Report of...

ROP Compliance Emission Sampling

Performed for...

Metal Technologies, Inc.
Auburn, Indiana

At the...

Ravenna Ductile Iron Plant
Ravenna, Michigan

On...

Various Sources

RECEIVED
APR 0 8 2015
AIR QUALITY DIV.

February 10-13, 2015

Project #: 187.04

Performed by...

Network Environmental, Inc.
Grand Rapids, MI

RECEIVED

APR 08 2015

AIR QUALITY DIV.

DEQ

MICHIGAN DEPARTMENT OF ENVIRONMENTAL QUALITY
AIR QUALITY DIVISION

RENEWABLE OPERATING PERMIT REPORT CERTIFICATION

Authorized by 1994 P.A. 451, as amended. Failure to provide this information may result in civil and/or criminal penalties.

Reports submitted pursuant to R 336.1213 (Rule 213), subrules (3)(c) and/or (4)(c), of Michigan's Renewable Operating Permit (ROP) program must be certified by a responsible official. Additional information regarding the reports and documentation listed below must be kept on file for at least 5 years, as specified in Rule 213(3)(b)(ii), and be made available to the Department of Environmental Quality, Air Quality Division upon request.

Source Name Metal Technologies, Inc. - Ravenna Ductile Iron County Muskegon

Source Address 3800 Adams Rd City Ravenna

AQD Source ID (SRN) N5866 ROP No N5866-2014 ROP Section No C & D

Please check the appropriate box(es):

☐ **Annual Compliance Certification (Pursuant to Rule 213(4)(c))**

Reporting period (provide inclusive dates) From ______ To ______

☐ 1. During the entire reporting period, this source was in compliance with ALL terms and conditions contained in the ROP, each term and condition of which is identified and included by this reference. The method(s) used to determine compliance is/are the method(s) specified in the ROP.

☐ 2. During the entire reporting period this source was in compliance with all terms and conditions contained in the ROP, each term and condition of which is identified and included by this reference, **EXCEPT** for the deviations identified on the enclosed deviation report(s). The method used to determine compliance for each term and condition is the method specified in the ROP, unless otherwise indicated and described on the enclosed deviation report(s).

☐ **Semi-Annual (or More Frequent) Report Certification (Pursuant to Rule 213(3)(c))**

Reporting period (provide inclusive dates) From ______ To ______

☐ 1. During the entire reporting period, ALL monitoring and associated recordkeeping requirements in the ROP were met and no deviations from these requirements or any other terms or conditions occurred.

☐ 2. During the entire reporting period, all monitoring and associated recordkeeping requirements in the ROP were met and no deviations from these requirements or any other terms or conditions occurred, **EXCEPT** for the deviations identified on the enclosed deviation report(s).

☒ **Other Report Certification**

Reporting period (provide inclusive dates): From ______ To ______

Additional monitoring reports or other applicable documents required by the ROP are attached as described:

Testing was conducted in accordance with the approved test plan and the facility operating conditions were in compliance with permit requirements or were at the maximum routine operating conditions for the facility.

I certify that, based on information and belief formed after reasonable inquiry, the statements and information in this report and the supporting enclosures are true, accurate and complete

Dean Lynn — Name of Responsible Official (print or type)

Plant Manager — Title

231-853-0289 — Phone Number

Signature of Responsible Official

4/6/15 — Date

* Photocopy this form as needed.

EQP 5736 (Rev 11-04)

I. INTRODUCTION

Network Environmental, Inc. was retained by Metal Technologies, Inc. of Auburn, Indiana to conduct emission sampling at their Ravenna Ductile Iron Plant, located in Ravenna, Michigan. The purpose of the sampling was to meet the testing requirements of the State of Michigan Renewable Operating Permit (ROP) No. MI-ROP-N5866-2014.

The following is a list of the sources that were sampled and the emission limits for each source:

Source	Compound(s) Sampled	Emission Limit(s)
FG-SAND	Particulate, Carbon Monoxide (CO), Benzene, Formaldehyde, Arsenic (As), Cadmium (Cd), Chromium (Cr) & Manganese (Mn)	**Particulate:** 0.01 Lbs/1000 Lbs, Dry, 6.0 Lbs/Hr & 26.3 Tons/Year; **CO:** 98.5 Lbs/Hr & 270 Tons/Year; **Benzene:** 0.77 Lbs/Hr & 2.2 Tons/Year; **Formaldehyde:** 0.12 Lbs/Hr & 0.32 Tons/Year; **As:** 0.0002 Lbs/Hr & 0.00034 Tons/Year; **Cd:** 0.00037 Lbs/Hr & 0.0006 Tons/Year; **Cr:** 0.002 Lbs/Hr & 0.0046 Tons/Year; **Mn:** 0.003 Lbs/Hr & 0.006 Tons/Year
EU-CLEAN	Particulate	**Particulate:** 0.01 Lbs/1000 Lbs, Dry, 2.2 Lbs/Hr & 9.6 Tons/Year
FG-MELTING	Particulate, Total Hydrocarbons (VOC), Carbon Monoxide (CO), Oxides of Nitrogen (NO_x), Benzene, Formaldehyde, Arsenic (As), Cadmium (Cd), Chromium (Cr), Manganese (Mn) & Lead (Pb)	**Particulate:** 0.01 Lbs/1000 Lbs, Dry, 2.5 Lbs/Hr & 10.95 Tons/Year; **VOC:** 4.4 Lbs/Hr & 10.8 Tons/Year; **CO:** 15.1 Lbs/Hr & 42.8 Tons/Year; **NO_x:** 3.1 Lbs/Hr & 13.2 Tons/Year **Benzene:** 0.07 Lbs/Hr & 0.19 Tons/Year; **Formaldehyde:** 0.022 Lbs/Hr & 0.06 Tons/Year; **As:** 0.00044 Lbs/Hr & 0.0011 Tons/Year; **Cd:** 0.00035 Lbs/Hr & 0.00086 Tons/Year; **Cr:** 0.00078 Lbs/Hr & 0.002 Tons/Year; **Mn:** 0.0042 Lbs/Hr, & 0.010 Tons/Year; **Pb:** 0.07 Lbs/Hr & 0.16 Tons/Year

- FG-MELTING consists of two (2) exhaust stacks; East Innoculation & West Melt. These exhausts were sampled simultaneously in order to determine the FG-MELTING emissions.

The sampling in the study was conducted over the period of February 10-13, 2015 by Stephan K. Byrd, R. Scott Cargill, Richard D. Eerdmans and David D. Engelhardt of Network Environmental, Inc.. Assisting with the study were Mr. Dan Plant of Metal Technologies, Inc. and the operating staff of the facility. Mr. Eric Grinstern and Mr. Jeremy Howe of the MDEQ – Air Quality Division were present to observe the sampling and source operation.

II. PRESENTATION OF RESULTS

II.1 TABLE 1
PARTICULATE EMISSION RESULTS
RAVENNA DUCTILE IRON
RAVENNA, MICHIGAN

Source	Sample	Date	Time	Air Flow Rate(1) DSCFM	Concentration(2) Lbs/1000 Lbs, Dry	Mass Emission Rate(3) Lbs/Hr
FG-Sand	1	2/10/15	09:52-11:17	107,268	0.0075	3.58
	2	2/10/15	12:09-13:30	106,052	0.0091	4.29
	3	2/10/15	14:30-15:59	106,302	0.0084	4.01
	Average			**106,541**	**0.0083**	**3.96**
EU-Clean	1	2/11/15	09:42-10:59	56,783	0.00075	0.19
	2	2/11/15	12:17-13:34	54,924	0.00110	0.27
	3	2/11/15	14:00-15:15	54,883	0.00094	0.23
	Average			**55,530**	**0.00093**	**0.23**
FG-Melting East Innoculation	1	2/12/15	11:35-12:56	61,619	0.00022	0.060
	2	2/12/15	15:02-16:23	62,370	0.00054	0.151
	3	2/12/15	17:32-18:49	60,264	0.00022	0.060
	Average			**61,418**	**0.00033**	**0.090**
FG-Melting West Melt	1	2/12/15	11:35-12:56	69,078	0.00066	0.20
	2	2/12/15	15:02-16:23	72,532	0.00057	0.19
	3	2/12/15	17:32-18:49	73,980	0.00079	0.26
	Average			**71,863**	**0.00067**	**0.22**
FG-Melting Combined East & West Exhausts	1	2/12/15	11:35-12:56	130,697	0.00045	0.26
	2	2/12/15	15:02-16:23	134,902	0.00056	0.34
	3	2/12/15	17:32-18:49	134,244	0.00053	0.32
	Average			**133,281**	**0.00051**	**0.31**

(1) DSCFM = Dry Standard Cubic Feet Per Minute where STP = 68 °F and 29.92 in. Hg
(2) Lbs/1000 Lbs, Dry = Pounds of Particulate Per Thousand Pounds of Exhaust Gas on a Dry Basis
(3) Lbs/Hr = Pounds of Particulate Per Hour

II.2 TABLE 2
TOTAL HYDROCARBON (VOC) EMISSION RESULTS
RAVENNA DUCTILE IRON
RAVENNA, MICHIGAN

Source	Sample	Date	Time	Air Flow Rate(1) SCFM	Concentration(2) PPM	Mass Emission Rate(3) Lbs/Hr
FG-Melting East Innoculation	1	2/12/15	11:36-12:51	61,941	2.6	1.10
	2	2/12/15	14:35-15:40	62,692	2.5	1.07
	3	2/12/15	15:57-16:57	60,638	2.7	1.12
	Average			**61,757**	**2.6**	**1.10**
FG-Melting West Melt	1	2/12/15	11:36-12:51	69,473	2.8	1.33
	2	2/12/15	14:35-15:40	72,930	2.3	1.15
	3	2/12/15	15:57-16:57	74,379	2.4	1.22
	Average			**72,261**	**2.5**	**1.23**
FG-Melting Combined East & West Exhausts	1	2/12/15	11:36-12:51	131,414	2.7	2.43
	2	2/12/15	14:35-15:40	135,622	2.4	2.22
	3	2/12/15	15:57-16:57	135,017	2.5	2.34
	Average			**134,018**	**2.5**	**2.33**

(1) SCFM = Standard Cubic Feet Per Minute where STP = 68 °F and 29.92 in. Hg
(2) PPM = Parts Per Million (v/v) On An Actual (Wet) Basis As Propane
(3) Lbs/Hr = Pounds of VOC Per Hour As Propane

II.3 TABLE 3
CARBON MONOXIDE (CO) EMISSION RESULTS
RAVENNA DUCTILE IRON
RAVENNA, MICHIGAN

Source	Sample	Date	Time	Air Flow Rate[1] DSCFM	Concentration[2] PPM	Mass Emission Rate[3] Lbs/Hr
FG-Sand	1	2/10/15	09:51-11:09	107,268	84.2	39.27
	2	2/10/15	11:38-13:22	106,052	63.4	29.24
	3	2/10/15	13:35-14:35	106,302	63.8	29.49
	Average			**106,541**	**70.5**	**32.67**
FG-Melting East Innoculation	1	2/13/15	10:16-11:16	61,353	6.5	1.73
	2	2/13/15	13:00-14:00	60,600	6.6	1.74
	3	2/13/15	14:25-15:25	62,130	7.5	2.03
	Average			**61,361**	**6.9**	**1.83**
FG-Melting West Melt	1	2/13/15	10:16-11:16	68,523	13.0	3.87
	2	2/13/15	13:00-14:00	72,901	12.0	3.80
	3	2/13/15	14:25-15:25	70,451	18.7	5.73
	Average			**70,625**	**14.6**	**4.47**
FG-Melting Combined East & West Exhausts	1	2/13/15	10:16-11:16	129,876	9.9	5.60
	2	2/13/15	13:00-14:00	133,501	9.5	5.54
	3	2/13/15	14:25-15:25	132,581	13.5	7.76
	Average			**131,986**	**11.0**	**6.30**

(1) DSCFM = Dry Standard Cubic Feet Per Minute where STP = 68 °F and 29.92 in. Hg
(2) PPM = Parts Per Million (v/v) On A Dry Basis
(3) Lbs/Hr = Pounds of CO Per Hour

II.4 TABLE 4
OXIDES OF NITROGEN (NO_x) EMISSION RESULTS
RAVENNA DUCTILE IRON
RAVENNA, MICHIGAN

Source	Sample	Date	Time	Air Flow Rate[1] DSCFM	Concentration[2] PPM	Mass Emission Rate[3] Lbs/Hr
FG-Melting East Innoculation	1	2/13/15	10:16-11:16	61,353	1.0	0.44
	2	2/13/15	13:00-14:00	60,600	1.6	0.69
	3	2/13/15	14:25-15:25	62,130	1.6	0.71
	Average			**61,361**	**1.4**	**0.61**
FG-Melting West Melt	1	2/13/15	10:16-11:16	68,523	1.7	0.83
	2	2/13/15	13:00-14:00	72,901	1.4	0.73
	3	2/13/15	14:25-15:25	70,451	1.8	0.91
	Average			**70,625**	**1.6**	**0.82**
FG-Melting Combined East & West Exhausts	1	2/13/15	10:16-11:16	129,876	1.4	1.27
	2	2/13/15	13:00-14:00	133,501	1.5	1.42
	3	2/13/15	14:25-15:25	132,581	1.7	1.62
	Average			**131,986**	**1.5**	**1.44**

(1) DSCFM = Dry Standard Cubic Feet Per Minute where STP = 68 °F and 29.92 in. Hg
(2) PPM = Parts Per Million (v/v) On A Dry Basis
(3) Lbs/Hr = Pounds of NO_x Per Hour

II.5 TABLE 5
BENZENE EMISSION RESULTS
RAVENNA DUCTILE IRON
RAVENNA, MICHIGAN

Source	Sample	Date	Time	Air Flow Rate[1] DSCFM	Concentration[2] Mg/M^3	Mass Emission Rate[3] Lbs/Hr
FG-Sand	1	2/10/15	11:10-12:10	107,268	1.74	0.70
	2	2/10/15	13:05-14:05	106,052	1.17	0.46
	3	2/10/15	15:17-16:17	106,302	1.86	0.74
	Average			**106,541**	**1.59**	**0.63**
FG-Melting East Innoculation	1	2/13/15	08:40-09:40	61,353	0.060	0.014
	2	2/13/15	10:41-11:41	60,600	0.066	0.015
	3	2/13/15	12:29-13:29	62,130	0.058	0.014
	Average			**61,361**	**0.062**	**0.014**
FG-Melting West Melt	1	2/13/15	08:40-09:40	68,523	0.070	0.018
	2	2/13/15	10:41-11:41	72,901	0.084	0.023
	3	2/13/15	12:29-13:29	70,451	0.071	0.019
	Average			**70,625**	**0.075**	**0.020**
FG-Melting Combined East & West Exhausts	1	2/13/15	08:40-09:40	129,876	0.065	0.032
	2	2/13/15	10:41-11:41	133,501	0.076	0.038
	3	2/13/15	12:29-13:29	132,581	0.065	0.033
	Average			**131,986**	**0.069**	**0.034**

(1) DSCFM = Dry Standard Cubic Feet Per Minute where STP = 68 °F and 29.92 in. Hg
(2) Mg/M^3 = Milligrams Per Dry Standard Cubic Meter
(3) Lbs/Hr = Pounds of Benzene Per Hour

II.6 TABLE 6
FORMALDEHYDE EMISSION RESULTS
RAVENNA DUCTILE IRON
RAVENNA, MICHIGAN

Source	Sample	Date	Time	Air Flow Rate(1) DSCFM	Concentration(2) Mg/M^3	Mass Emission Rate(3) Lbs/Hr
FG-Sand	1	2/10/15	16:39-17:39	106,937	N.D.(4)	N.D.(4)
	2	2/11/15	10:46-11:46	106,953	N.D.(4)	N.D.(4)
	3	2/11/15	11:51-12:51	106,931	0.153	0.061
	Average			**106,940**	**0.084**	**0.034**
FG-Melting East Innoculation	1	2/13/15	14:42-15:42	58,999	N.D.(4)	N.D.(4)
	2	2/13/15	16:50-17:50	61,159	N.D.(4)	N.D.(4)
	3	2/13/15	18:04-19:04	60,003	N.D.(4)	N.D.(4)
	Average			**60,054**	**----**	**----**
FG-Melting West Melt	1	2/13/15	14:42-15:42	70,775	0.232	0.061
	2	2/13/15	16:50-17:50	70,367	0.166	0.044
	3	2/13/15	18:04-19:04	71,525	0.134	0.036
	Average			**70,889**	**0.177**	**0.047**
FG-Melting Combined East & West Exhausts	1	2/13/15	14:42-15:42	129,774	0.150	0.073
	2	2/13/15	16:50-17:50	131,526	0.113	0.056
	3	2/13/15	18:04-19:04	131,528	0.096	0.048
	Average			**130,943**	**0.120**	**0.059**

(1) DSCFM = Dry Standard Cubic Feet Per Minute where STP = 68 °F and 29.92 in. Hg
(2) Mg/M^3 = Milligrams Per Dry Standard Cubic Meter
(3) Lbs/Hr = Pounds of Formaldehyde Per Hour
(4) N.D. = Non Detected at detection limits of 0.050 Mg/M^3 & 0.020 Lbs/Hr the FG-Sand and 0.051 Mg/M^3 & 0.012 Lbs/Hr for the East Innoculation. The detection limit values were used in calculating the FG-Sand averages. The East Innoculation detection limit values were used when calculating the combined FG-Melting results.

II.7 TABLE 7
ARSENIC (As) EMISSION RESULTS
RAVENNA DUCTILE IRON
RAVENNA, MICHIGAN

Source	Sample	Date	Time	Air Flow Rate(1) DSCFM	Concentration(2) Mg/M^3	Mass Emission Rate(3) Lbs/Hr
FG-Sand	1	2/10/15	09:52-11:17	107,268	N.D.(4)	N.D.(4)
	2	2/10/15	12:09-13:30	106,052	N.D.(4)	N.D.(4)
	3	2/10/15	14:30-15:59	106,302	N.D.(4)	N.D.(4)
	Average			**106,541**	----	----
FG-Melting East Innoculation	1	2/12/15	11:35-12:56	61,619	N.D.(4)	N.D.(4)
	2	2/12/15	15:02-16:23	62,370	N.D.(4)	N.D.(4)
	3	2/12/15	17:32-18:49	60,264	N.D.(4)	N.D.(4)
	Average			**61,418**	----	----
FG-Melting West Melt	1	2/12/15	11:35-12:56	69,078	N.D.(4)	N.D.(4)
	2	2/12/15	15:02-16:23	72,532	N.D.(4)	N.D.(4)
	3	2/12/15	17:32-18:49	73,980	N.D.(4)	N.D.(4)
	Average			**71,863**	----	----
FG-Melting Combined East & West Exhausts	1	2/12/15	11:35-12:56	130,697	N.D.(4)	N.D.(4)
	2	2/12/15	15:02-16:23	134,902	N.D.(4)	N.D.(4)
	3	2/12/15	17:32-18:49	134,244	N.D.(4)	N.D.(4)
	Average			**133,281**	----	----

(1) DSCFM = Dry Standard Cubic Feet Per Minute where STP = 68 °F and 29.92 in. Hg
(2) Mg/M^3 = Milligrams Per Dry Standard Cubic Meter
(3) Lbs/Hr = Pounds of Arsenic Per Hour
(4) N.D. = Non Detected with detection limits of 0.00016 Mg/M^3 & 0.000066 Lbs/Hr for the FG-Sand, 0.00013 Mg/M^3 & 0.000030 Lbs/Hr for the East Innoculation, 0.00014 Mg/M^3 & 0.000037 Lbs/Hr for the West Melt and 0.00014 Mg/M^3 & 0.000067 Lbs/Hr for the Combined Melt Exhausts.

II.8 TABLE 8
CADMIUM (Cd) EMISSION RESULTS
RAVENNA DUCTILE IRON
RAVENNA, MICHIGAN

Source	Sample	Date	Time	Air Flow Rate(1) DSCFM	Concentration(2) Mg/M^3	Mass Emission Rate(3) Lbs/Hr
FG-Sand	1	2/10/15	09:52-11:17	107,268	0.00026	0.00011
	2	2/10/15	12:09-13:30	106,052	0.00027	0.00011
	3	2/10/15	14:30-15:59	106,302	0.00028	0.00011
	Average			**106,541**	**0.00027**	**0.00011**
FG-Melting East Innoculation	1	2/12/15	11:35-12:56	61,619	0.00055	0.00013
	2	2/12/15	15:02-16:23	62,370	0.00072	0.00017
	3	2/12/15	17:32-18:49	60,264	0.00031	0.00007
	Average			**61,418**	**0.00053**	**0.00012**
FG-Melting West Melt	1	2/12/15	11:35-12:56	69,078	0.00025	0.00007
	2	2/12/15	15:02-16:23	72,532	0.00039	0.00011
	3	2/12/15	17:32-18:49	73,980	0.00059	0.00016
	Average			**71,863**	**0.00041**	**0.00011**
FG-Melting Combined East & West Exhausts	1	2/12/15	11:35-12:56	130,697	0.00039	0.00020
	2	2/12/15	15:02-16:23	134,902	0.00054	0.00028
	3	2/12/15	17:32-18:49	134,244	0.00046	0.00023
	Average			**133,281**	**0.00046**	**0.00023**

(1) DSCFM = Dry Standard Cubic Feet Per Minute where STP = 68 °F and 29.92 in. Hg
(2) Mg/M^3 = Milligrams Per Dry Standard Cubic Meter
(3) Lbs/Hr = Pounds of Cadmium Per Hour

II.9 TABLE 9
TOTAL CHROMIUM (Cr) EMISSION RESULTS
RAVENNA DUCTILE IRON
RAVENNA, MICHIGAN

Source	Sample	Date	Time	Air Flow Rate(1) DSCFM	Concentration(2) Mg/M^3	Mass Emission Rate(3) Lbs/Hr
FG-Sand	1	2/10/15	09:52-11:17	107,268	0.0056	0.0022
	2	2/10/15	12:09-13:30	106,052	0.0032	0.0013
	3	2/10/15	14:30-15:59	106,302	0.0021	0.0009
	Average			**106,541**	**0.0036**	**0.0014**
FG-Melting East Innoculation	1	2/12/15	11:35-12:56	61,619	0.0009	0.00022
	2	2/12/15	15:02-16:23	62,370	0.0024	0.00055
	3	2/12/15	17:32-18:49	60,264	0.0013	0.00029
	Average			**61,418**	**0.0015**	**0.00035**
FG-Melting West Melt	1	2/12/15	11:35-12:56	69,078	0.0019	0.00049
	2	2/12/15	15:02-16:23	72,532	0.0013	0.00034
	3	2/12/15	17:32-18:49	73,980	0.0011	0.00031
	Average			**71,863**	**0.0014**	**0.00038**
FG-Melting Combined East & West Exhausts	1	2/12/15	11:35-12:56	130,697	0.0014	0.00071
	2	2/12/15	15:02-16:23	134,902	0.0018	0.00089
	3	2/12/15	17:32-18:49	134,244	0.0012	0.00060
	Average			**133,281**	**0.0015**	**0.00073**

(1) DSCFM = Dry Standard Cubic Feet Per Minute where STP = 68 °F and 29.92 in. Hg
(2) Mg/M^3 = Milligrams Per Dry Standard Cubic Meter
(3) Lbs/Hr = Pounds of Chromium Per Hour

II.10 TABLE 10
MANGANESE (Mn) EMISSION RESULTS
RAVENNA DUCTILE IRON
RAVENNA, MICHIGAN

Source	Sample	Date	Time	Air Flow Rate(1) DSCFM	Concentration(2) Mg/M^3	Mass Emission Rate(3) Lbs/Hr
FG-Sand	1	2/10/15	09:52-11:17	107,268	0.0066	0.0027
	2	2/10/15	12:09-13:30	106,052	0.0046	0.0018
	3	2/10/15	14:30-15:59	106,302	0.0040	0.0016
	Average			**106,541**	**0.0051**	**0.0020**
FG-Melting East Innoculation	1	2/12/15	11:35-12:56	61,619	0.0006	0.00014
	2	2/12/15	15:02-16:23	62,370	0.0025	0.00058
	3	2/12/15	17:32-18:49	60,264	0.0004	0.00009
	Average			**61,418**	**0.0012**	**0.00027**
FG-Melting West Melt	1	2/12/15	11:35-12:56	69,078	0.0052	0.0014
	2	2/12/15	15:02-16:23	72,532	0.0040	0.0011
	3	2/12/15	17:32-18:49	73,980	0.0072	0.0020
	Average			**71,863**	**0.0055**	**0.0015**
FG-Melting Combined East & West Exhausts	1	2/12/15	11:35-12:56	130,697	0.0030	0.0015
	2	2/12/15	15:02-16:23	134,902	0.0033	0.0017
	3	2/12/15	17:32-18:49	134,244	0.0041	0.0021
	Average			**133,281**	**0.0035**	**0.0018**

(1) DSCFM = Dry Standard Cubic Feet Per Minute where STP = 68 °F and 29.92 in. Hg
(2) Mg/M^3 = Milligrams Per Dry Standard Cubic Meter
(3) Lbs/Hr = Pounds of Manganese Per Hour

II.11 TABLE 11
LEAD (Pb) EMISSION RESULTS
RAVENNA DUCTILE IRON
RAVENNA, MICHIGAN

Source	Sample	Date	Time	Air Flow Rate⁽¹⁾ DSCFM	Concentration⁽²⁾ Mg/M³	Mass Emission Rate⁽³⁾ Lbs/Hr
FG-Melting East Innoculation	1	2/12/15	11:35-12:56	61,619	0.0021	0.00047
	2	2/12/15	15:02-16:23	62,370	0.0025	0.00058
	3	2/12/15	17:32-18:49	60,264	0.0008	0.00019
	Average			**61,418**	**0.0018**	**0.00041**
FG-Melting West Melt	1	2/12/15	11:35-12:56	69,078	0.0031	0.00080
	2	2/12/15	15:02-16:23	72,532	0.0019	0.00052
	3	2/12/15	17:32-18:49	73,980	0.0032	0.00088
	Average			**71,863**	**0.0027**	**0.00074**
FG-Melting Combined East & West Exhausts	1	2/12/15	11:35-12:56	130,697	0.0026	0.0013
	2	2/12/15	15:02-16:23	134,902	0.0022	0.0011
	3	2/12/15	17:32-18:49	134,244	0.0021	0.0011
	Average			**133,281**	**0.0023**	**0.0012**

(1) DSCFM = Dry Standard Cubic Feet Per Minute where STP = 68 °F and 29.92 in. Hg
(2) Mg/M³ = Milligrams Per Dry Standard Cubic Meter
(3) Lbs/Hr = Pounds of Lead Per Hour

III. DISCUSSION OF RESULTS

The results of the emission sampling are summarized in Tables 1 through 11 (Sections II.1 through II.11). The results are presented as follows:

III.1 Particulate Emission Results (Table 1)

Table 1 summarizes the particulate emission results as follows:

- Source
- Sample
- Date
- Time
- Air Flow Rate (DSCFM) – Dry Standard Cubic Feet Per Minute (STP = 68 °F & 29.92 in. Hg)
- Particulate Concentration (Lbs/1000 Lbs, Dry) – Pounds of Particulate Per Thousand Pounds of Exhaust Gas On A Dry Basis
- Particulate Mass Emission Rate (Lbs/Hr) – Pounds of Particulate Per Hour

A more detailed breakdown for each sample can be found in Appendix A.

III.2 Total Hydrocarbon (VOC) Emission Results (Table 2)

Table 2 summarizes the FG-MELTING VOC emission results as follows:

- Source
- Sample
- Date
- Time
- Air Flow Rate (SCFM) – Standard Cubic Feet Per Minute (STP = 68 °F & 29.92 in. Hg)
- VOC Concentration (PPM) – Parts Per Million (v/v) On An Actual (Wet) Basis As Propane
- VOC Mass Emission Rate (Lbs/Hr) – Pounds of VOC Per Hour As Propane

III.3 Carbon Monoxide (CO) Emission Results (Table 3)

Table 3 summarizes the CO emission results as follows:

- Source
- Sample
- Date

- Time
- Air Flow Rate (DSCFM) – Dry Standard Cubic Feet Per Minute (STP = 68 °F & 29.92 in. Hg)
- CO Concentration (PPM) – Parts Per Million (v/v) On A Dry Basis
- CO Mass Emission Rate (Lbs/Hr) – Pounds of CO Per Hour

III.4 Oxides of Nitrogen (NO_x) Emission Results (Table 4)

Table 4 summarizes the NO_x emission results as follows:

- Source
- Sample
- Date
- Time
- Air Flow Rate (DSCFM) – Dry Standard Cubic Feet Per Minute (STP = 68 °F & 29.92 in. Hg)
- NO_x Concentration (PPM) – Parts Per Million (v/v) On A Dry Basis
- NO_x Mass Emission Rate (Lbs/Hr) – Pounds of NO_x Per Hour

III.5 Benzene Emission Results (Table 5)

Table 5 summarizes the benzene emission results as follows:

- Source
- Sample
- Date
- Time
- Air Flow Rate (DSCFM) – Dry Standard Cubic Feet Per Minute (STP = 68 °F & 29.92 in. Hg)
- Benzene Concentration (Mg/M^3) – Milligrams Per Dry Standard Cubic Meter
- Benzene Mass Emission Rate (Lbs/Hr) – Pounds of Benzene Per Hour

A spiked (spiked with 48.3 ug of benzene)/duplicate sampling train was run simultaneously with each sample. All the benzene results were corrected for the recovery efficiencies obtained from the spiked/duplicate samples (as specified in U.S. EPA Method 18). The benzene recovery efficiencies for each sample were as follows:

Source	Sample	Date	Time	Benzene % Recovery Efficiency
FG-SAND	1	2/10/15	11:10-12:10	88.85
	2	2/10/15	13:05-14:05	81.02
	3	2/10/15	15:17-16:17	90.83
East Innoculation	1	2/13/15	08:40-09:40	90.14
	2	2/13/15	10:41-11:41	90.20
	3	2/13/15	12:29-13:29	88.84
West Melt	1	2/13/15	08:40-09:40	87.06
	2	2/13/15	10:41-11:41	86.28
	3	2/13/15	12:29-13:29	87.56

All the results of the spiked/duplicate sampling trains and the % recovery efficiencies can be found in Appendix F.

III.6 Formaldehyde Emission Results (Table 6)

Table 6 summarizes the Formaldehyde emission results as follows:

- Source
- Sample
- Date
- Time
- Air Flow Rate (DSCFM) – Dry Standard Cubic Feet Per Minute (STP = 68 °F & 29.92 in. Hg)
- Formaldehyde Concentration (Mg/M^3) – Milligrams Per Dry Standard Cubic Meter
- Formaldehyde Mass Emission Rate (Lbs/Hr) – Pounds of Formaldehyde Per Hour

The formaldehyde results were field blank corrected. The field blank value of 2.63 ug N.D. (Sample T-13) was used for any of the sample values (EU-SAND samples 1 & 2, East Innoculation samples 1, 2 & 3) that were at or below the field blank detection limit.

A spiked (spiked with 49.3 ug of formaldehyde)/duplicate sampling train was run simultaneously with one (1) sample on each of the three (3) sources sampled. The formaldehyde recovery efficiencies for each source were as follows:

Source	Date	Time	Formaldehyde % Recovery Efficiency
FG-SAND	2/11/15	10:46-11:46	102.70
East Innoculation	2/13/15	18:04-19:04	86.93
West Melt	2/13/15	16:50-17:50	93.77

All the results of the spiked/duplicate sampling trains and the % recovery efficiencies can be found in Appendix F.

III.7 Metals (As, Cd, Cr, Mn & Pb) Emission Results (Tables 7-11)

Tables 7 through 11 summarize the metals emission results as follows:

- Source
- Sample
- Date
- Time
- Air Flow Rate (DSCFM) – Dry Standard Cubic Feet Per Minute (STP = 68 °F & 29.92 in. Hg)
- Metals Concentration (Mg/M^3) – Milligrams Per Dry Standard Cubic Meter
- Metals Mass Emission Rate (Lbs/Hr) – Pounds of Metal Per Hour

All the metals results were field blank corrected. Sample T-10 is the field blank. All the calculations can be found in Appendix F.

IV. SAMPLING AND ANALYTICAL PROTOCOL

The sampling location for each source was as follows:

- FG-SAND – A 80 inch I.D. diameter exhaust stack with 2 sample ports in a location approximately 2.5 duct diameters downstream and > 2 duct diameters upstream from the nearest disturbances.

Twenty- Four (24) sampling points were used for the isokinetic sampling on this source. Sixteen (16) sampling points were used for air flow traverse determinations.

- EU-CLEAN – A 60 inch I.D. diameter exhaust stack with 2 sample ports in a location approximately 2.5 duct diameters downstream and >2 duct diameters upstream from the nearest disturbances. Twenty-Four (24) sampling points were used for the isokinetic sampling on this source.
- East Innoculation (FG-Melting) – A 52 inch I.D. diameter exhaust stack with 2 sample ports in a location approximately 4.5 duct diameters downstream and > 2 duct diameters upstream from the nearest disturbances. Twenty-Four (24) sampling points were used for the isokinetic sampling on this source. Sixteen (16) sampling points were used for air flow traverse determinations.
- West Melt (FG-Melting) – A 60 inch I.D. diameter exhaust stack with 2 sample ports in a location approximately 4.5 duct diameters downstream and > 2 duct diameters upstream from the nearest disturbances. Twenty-Four (24) sampling points were used for the isokinetic sampling on this source. Sixteen (16) sampling points were used for air flow traverse determinations.

Sample Points For Isokinetic Sampling

Sample Point	FG-Sand Dimension (Inches)	EU-CLEAN Dimension (Inches)	East Innoculation Dimension (Inches)	West Melt Dimension (Inches)
1	1.68	1.26	1.09	1.26
2	5.36	4.02	3.48	4.02
3	9.44	7.08	6.14	7.08
4	14.16	10.62	9.20	10.62
5	20.00	15.00	13.00	15.00
6	28.48	21.36	18.51	21.36
7	51.52	38.64	33.49	38.64
8	60.00	45.00	39.00	45.00
9	65.84	49.38	42.80	49.38
10	70.56	52.92	45.86	52.92
11	74.64	55.98	48.52	55.98
12	78.32	58.74	50.91	58.74

Sample Points For Air Flow Traverses

Sample Point	FG-Sand Dimension (Inches)	East Innoculation Dimension (Inches)	West Melt Dimension (Inches)
1	2.56	1.66	1.92
2	8.40	5.46	6.30
3	15.52	10.08	11.64
4	25.84	16.79	19.38
5	54.16	35.20	40.62
6	64.48	41.91	48.36
7	71.60	46.54	53.70
8	77.44	50.33	58.08

The emission sampling was conducted by employing the following reference methods:

- Particulate & Metals – U.S. EPA Method 29
- Particulate (EU-CLEAN Only) – U.S. EPA Method 17
- Total Hydrocarbons (VOC)– U.S. EPA Method 25A
- Carbon Monoxide (CO) – U.S. EPA Method 10
- Oxides of Nitrogen (NO_x) – U.S. EPA Method 7E
- Benzene – U.S. EPA Method 18
- Formaldehyde – NACSI Method CI/WP-98.01
- Exhaust Gas Parameters (air flow, temperature, moisture & density) - U.S. EPA Methods 1-4

IV.1 Particulate & Metals (FG-SAND & FG-MELTING)

The total particulate & metals emission sampling was determined by employing U.S. EPA Method 29 (multiple metals train). Three (3) samples were collected from each of the sources tested. The samples were seventy-two (72) minutes in duration. Each sample had a minimum sample volume of thirty (30) dry standard cubic feet. The samples were collected isokinetically on quartz filters, in a nitric acid/hydrogen peroxide solution.

The filters, nozzle/probe rinses (front half) were analyzed gravimetrically for particulates in accordance with U.S. EPA Reference Method 5. The front half and the nitric acid/hydrogen peroxide solutions were analyzed for the specific metals by inductively coupled argon plasma mass spec (ICAP/MS) analysis. All the quality assurance and quality control procedures listed in the methods will be incorporated in the sampling and analysis.

The metals analyzed were as follows:

- Arsenic (As)
- Cadmium (Cd)
- Chromium (Cr)
- Lead (Pb) (On FG-MELTING Only)
- Manganese (Mn)

A diagram of the particulate and metals (Method 29) sampling train is shown in Figure 1.

IV.2 Particulate (EU-CLEAN Only)

The particulate emission sampling was conducted in accordance with U.S. EPA Method 17. Method 17 is an in-stack filtration method. Three (3) samples were collected from the EU-CLEAN exhaust. Each sample was sixty (60) minutes in duration and had minimum sample volumes of thirty (30) dry standard cubic feet. The samples were collected isokinetically and analyzed for Particulate by gravimetric analysis.

All the quality assurance and quality control procedures listed in the methods were incorporated in the sampling and analysis. Figure 2 is a diagram of the Method 17 particulate sampling train.

IV.3 Total Hydrocarbons (VOC) – The VOC sampling was conducted in accordance with U.S. EPA Reference Method 25A. J.U.M. Model 3-500 and Thermo Environmental Model 51 flame ionization detector (FID) analyzers were used to monitor the two (2) FG-MELTING exhausts. Sample gas was extracted through heated probes. Heated teflon sample lines were used to transport the exhaust gases to the analyzers. The analyzers produce instantaneous readouts of the VOC concentrations (PPM).

The analyzers were calibrated by system injection (from the back of the stack probes to the analyzers) prior to the testing. A span gas of 85.78 PPM Propane was used to establish the initial instrument calibrations. Calibration gases of 30.37 PPM and 50.19 PPM Propane were used to determine the calibration error of the analyzers. After each sample, a system zero and system injection of 30.37 PPM Propane were performed to establish system drift and system bias during the test period. All calibration gases used were EPA Protocol Calibration Gases. Three (3) samples were collected from each of the sources. Each sample was sixty (60) minutes in duration. The sampling on the two FG-MELTING stacks was conducted simultaneously.

The analyzer was calibrated to the output of the data acquisition system (DAS) used to collect the data from the exhaust. The analyzer averages were corrected for calibration error and drift using formula EQ.7E-5 from 40 CFR Part 60, Appendix A, Method 7E. Figure 3 is a diagram of the VOC sampling train.

IV.4 Carbon Monoxide (CO) - The Carbon Monoxide (CO) emission sampling was conducted in accordance with U.S. EPA Reference Method 10. The sample gas was extracted from the exhausts through heated teflon sample lines which led to a VIA MAK 2 sample gas conditioner and then to either a Thermo Environmental Model 48 or 48C portable stack gas monitor. These analyzers are capable of giving instantaneous readouts of the CO concentrations (PPM). Three (3) samples were collected from each of the exhausts sampled. Each sample was sixty (60) minutes in duration. The sampling on the 2 FG-MELTING stacks was conducted simultaneously.

The analyzers were calibrated with EPA protocol CO calibration gases. For the FG-SAND exhaust a span gas of 492.5 PPM was used to establish the initial instrument calibration. For the FG-MELTING exhausts a span gas of 92.97 PPM was used to establish the initial instrument calibrations. On the FG-SAND calibration gases of 250.2 PPM and 169.2 PPM were used to determine the calibration error of the analyzer. On the FG-MELTING exhausts a calibration gas of 49.66 PPM was used to determine the calibration error of the analyzers. The sampling systems (from the back of the stack probes to the analyzers) were injected using either the 169.2 PPM or the 49.66 PPM gas to determine the system bias. After each sample, a system zero and system injection of either 169.2 PPM or 49.66 PPM 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 exhausts. The analyzer averages were corrected for calibration error and drift using formula EQ.7E-5 from 40 CFR Part 60, Appendix A, Method 7E. A diagram of the sampling train is shown in Figure 4.

IV.5 Oxides of Nitrogen (NO_x) - The oxides of nitrogen (NO_x) emission sampling was conducted in accordance with U.S. EPA Reference Method 7E. The sample gas was extracted from the exhausts through heated teflon sample lines which led to a VIA MAK 2 sample gas conditioner and then to either a Thermo Environmental Model 42H or 42i-HL portable stack gas monitor. These analyzers are capable of giving instantaneous readouts of the NO_x concentrations (PPM). Three (3) samples were collected from each of the exhausts sampled. Each sample was sixty (60) minutes in duration. The sampling on the two FG-MELTING stacks was conducted simultaneously.

The analyzers were calibrated with EPA protocol NO_x calibration gases. A span gas of 99.46 PPM was used to establish the initial instrument calibrations. Calibration gases of 54.58 PPM and 25.27 PPM were used to determine the calibration error of the analyzers. The sampling systems (from the back of the stack probes to the analyzers) were injected using the 25.27 PPM gas to determine the system bias. After each sample, a system zero and system injection of 25.27 PPM 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 exhausts. The analyzer averages were corrected for calibration error and drift using formula EQ.7E-5 from 40 CFR Part 60, Appendix A, Method 7E. A diagram of the sampling train is shown in Figure 4.

It should also be noted that after the first sample on the West Innoculation exhaust (2/13/15) a partial blockage (restriction) on the calibration side of the sampling system (line) was discovered that caused a partial pressurization on the NOx analyzer during the post calibration drift/bias check. The analyzer was disconnected from the sampling system and allowed to stabilize. The restriction was resolved and then the analyzer was re-connected. A calibration drift/bias check was then performed to demonstrate compliance with the drift/bias requirement. At no time was this NO_x analyzer adjusted during the issue.

IV.6 Benzene – The sampling for benzene was conducted by employing U.S. EPA Method 18. The samples were collected on charcoal sorbent tubes using pumps equipped with calibrated critical orifices (calibrated at approximately 500 cc/min). The samples were analyzed for benzene by gas chromatography (GCFID). A duplicate spiked sample was run simultaneously with each sampling run. Six (6) samples (3 sample runs & 3 spiked/duplicates) were collected from each of the sources tested. Each sample was sixty (60) minutes in duration. The final results were corrected in accordance with Method 18 by using the recovery efficiencies of the spiked samples. The calculations for each sample can be found in Appendix F. All the quality assurance and quality control procedures listed in the method were incorporated in the sampling and analysis. Figure 5 is a diagram of the benzene sampling train

IV.7 Formaldehyde – The formaldehyde emissions were determined by employing NCASI Method CI/WP-98.01 (Chilled Impinger Method). Three (3) samples were collected from each of the sources tested. Each sample was sixty (60) minutes in duration. In addition, a spiked duplicate train was run during one of the samples on each source to document recovery efficiency for formaldehyde (See Appendix F).

The samples were collected in midget impinger trains containing de-ionized distilled water. The samples were collected using a pump equipped with a calibrated critical orifice (calibrated at approximately 1000 cc/min). The samples were analyzed for formaldehyde by colorimetric analysis (acetylacetone procedure). All the quality assurance and quality control procedures listed in the method were incorporated in the sampling and analysis. Figure 6 is a diagram of the sampling train.

IV.8 Oxygen & Carbon Dioxide

IV.8.1 FG-SAND 2/10/15 – The O_2 & CO_2 sampling was conducted in accordance with U.S. EPA Reference Method 3A. Servomex Model 1400M portable stack gas analyzers were used to monitor the FG-SAND exhaust. 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 O_2 & CO_2 concentrations (%). Three (3) samples were collected from the FG-SAND on 2/11/15. Each sample was sixty (60) minutes in duration.

The analyzers were calibrated by direct injection prior to the testing. Span gases of 21.03% O_2 and 20.42% CO_2 were used to establish the initial instrument calibrations. Calibration gases of 12.06% O_2/5.989% CO_2 and 5.989% O_2/11.98% CO_2 were used to determine the calibration error of the analyzers. The sampling system (from the back of the stack probe to the analyzers) was injected using the 12.06% O_2/5.989% CO_2 gas to determine the system bias. After each sample, a system zero and system injection 12.06% O_2/5.989% CO_2 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 exhaust. The analyzer averages were corrected for calibration error and drift using formula EQ.7E-5 from 40 CFR Part 60, Appendix A, Method 7E. A diagram of the sampling train is shown in Figure 4.

IV.8.2 EU-CLEAN 2/11/15 & FG-MELTING 2/12/15 – Integrated bag samples were collected from the back of the isokinetic sampling trains and analyzed by Orsat to determine the O_2 & CO_2 content.

IV.8.3 FG-SAND 2/11/15 & FG-MELTING 2/13/15 – Because prior analysis showed ambient concentrations, the ambient default values of 20.9% O_2 and 0.0% CO_2 were used on these days.

IV.9 Exhaust Gas Parameters – The exhaust gas parameters (air flow rate, temperature, moisture and density) were determined by employing U.S. EPA Methods 1 through 4.

Air flow rates, temperatures and moistures were determined using the isokinetic sampling trains (when possible). Separate velocity and temperature traverses were conducted for the testing when isokinetic sampling was not being conducted. During these velocity traverses, moisture was determined by employing the wet bulb/dry bulb technique.

All the quality assurance and quality control procedures listed in the methods were incorporated in the sampling and analysis.

This report was prepared by:

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Stephan K. Byrd

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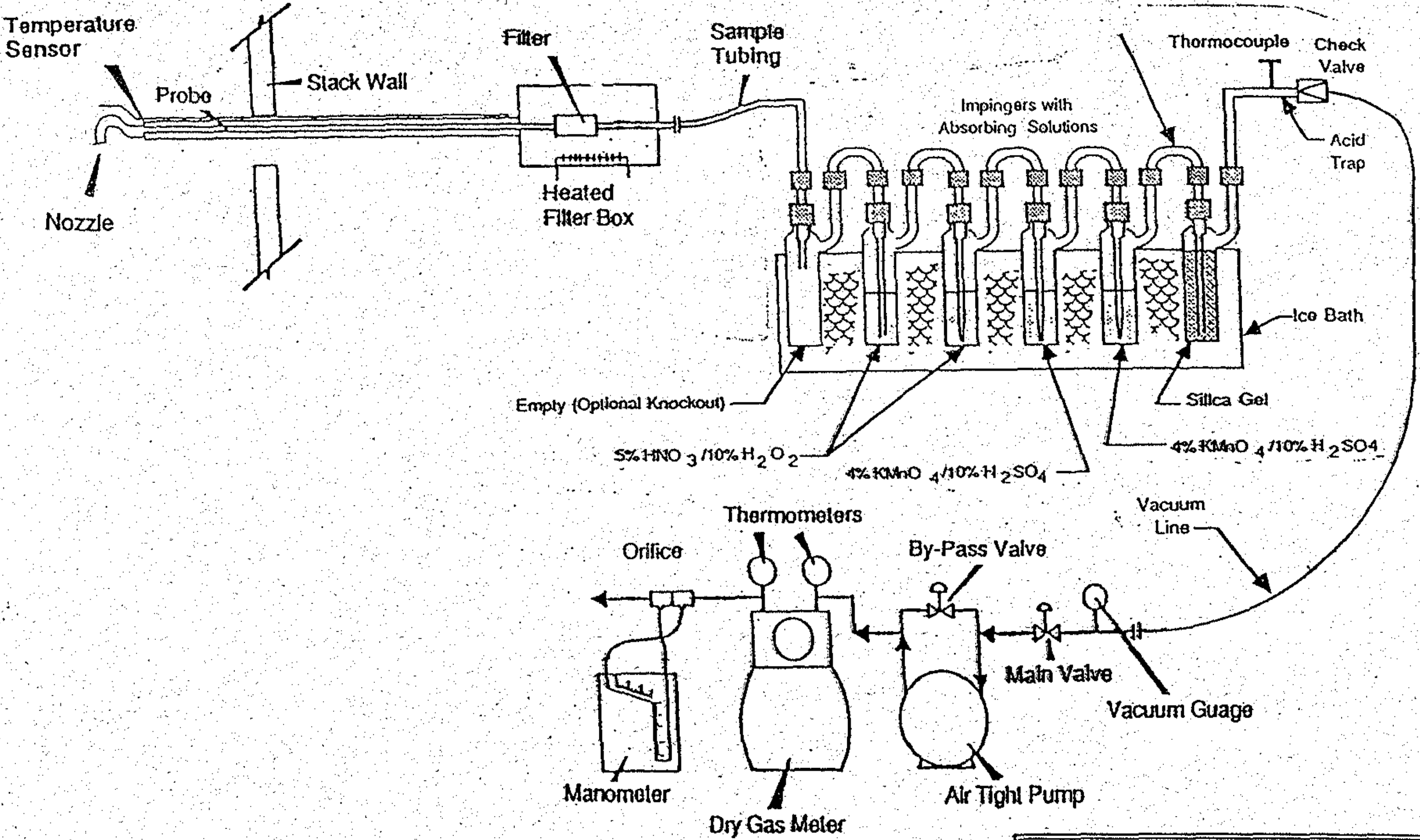

Figure 1

Particulate & Metals
(Method 29) Sampling Train

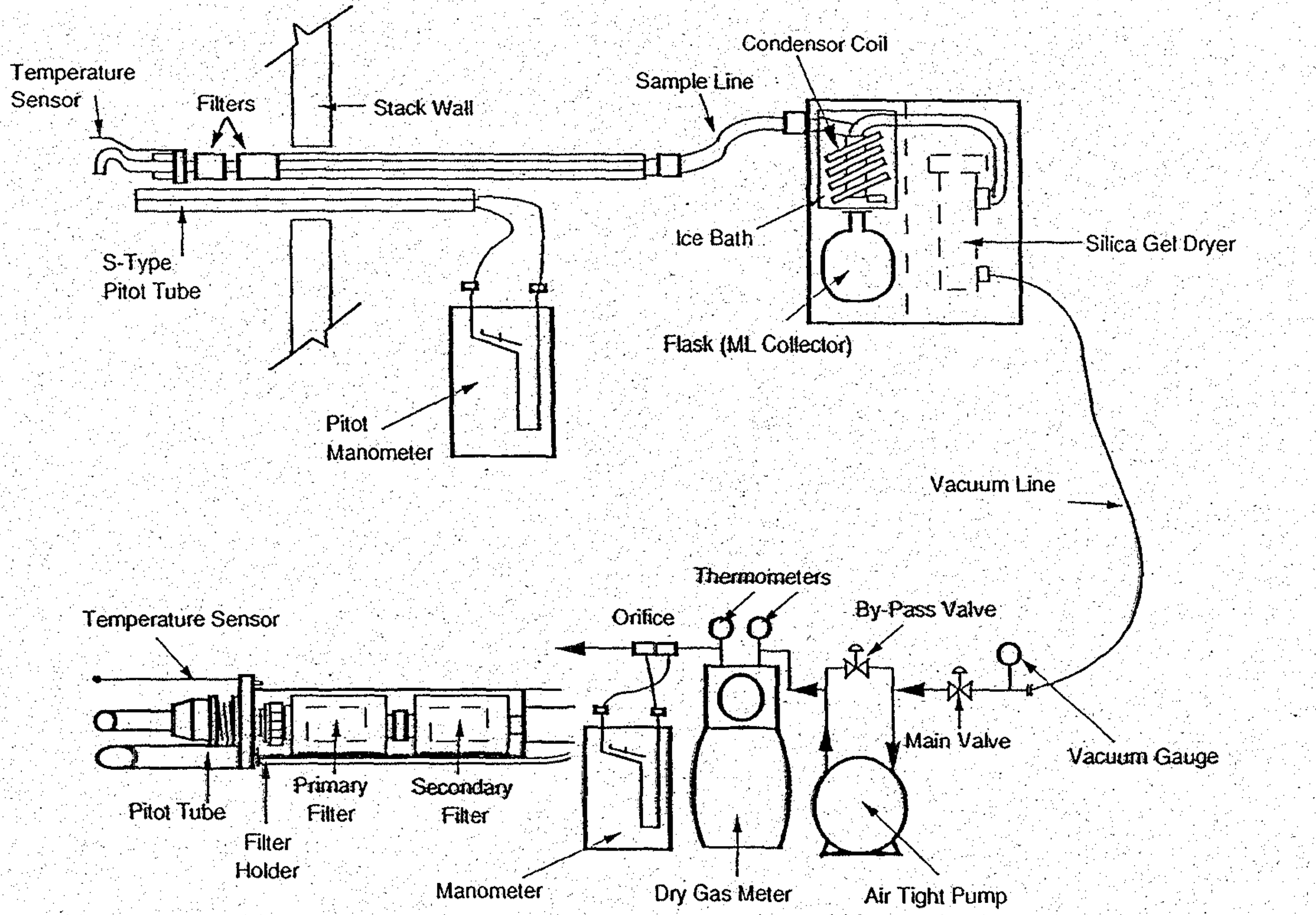

Figure 2

Particulate (Method 17) Sampling Train

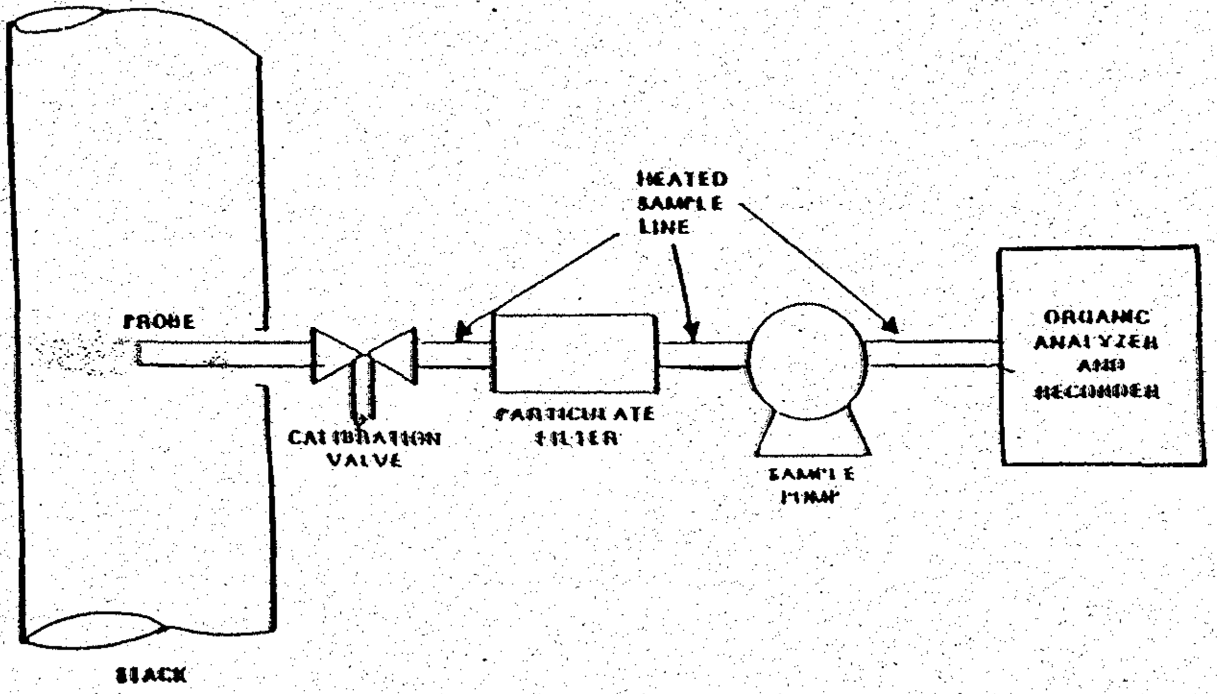

Figure 3

VOC
Sampling Train

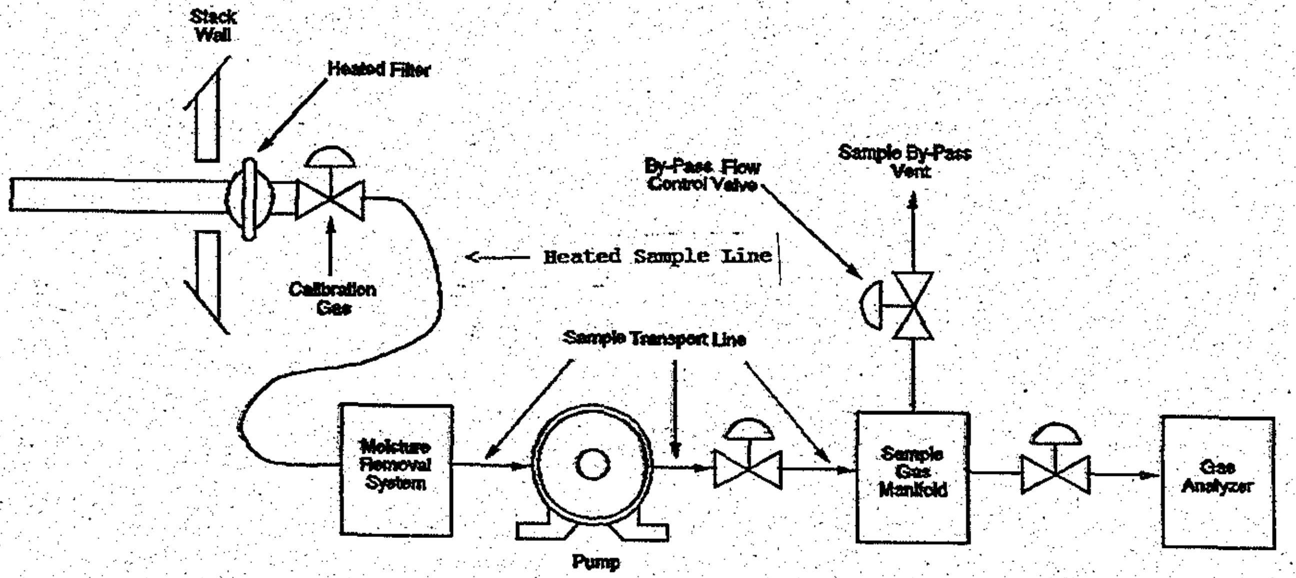

Figure 4

CO, NO$_x$, O$_2$ & CO$_2$
Sampling Train

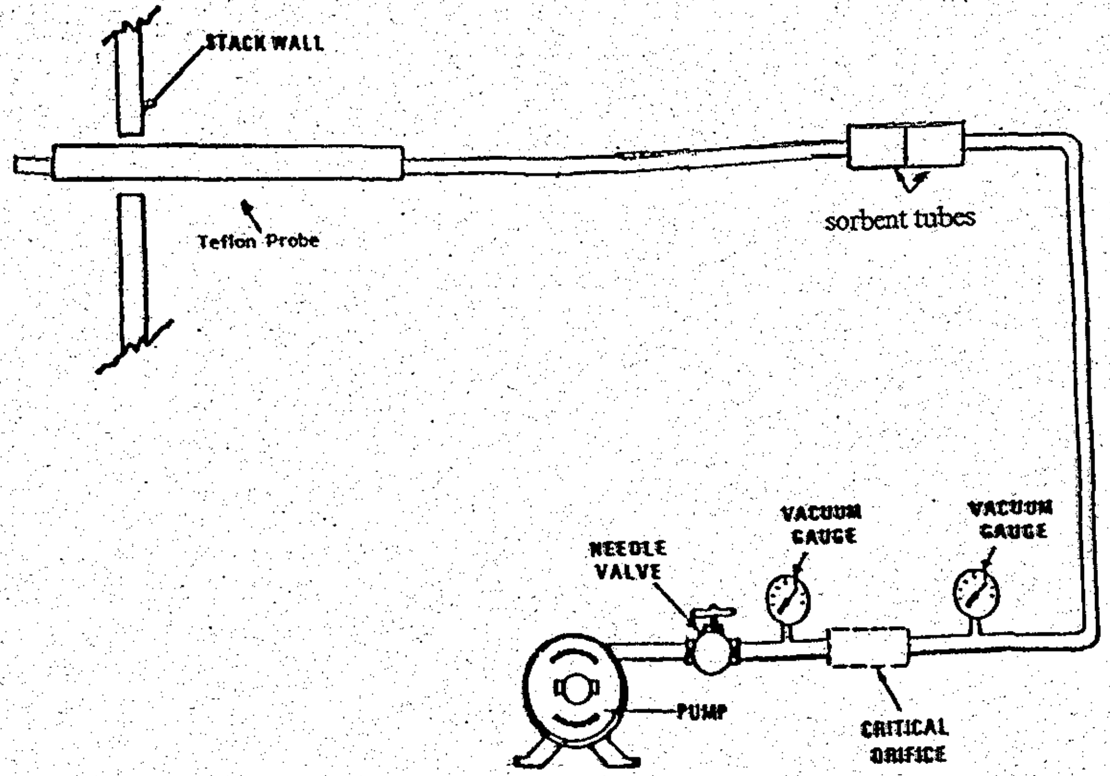

Figure 5

Benzene
Sampling Train

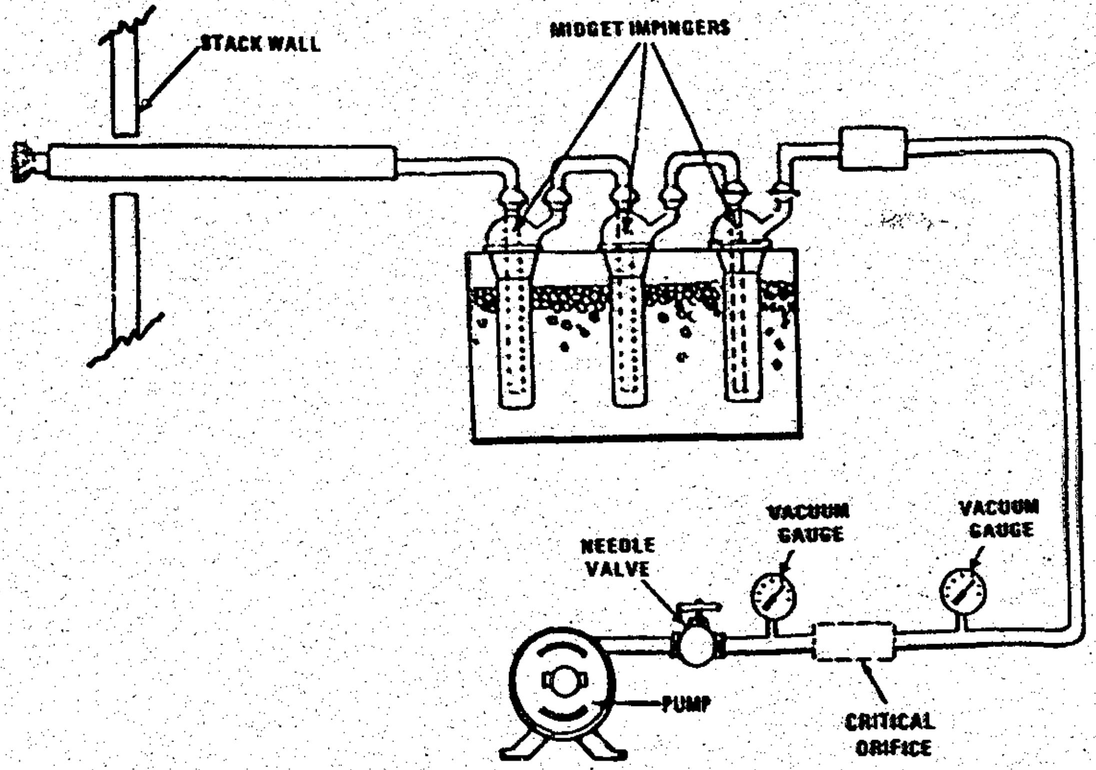

Figure 6

Formaldehyde
Sampling Train