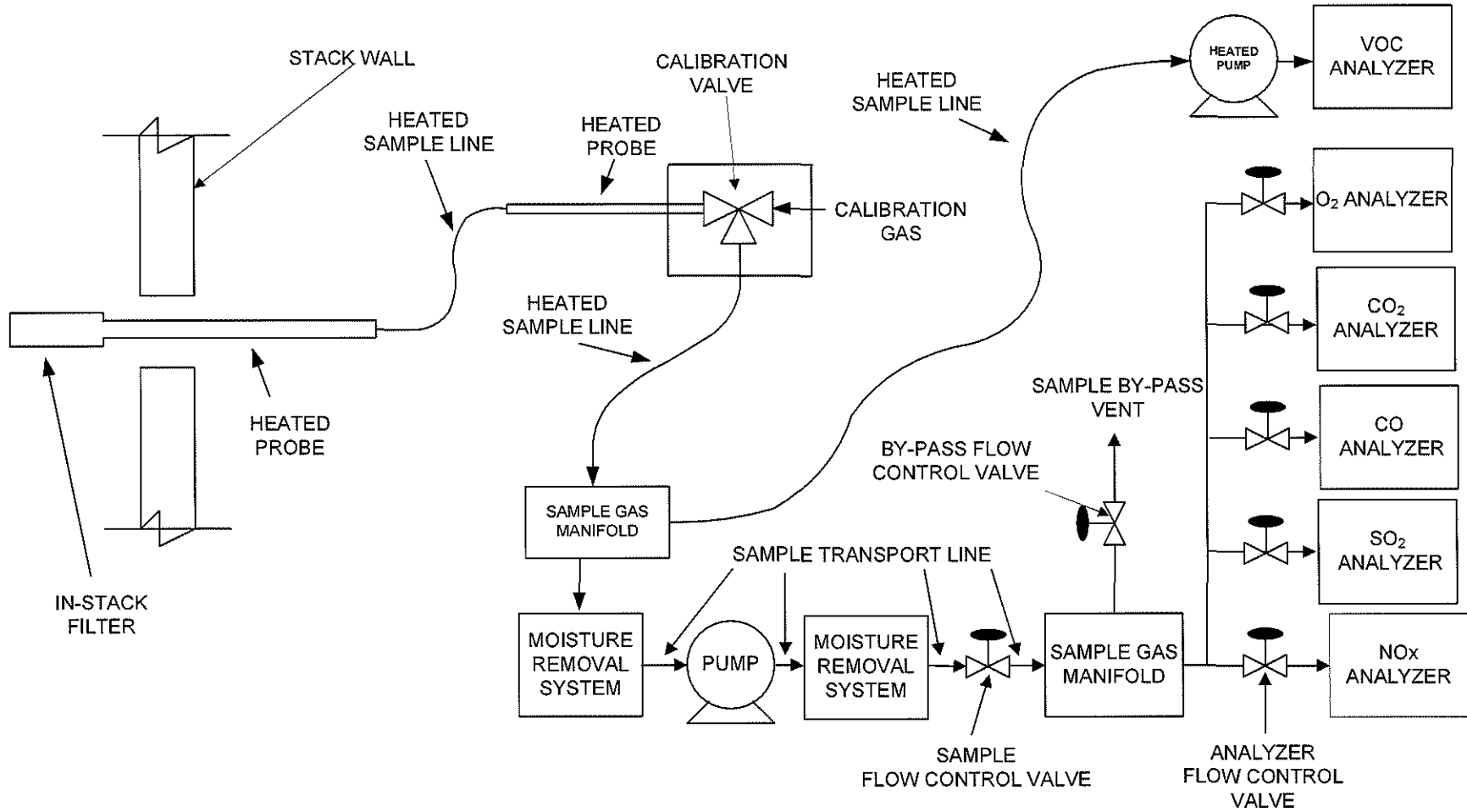


Figure 4.3 - EPA CEMS Sampling Train Schematic