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I. INTRODUCTION

Network Environmental, Inc. was retained by CMI Cast Parts, Inc. of Cadillac, Michigan to conduct an emission study at their facility. The study was designed to generate results to be used for in-house evaluation purposes. The following testing was conducted:

Line/Department	Source	Compounds
Melting Department	Cupola Scrubber Exhaust	Particulate, CO, SO_2 & Lead
SPO-Line	N. Multiwash (Sand System)	Particulate
	S. Multiwash (Shakeout/Molding)	Particulate
	Pouring/Cooling (3 Exhausts)	Particulate & Lead
	80K Baghouse (Breaking/Sorting)	Particulate
Finishing	12K Baghouse Exhaust	Particulate
	40K Baghouse Exhaust	Particulate

The following reference test methods were employed to conduct the sampling:

* Total Particulate - U.S. EPA Methods 5 or 17
* Lead (Pb) - U.S. EPA Method 29
* Carbon Monoxide (CO) - U.S. EPA Method 10
* Sulfur Dioxide (SO_2) - U.S. EPA Method 6C
* Exhaust Gas Parameters (flow rate, moisture, temperature & density) - U.S. EPA Methods 1-4

The sampling was conducted over the period of July 22-24, 1997 by R. Scott Cargill, David D. Engelhardt, Vincent G. Schultes and Bertram J. Smith of Network Environmental, Inc.. Assisting in the study was Mr. Erik A. Olson of CMI Cast Parts, Inc.

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II.1 TABLE 1
PARTICULATE EMISSION RESULTS
CMI CAST PARTS, INC.
CADILLAC, MICHIGAN

Source	Sample	Date	Time	Air Flow Rate SCFM	Particulate Emissions		
					Lbs/1000 Lbs, Dry	Lbs/Hr	Lbs/Ton of Charge
12K Baghouse Exhaust	1	7/22/97	09:44-10:45	11,235	0.0047	0.23	N.A.
	2	7/22/97	11:50-12:50	11,204	0.0035	0.17	
	Average			**11,220**	**0.0041**	**0.20**	
40K Baghouse Exhaust	1	7/22/97	14:15-15:18	29,143	0.0063	0.81	N.A.
	2	7/22/97	15:32-16:35	27,957	0.0046	0.57	
	Average			**28,550**	**0.0055**	**0.69**	
80K Baghouse Exhaust	1	7/23/97	08:55-09:59	69,986	0.0045	1.40	N.A.
	2	7/23/97	10:19-11:22	75,317	0.0039	1.30	
	Average			**72,651**	**0.0042**	**1.35**	
SPO-Line Pouring/ Cooling #1 Exhaust	1	7/23/97	09:31-11:34	8,245	0.0042	0.15	0.0060
	2	7/23/97	11:46-13:55	8,356	0.0032	0.12	0.0057
	Average			**8,301**	**0.0037**	**0.13**	**0.0059**
SPO-Line Pouring/ Cooling #2 Exhaust	1	7/23/97	14:09-16:12	8,416	0.0041	0.15	0.0073
	2	7/23/97	16:22-18:25	8,422	0.0030	0.11	0.0056
	Average			**8,419**	**0.0036**	**0.13**	**0.0065**
SPO-Line Pouring/ Cooling #3 Exhaust	1	7/24/97	12:30-14:32	8,359	0.0034	0.13	0.0053
	2	7/24/97	14:39-16:42	8,369	0.0031	0.11	0.0037
	Average			**8,364**	**0.0032**	**0.12**	**0.0045**

N.A. = Not Applicable

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II.1 TABLE 1 (CONTINUED)
PARTICULATE EMISSION RESULTS
CMI CAST PARTS, INC.
CADILLAC, MICHIGAN

Source	Sample	Date	Time	Air Flow Rate SCFM	Particulate Emissions		
					Lbs/1000 Lbs, Dry	Lbs/Hr	Lbs/Ton of Charge
North Multiwash Exhaust	1	7/23/97	14:20-15:23	58,374	0.0067	1.66	0.067
	2	7/23/97	15:33-16:36	57,317	0.0069	1.64	0.072
	Average			**57,846**	**0.0068**	**1.65**	**0.070**
South Multiwash Exhaust	1	7/23/97	16:00-17:03	60,563	0.0071	1.85	0.075
	2	7/23/97	17:21-18:23	61,205	0.0085	2.21	0.108
	Average			**60,884**	**0.0078**	**2.03**	**0.092**
Cupola Scrubber Exhaust	1	7/22/97	09:20-11:18	50,023	0.040	7.06	0.255
	2	7/22/97	12:58-14:03	48,847	0.030	5.25	0.225
	Average			**49,435**	**0.035**	**6.16**	**0.240**

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II.2 TABLE 2
LEAD (Pb) EMISSION RESULTS
CMI CAST PARTS, INC.
CADILLAC, MICHIGAN

Source	Sample	Date	Time	Air Flow Rate SCFM	Lead (Pb) Emissions	
					ug/M^3	Lbs/Hr
Cupola Scrubber Exhaust	1	7/22/97	09:20-11:18	50,023	114.82	0.022
	2	7/22/97	12:58-14:03	48,847	75.42	0.014
	Average			**49,435**	**95.12**	**0.018**
SPO-Line Pouring/ Cooling #1 Exhaust	1	7/23/97	09:31-11:34	8,245	N.D.(1)	N.D.
	2	7/23/97	11:46-13:55	8,356	5.73	1.79×10^{-4}
	Average(2)			**8,301**	**4.45**	**1.39×10^{-4}**
SPO-Line Pouring/ Cooling #2 Exhaust	1	7/23/97	14:09-16:12	8,416	N.D.	N.D.
	2	7/23/97	16:22-18:25	8,422	N.D.	N.D.
	Average			**8,419**	**N.D.**	**N.D.**
SPO-Line Pouring/ Cooling #3 Exhaust	1	7/24/97	12:30-14:32	8,359	N.D.	N.D.
	2	7/24/97	14:39-16:42	8,369	N.D.	N.D.
	Average			**8,364**	**N.D.**	**N.D.**

(1) N.D. = Not Detected at a detection limit of 3.16 ug/M^3 (9.89×10^{-5} Lbs/Hr).

(2) Averages for the Pouring/Cooling #1 Exhaust were calculated using the detection limit values for sample #1.

(3) Cupola mass rates in terms of Lbs of Particulate/Ton of Metal Charged were 7.94×10^{-4} Lbs/Ton of Charge for sample one and 6.01×10^{-4} Lbs/Ton of Charge for sample two. The average of the two samples was 6.98×10^{-4} Lbs/Ton of Charge.

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II.3 TABLE 3
CARBON MONOXIDE (CO) EMISSION RESULTS
CMI CAST PARTS, INC.
CADILLAC, MICHIGAN

Source	Sample	Date	Time	Air Flow Rate DSCFM	CO Emissions		
					PPM	Lbs/Hr	Lbs/Ton of Charge
Cupola Scrubber Exhaust	1	7/22/97	09:19-11:17	37,303	136	21.98	0.793
	2	7/22/97	12:57-14:01	37,138	184	29.60	1.270
	Average			**37,221**	**160**	**25.79**	**1.032**

II.4 TABLE 4
SULFUR DIOXIDE (SO_2) EMISSION RESULTS
CMI CAST PARTS, INC.
CADILLAC, MICHIGAN

Source	Sample	Date	Time	Air Flow Rate DSCFM	SO_2 Emissions	
					PPM	Lbs/Hr
Cupola Scrubber Exhaust	1	7/22/97	09:19-11:17	37,303	N.D.	N.D.
	2	7/22/97	12:57-14:01	37,138	N.D.	N.D.
	Average			**37,221**	**N.D.**	**N.D.**

N.D. = Not detected at a detection limit of 0.1 PPM (0.037 Lbs/Hr & 0.0015 Lbs/Ton of Charge)

III. DISCUSSION OF RESULTS

The results of the testing are summarized in Tables 1 through 4 (Sections II.1 through II.4) as follows:

Table 1 - Particulate Emission Results

Table 2 - Lead (Pb) Emission Results

Table 3 - Carbon Monoxide (CO) Emission Results

Table 4 - Sulfur Dioxide (SO_2) Emission Results

III.1 SPO Line

Testing for the SPO Line consisted of sampling the North Multiwash Exhaust (Sand System), the South Multiwash Exhaust (shakeout & mold system), the 80K Baghouse Exhaust (Breaking/Sorting) and the three Mold Pouring/Cooling Exhausts.

III.1.1 Particulate - The average particulate emission rates for these sources in terms of pounds of particulate per hour (Lbs/Hr) were 1.65 Lbs/Hr for the North Multiwash, 2.03 Lbs/Hr for the South Multiwash, 0.13 Lbs/Hr for the #1 Mold Pouring/Cooling Exhaust, 0.13 Lbs/Hr for the #2 Mold Pouring/Cooling Exhaust, 0.12 Lbs/Hr for the #3 Mold Pouring/Cooling Exhaust and 1.35 Lbs/Hr for the 80K Baghouse Exhaust.

The average particulate mass rates in terms of pounds of particulate per ton of metal charged (Lbs/Ton) were 0.070 Lbs/Ton for the North Multiwash, 0.092 Lbs/Ton for the South Multiwash, 0.0059 Lbs/Ton for the #1 Mold Pouring/Cooling Exhaust, 0.0065 Lbs/Ton for the #2 Mold Pouring/Cooling Exhaust and 0.0045 Lbs/Ton for the #3 Mold Pouring/Cooling Exhaust.

III.1.2 Lead (Pb) - Lead was not detected for all the samples on the pouring/cooling exhausts except the second sample on the #1 Pouring/Cooling Exhaust. The detection limit was 3.16 ug/M^3 (9.89×10^{-5} Lbs/Hr). Pb was detected in the second sample on the #1 Pouring/Cooling Exhaust at 5.73 ug/M^3 (1.79×10^{-4} Lbs/Hr).

III.2 Finishing Department

Testing the Finishing Department consisted of sampling the 12K and the 40K Baghouse Exhausts.

III.2.1 Particulate - The average particulate mass emission rates for the Finishing Department were 0.20 Lbs/Hr for the 12K Baghouse Exhaust and 0.69 Lbs/Hr for the 40K Baghouse Exhaust.

III.3 Melting Department

Testing the Melting Department consisted of sampling the Cupola Scrubber Exhaust.

III.3.1 Particulate - The particulate mass emission rates for the Cupola Scrubber Exhaust were 7.06 Lbs/Hr for sample one and 5.25 Lbs/Hr for sample two. **The average particulate mass emission rate for the Cupola Scrubber Exhaust was 6.16 Lbs/Hr.**

The particulate mass emission rate in terms of pounds of particulate per ton of metal charged (Lbs/Ton of Charge) were 0.255 Lbs/Ton for sample one and 0.225 Lbs/Ton for sample two. **The average of the two samples for the Cupola Scrubber Exhaust was 0.240 Lbs/Ton.**

III.3.2 Lead - The Pb mass emission rates for the Cupola Scrubber Exhaust were 0.022 Lbs/Hr for sample one and 0.014 Lbs/Hr for sample two. **The average Pb mass emission rate for the Cupola Scrubber Exhaust was 0.018 Lbs/Hr.**

The Pb mass emission rate in terms of pounds of Pb per ton of metal charged (Lbs/Ton of Charge) were 7.94×10^{-4} Lbs/Ton for sample one and 6.01×10^{-4} Lbs/Ton for sample two. **The average of the two samples for the Cupola Scrubber Exhaust was 6.98×10^{-4} Lbs/Ton.**

III.3.3 CO - The CO mass emission rates for the Cupola Scrubber Exhaust were 21.98 Lbs/Hr for sample one and 29.60 Lbs/Hr for sample two. **The average CO mass emission rate for the Cupola Scrubber Exhaust was 25.79 Lbs/Hr.**

The CO mass emission rate in terms of pounds of CO per ton of metal charged (Lbs/Ton of Charge) were 0.793 Lbs/Ton for sample one and 1.270 Lbs/Ton for sample two. **The average of the two samples for the Cupola Scrubber Exhaust was 1.032 Lbs/Ton.**

III.3.4 SO_2 - SO_2 was not detected during both samples. The detection limit was 0.1 PPM (0.037 Lbs/Hr & 0.0015 Lbs/Ton of Charge).

IV. SAMPLING AND ANALYTICAL PROTOCOL

The sampling on the sources was conducted at the following locations:

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North Multiwash	52 inch I.D. exhaust. Location meets the 8 duct diameters downstream and 2 duct diameters upstream requirement of U.S. EPA Reference Method 1.
South Multiwash	52 inch I.D. exhaust. Location meets the 8 duct diameters downstream and 2 duct diameters upstream requirement of U.S. EPA Reference Method 1.
Iron Pouring & Mold Cooling	Three (3) - 24 inch I.D. exhausts. All the locations meet the 8 duct diameters downstream and 2 duct diameters upstream requirement of U.S. EPA Reference Method 1.
80K Baghouse	72 inch I.D. exhaust. Location meets the 8 duct diameters downstream and 2 duct diameters upstream requirement of U.S. EPA Reference Method 1.
12K Baghouse	28 inch I.D. exhaust. Location meets the 8 duct diameters downstream and 2 duct diameters upstream requirement of U.S. EPA Reference Method 1.
40K Baghouse	48 inch I.D. exhaust. Location meets the 8 duct diameters downstream and 2 duct diameters upstream requirement of U.S. EPA Reference Method 1.
Cupola Scrubber	48 inch I.D. exhaust. Location meets the 8 duct diameters downstream and 2 duct diameters upstream requirement of U.S. EPA Reference Method 1.

IV.1 Total Particulate (Cupola Scrubber & SPO-Line Pouring/Cooling Exhausts) - The total particulate emission sampling was conducted in accordance with U.S EPA Reference Method 5. Method 5 is an out of stack filtration method. Two (2) samples were collected from each exhaust. Each sample was 120 minutes in duration for the pouring/cooling exhausts and 60 minutes for the cupola exhaust, and had minimum sample volumes of sixty (60) dry standard cubic feet for the pouring/cooling exhausts and 30 dry standard cubic for the cupola exhaust. The particulate sampling train was combined with the lead (Pb) sampling train (EPA Method 29). The samples were collected isokinetically. The filters and probe/nozzle rinses were analyzed for total particulate by gravimetric analysis before being analyzed for lead. All the quality assurance and quality control procedures listed in the method were incorporated in the sampling and analysis. A diagram of the sampling train is shown in Figure 1.

IV.2 Total Particulate (North Multiwash, South Multiwash, 80K Baghouse, 40K Baghouse & 12K Baghouse) - The particulate emission sampling was conducted in accordance with U.S. EPA Reference Method 17. Method 17 is an in-stack filtration method. Two (2) samples were collected from each exhaust. Each sample was sixty (60) minutes in duration, and had a minimum sample volume of thirty (30) dry standard cubic feet. The samples were collected isokinetically and analyzed for total particulate by gravimetric analysis. All the quality assurance and quality control procedures listed in the method were incorporated in the sampling and analysis. A diagram of the sampling train

is shown in Figure 2.

IV.3 Lead - The Pb emission sampling was conducted by employing U.S EPA Method 29. Two (2) samples were collected from each source that was sampled. Each sample was 60 minutes in duration for the cupola and 120 minutes in duration for the pouring/cooling exhausts. The samples had minimum sample volumes of thirty (30) dry standard cubic feet on the cupola and sixty (60) dry standard cubic feet on the pouring/cooling exhausts. The samples were collected on quartz filters, and in a nitric acid/hydrogen peroxide solution. The filters and nozzle/probe rinses were analyzed for particulate by gravimetric analysis prior to the lead analysis. The filters, nozzle/probe rinses and impinger soultions were combined and analyzed for lead by graphite furnace atomic absorption spectrophotometry. All the quality assurance and quality control procedures listed in the method were incorporated in the sampling and analysis. A diagram of the sampling train is shown in Figure 1.

IV.4 Carbon Monoxide - The CO sampling was conducted in accordance with U.S. EPA Reference Method 10. Two (2) samples, each sixty minutes in duration, were collected from the cupola scrubber exhaust. A Thermo Environmental Model 48H gas analyzer was used to monitor the 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 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 843.0 PPM was used to establish the initial instrument calibration. Calibration gases of 254.0 PPM and 409.7 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 409.7 PPM gas to determine the system bias. After each sample, a system zero and system injection of 409.7 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 exhausts. A strip chart recorder was also used to record the data as a backup to the DAS. A diagram of the sampling train is shown in Figure 3.

IV.5 Sulfur Dioxide - The SO_2 sampling was conducted in accordance with U.S. EPA Reference

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Method 6C. Two (2) samples, each sixty minutes in duration, were collected from the cupola scrubber exhaust. A Bovar Model 721M gas analyzer was used to monitor the 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 analyzer. The analyzer produces instantaneous readouts of the SO_2 concentrations (PPM).

The analyzer was calibrated by direct injection prior to the testing. A span gas of 427.1 PPM was used to establish the initial instrument calibration. Calibration gases of 149.4 PPM and 251.5 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 149.4 PPM gas to determine the system bias. After each sample, a system zero and system injection of 149.4 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 exhausts. A strip chart recorder was also used to record the data as a backup to the DAS. A diagram of the sampling train is shown in Figure 3.

IV.6 Exhaust Gas Parameters - In conjunction with the other sampling, 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 control and quality assurance requirements listed in the methods were incorporated in the sampling and analysis.

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