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An Inventory of Iron Foundry Emissions*

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This article is the second of highly valuable studies undertaken by the A. T. Kearney Co. that we have been privileged to bring to MODERN CASTING readers (First article appeared in March '71 issue). Mr. Gutow's work serves to place metalcasting's contribution to the air pollution problem in its correct perspective. It should be required reading for every air pollution control board.

WIDESPREAD distribution of iron foundries and the high visibility of the cupola stack in most communities in which an iron foundry is located, have combined to label the industry as a major source of air pollution. This opinion is often strongly shared by downwind neighbors of a foundry using an uncontrolled cupola for iron melting, and air pollution control agencies receiving complaints of foundry emissions.

Iron foundries are located in almost every state. However, the highest concentration is in the Great Lakes states of Pennsylvania, Ohio, Michigan, Illinois, Wisconsin, New York and Indiana. Almost half of all iron foundries in the United States and more than half of the iron castings capacity are found in Great Lakes States.

California contains the greatest concentration of iron foundries in the western half of the country. One-third of iron foundries in that 17-state area are in California. Other areas of high iron foundry concentration are the southeastern states and the northern states bordering on the west bank of the Mississippi River.

Principal concentrations of iron foundries lie in major metropolitan areas. Fifty such areas account for more than two-thirds of the iron foundries. Here again, principal concentration is in the industrial cities in the seven Great Lakes states, with two-thirds of these centers being in, or bordering on, those states.

Pollutants discharged by the iron foundry can be classified as:

1. Emissions from melting furnace operations.
2. Emissions from other dust producing operations within the plant.
3. Odors and gaseous compounds from both sources.

Two questions arise immediately:

1. How much of these pollutants are discharged into the atmosphere, uncollected, by iron foundries in the United States?
2. In which states or regions are concentrations the greatest?

The answers were arrived at by A. T. Kearney & Company, Inc. during the work it performed for the Air Pollution Control Office of the Environmental Protection Agency in a study titled "Systems Analysis of Emissions and Emissions Control in the Iron Foundry Industry."

The A. T. Kearney Report, a work which many foundrymen will want added to their store of valuable operating information, can be purchased. The reports can be obtained from the National Technical Information Service, Springfield, VA., 22151.

The reports are numbered and priced as follows: Volume I is PB 198348 $6.00; Volume II is PB 198349 $3.00; Volume III is PB 198350 $6.00. These are typed reports. They are also available as microfiche for metalcasters equipped with reader-duplicating equipment.

The most recent nationwide estimates of emissions from all sources were prepared by the Public Health Service in 1968 and are presented in Table 1. The data are presented as estimates of five primary air pollutants; carbon monoxide, particulates, sulfur oxides, hydrocarbons and nitrogen oxides. The nationwide estimate for each air pollutant is presented for several source categories.

In 1968, all industrial processes, including iron foundries, accounted for an estimated 7.5 million tons or 26.5% of total particulate emissions and 9.7 million tons or 9.7% of total carbon monoxide emissions. Carbon monoxide and particulates are the primary air pollutants in the iron foundry industry.

Inventory of Iron Foundry Emissions

Estimates of iron foundry emissions in 1969 were made during the Kearney study for both melting and non-melting operations. The basis used for determining amounts of particulate and gaseous emissions was molten iron production. Data were obtained from the Department of Commerce giving total 1969 gray iron casting tonnage for each of nine geographical regions.

A calculation of the percent of casting tonnage produced from iron melted in cupolas, electric arc and other furnaces was made for for each geographical region. Only production from cupolas and electric arc furnaces was considered in determining emissions from melting operations. Total production was used for estimating emissions from non-melting operations.

Emissions from other melting equipment, including induction furnaces and reverberatory furnaces are negligible. Not only because generally cleaner scrap metal is used for furnace charges. Also, a relatively small percentage of the total iron is melted in these furnaces.

Preheating of dirtier scrap for charging into induction furnaces will add significantly to the emissions inventory only when the process is substantially more widely used. At its present level of application, preheater emissions are also

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negligible.

The sum of both cupola and electric arc furnace production figures provided casting production totals for each region for the emissions generating melters. Assuming an average iron yield of 65%, from molten metal to castings, the total tonnage of molten iron produced was calculated for cupolas and electric arc furnaces.

An analysis of cupola and electric furnace emissions and factors affecting the rates of emissions, made during the Kearney study cited earlier, shows that an average of 20.8 lb of particulate emissions are produced per ton of metal melted in an iron foundry cupola.

An average of 13.8 lb of particulate emissions per ton of metal results from direct electric arc furnace iron production. These air pollutant emission factors were applied to the molten iron production to determine the particulate emissions generated in melting operations.

In using the estimated molten iron tonnage to develop emission levels for non-melting operations, considerable care was exercised to avoid artificially inflating the emissions total by including emissions from non-emissions producing operations. For example, the production tonnage of centrifugally cast pipe accounts for over 10% of all iron castings tonnage.

This was carefully excluded from the appropriate regional production totals when particulate emission values were determined for operations such as molding and shakeout, since most iron pipe is cast in metal molds. Also, centrifugally cast pipe production was allocated more towards cupola melting than electric arc melting in accordance with what is usually the case in pipe foundries.

Based on a survey of iron foundries, considering the number and capacity of furnaces equipped with control systems, the effectiveness of the control systems, and the number of uncontrolled furnaces, it was estimated that on the average, 75% of the particulate emissions generated are presently being released to the atmosphere. Estimated particulate emissions not captured and collected, but emitted to the atmosphere accounted for a nationwide total of 182,000 tons in 1969.

TABLE 1. Estimated Nationwide Emission, 1968. (10^6 Tons/Year).

Source	CO	Particulates	SO_x	HC	NO_x
Transportation	63.8	1.2	0.8	16.6	8.1
Fuel combustion in stationary sources	1.9	8.9	24.4	0.7	10.0
Industrial processes	9.7	7.5	7.3	4.6	0.2
Solid waste disposal	7.8	1.1	0.1	1.6	0.6
Miscellaneous	16.9	9.6	0.6	8.5	1.7
Total	100.1	28.3	33.2	32.0	20.6

Source: National Air Pollution Control Administration, Publication No. AP-73, August, 1970.

The estimates of tons of carbon monoxide generated in cupolas are based upon an average cupola operating with a seven to one metal to coke ratio and using coke with an average carbon content of 91%. It is also assumed that the carbon dioxide content of the top gas is at equilibrium. Under these conditions, 276 lb of carbon monoxide are generated per ton of metal melted.

The amount of carbon monoxide emitted to the atmosphere depends on a number of factors, including temperature of top gas, availability of infiltrated air to provide oxygen for combustion, completeness of combustion and percent of total time burning of carbon monoxide occurs.

Theoretically, with sufficient oxygen from the infiltrated air and with constant combustion, carbon monoxide content should be completely burned. However, several factors tend to work against this ideal condition.

These include: the flame being extinguished by each charge addition, lack of immediate reignition either with or without an afterburner, or with an improperly directed flame from an afterburner, varying carbon monoxide content precluding constant combustion and a variable air supply. A conservative estimate of 50% combustion efficiency has been applied to the quantities of total carbon monoxide generated to obtain the estimated weight of this gas emitted into the atmosphere. The estimated total 1969 tonnage of carbon monoxide emitted by iron foundries was 1,462,000 tons nationwide.

The results of these calculations for emissions from melting operation for 1969 nationwide produc-

TABLE 2. Particulate Emission Factors From Non-Melting Operations.

		(1)	(2)	(3)	(4)	(5)	(6)
		Emissions Generated	Normal Collection	Emissions to Foundry Environment	Settling Factor	Emissions Released to Atmosphere	Emissions to Atmosphere Nationwide*
Department	Operation	Lb./Ton Melt	Percent	Lb./Ton Melt	Percent	Lb./Ton Melt	Lb./Ton Melt
Scrap Yard	Raw Material Handling	.20	0	.20	80%	.04	.04
	Charge Make-up	.15	0	.15	80	.03	.03
	Charge Pre-heating	.20	10%	.18	40	.11	.01
Molding, Pouring and Shakeout	Molding	.50	0	.50	90	.05	.04
	Magnesium Treatment	5.00	10	4.50	75	1.12	.11
	Pouring	5.10	10	4.59	60	1.84	1.45
	Cooling	10.30	10	9.27	90	.93	.75
	Shakeout	32.20	60	12.80	90	1.28	1.02
Cleaning and Finishing	Shot Blast	15.50	99	.16	80	.03	.02
	Grinding	1.60	95	.08	80	.02	.01
	Annealing	.10	0	.10	30	.07	.03
	Painting	.02	95	—	40	—	—
Sand Conditioning	Dry Sand Handling	10.30	10	9.27	90	.93	.75
	Prepared Sand Handling	.50	0	.50	90	.05	.04
	Screening	10.00	20	8.00	90	.80	.64
	Mulling	20.60	60	8.24	90	.82	.65
	Drying and Sand Reclamation	1.50	60	.60	80	.12	.01
Core Department	Oil Sand Core Baking	.10	5	.05	0	.05	.03
	Shell, Hot Box and Cold Set Sand Cores	1.02	0	1.02	0	1.02	.20
Pattern Shop	Wood Patternmaking	.01	80	—	50	—	—
	Metal Patternmaking	.02	80	—	50	—	—
Total		114.92		60.21		9.31	5.83

Note: *Incidence factor has been applied to these emissions rates to reflect actual industry application of each operation.

tion levels are summarized below.

Reported 1969 castings production	17,155,000 Tons
Total castings produced cupola and electric arc	16,614,000 Tons
Total molten iron produced cupola and electric arc	24,367,000 Tons
Total particulate emissions generated	243,000 Tons
Total carbon monoxide generated	2,924,000 Tons
Total particulate emissions emitted	182,000 Tons
Total carbon monoxide emitted	1,462,000 Tons

The impact of particulate emissions discharged to the atmosphere from foundry melting operations on the 1968 inventory by NAPCA, Figure 1, is that iron foundry particulate matter represents about 0.64% of particulates from all sources and 2.4% of particulates from industrial sources. Carbon monoxide emissions emitted from iron foundries represent about 1.46% of carbon monoxide from all sources and about 15.1% of carbon monoxide from industrial sources.

Particles small enough to remain suspended in air over an extended period are defined as aerosols. The diameter of such particles has been identified as from 0.01 to 100 microns. Particles under 50 microns in diameter tend to remain airborne indefinitely. These are readily transported by the wind, while larger particles generally settle out of the atmosphere.

Using 50 microns as a limiting diameter, aerosols resulting from iron melting operations amount to approximately 56% by weight of total emissions generated. On this basis, the suspendible particulate matter generated by melting operations in 1969 amounted to 136,000 tons, of which approximately 102,000 tons were emitted to the atmosphere.

Particulates over 50 microns in diameter emitted to the atmosphere, being too large to remain suspended, settled out in a short time, depending on meteorological conditions. These totaled 80,000 tons in 1969.

Emissions from non-melting foundry processes, with a single important exception are often controlled as standard practice. These generally and principally affect the internal foundry environment. They are released to the atmosphere only in relatively minor quantities compared to melting furnace emissions.

TABLE 3. Results of Nationwide Emissions Estimated From Iron Foundries

CO emitted from iron foundries	1,462,000 Tons Per Year
Percent of all sources	1.46%
Percent of industrial processes	15.1 %
Particulate emissions emitted to atmosphere	
From melting operations	182,000 Tons Per Year
From non-melting operations	76,600
Total	258,600 Tons Per Year
Percent of all sources	.91%
Percent of all industrial processes	3.46%

Concentration of these emissions at their source can be substantial as in shakeout, abrasive cleaning and grinding operations. But, the particles emitted are generally large with a relatively high settling rate. The portion of the particulate matter escaping normal ductwork collection largely tends to settle out within the foundry building.

An analysis of non-melting operations indicates that about 115 pounds of emissions are estimated to be generated for each ton of metal melted. On the average, only 5.83 pounds or 5% of this total is estimated to be released to the atmosphere. Normal collection practices and settling out within the foundry building account for the difference between these two quantities.

Table 2 illustrates the development of particulate emissions factors for non-melting operations. The various non-melting departments which produce particulate emissions are listed with the different operations occurring in each department. The emissions generated in pounds per ton of melt are estimated for each operation and tabulated in Column 1. Values range from 0.01 lb/ton for wood patternmaking to 32.20 lb/ton for shakeout, and total 114.92 lb/ton generated from all sources.

An estimate of the percent collected monthly is tabulated in Column 2 of the Table. This was applied to the emissions generated to estimate the amount of emission from each operation released to the foundry environment. It is tabulated in Column 3, and totals 60.21 lb/ton. Of the amount released to the foundry environment, a large percentage settles out relatively soon. Settling factors, shown in Column 4, were estimated and applied to emissions released to the foundry environment. These were used to determine the emissions released to the atmosphere as given in Column 5 and totals 9.31 lb/ton from all operations.

All iron foundries do not have all of the departments and operations. To account for this and adjust emission factors accordingly, an incidence factor was applied to the emissions released to the atmosphere for each operation. This was used to obtain the average emissions released to the atmosphere, nationwide. It is tabulated in Column 6 and totals 5.83 lb/ton.

Summary of Results

The high concentration of iron foundries in the Great Lakes states, discussed earlier, accounted for almost 70% of the national molten iron production and approximately 72% of the particulate emissions emitted from the melting and non-melting operations. If the East South Central states of Kentucky, Mississippi, Alabama and Tennessee are also included, almost 85% of the total iron foundry particulate emissions are accounted for.

About 73% of the carbon monoxide emitted from iron foundries occurs in the Great Lakes states. An additional 10% of carbon monoxide emissions occur in the East South Central states for a combined total of almost 83%.

The results of the total nationwide emissions estimated to come from iron foundries are summarized in Table 3.

Although iron foundries annually emit a significant tonnage of carbon monoxide and particulate matter, their percent of the total is relatively small.

TECHNICAL SUPPORT DOCUMENT

for

CONTROL OF LEAD EMISSIONS

from

NONFERROUS METAL PRODUCTION FACILITIES IN LEAD NONATTAINMENT AREAS

AQPSTR 13-07

October 2013

ILLINOIS ENVIRONMENTAL PROTECTION AGENCY
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List of Acronyms

AQPSTR	Air Quality Planning Section Technical Report
CAA	Clean Air Act
CFR	Code of Federal Regulations
gr/dscf	grains per dry standard cubic foot
g/s	grams per second
H. Kramer	H. Kramer and Co. Brass and Bronze Foundry
HAP	hazardous air pollutant
hr/year	hours per year
Illinois EPA	Illinois Environmental Protection Agency
lbs	pounds
lb/hr	pounds per hour
Mayco	Mayco Industries LLC
$\mu g/m^3$	micrograms per cubic meter
NAA	nonattainment area
NAAQS	National Ambient Air Quality Standard
Pb-TSP	lead in total suspended particulates
PM	particulate matter
SIP	State Implementation Plan
USEPA	United States Environmental Protection Agency

Executive Summary

On November 12, 2008, the United States Environmental Protection Agency ("USEPA") revised the primary and secondary National Ambient Air Quality Standards ("NAAQS") for lead to a level of 0.15 micrograms per cubic meter ("$\mu g/m^3$"), maintaining the current indicator of lead in total suspended particulates ("Pb-TSP"), and using a "not-to-be-exceeded" form based upon a three-month rolling average evaluated over a three-year period.[1]

Based on data from air quality monitoring, two areas in Illinois were designated as nonattainment for the lead NAAQS. The area bounded by Granite City Township and Venice Township was designated nonattainment for the lead NAAQS effective December 31, 2010.[2] The area surrounding H. Kramer and Co. Brass and Bronze Foundry ("H. Kramer") was designated as nonattainment for the lead NAAQS effective December 31, 2011.[3]

For the purposes of this document, these areas are respectively referred to as the Granite City Lead Nonattainment Area ("NAA") and the Chicago NAA. These designations of nonattainment triggered requirements for Illinois to revise its State Implementation Plan ("SIP") for lead to address requirements in 40 CFR Parts 51 and 52.

The State of Illinois is required to identify potential sources of lead emissions that may cause or contribute to exceedance of the NAAQS, and develop a control strategy to reduce lead emissions to attain and maintain the NAAQS. Illinois is further required to submit to USEPA an implementation plan that includes: a description of control measures; a demonstration of the adequacy of those measures; lead emissions data and projected emissions data resulting from the plan; air quality data and projected air quality estimates resulting from the plan; and a control strategy demonstration showing that the plan will attain and maintain the NAAQS in these areas specific to the lead NAAQS requirements at 40 CFR 51.117.

Illinois EPA conducted an analysis of potential lead sources in the Chicago and Granite City NAAs that included an inventory for lead and particulate matter ("PM") emissions in the area, laboratory analysis of lead concentrations in the PM emitted from these sources, and dispersion modeling of specific sources for their contribution to ambient lead concentrations.

In its analysis of the Granite City NAA, Illinois EPA determined that one particular source in the area, Mayco Industries LLC ("Mayco"), was the most significant source of lead emissions in the area, and capable of causing exceedances of the NAAQS in the absence of any other sources in the area. Mayco is a secondary lead production facility and fabricator of a variety of lead products. As a result of the facility being dedicated solely to lead products, the concentration of lead in the PM emissions from the source is extremely high relative to other sources in the area.

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[1] "National Ambient Air Quality Standards for Lead, Final Rule." Federal Register 73 (12 November 2008): 66964-67062.

[2] "Air Quality Designations for the 2008 Lead (Pb) National Ambient Air Quality Standards, Final Rule." Federal Register (22 November 2010): 75 FR 71033-01.

[3] "Air Quality Designations for the 2008 Lead (Pb) National Ambient Air Quality Standards, Final Rule." Federal Register (22 November 2011): 76 FR 72097-01.

In its analysis of the Chicago NAA, Illinois EPA identified H. Kramer as the most significant source of lead emissions in the area, and also determined that this source was capable of causing exceedances of the NAAQS in the absence of any other sources in the area.

Dispersion modeling of each source identified above shows that these sources, as currently configured, cause exceedances of the NAAQS in areas outside the property on which they are located, and can cause exceedances of the NAAQS at the nearest air quality monitor when the contributions of the sources are isolated.

In order to reduce lead emissions in the Chicago and Granite City NAAs, and to attain and maintain the NAAQS in these areas, Illinois EPA is proposing to limit lead emissions from nonferrous metal production facilities in lead NAAs. The purpose of this document is to provide technical support for the proposed regulation, and includes a description of the affected sources and their emissions, emission limits and work practices required by the proposed regulation, and an analysis of the technical feasibility of achieving those limits and implementing those practices at the affected sources.

Illinois EPA is proposing to limit lead emissions from affected emission units charging lead bearing materials through the use of pollution control devices. Illinois EPA is also proposing various measures to limit fugitive lead emissions from these sources to the greatest degree practicable.

1.0 Introduction

On November 12, 2008, USEPA revised the primary and secondary NAAQS for lead. The revised primary standard was lowered to 0.15 $\mu g/m^3$ from the previous standard of 1.5 $\mu g/m^3$. In the same action, USEPA revised the secondary standard to be identical to the primary standard in all respects. The averaging time for these standards was also revised to a three-month rolling average, evaluated over a three-year period.

Lead is a naturally-occurring element that has been designated a hazardous air pollutant ("HAP"). Sources of lead emissions from human activities include contamination from past use of leaded gasoline and lead paints, burning of fossil fuels, and various other industrial processes using lead.

Lead is toxic to humans, with health effects that are particularly harmful to children and women of childbearing age. Health effects of lead toxicity to children can include damage to the brain and nervous system, behavior and learning problems, lower IQ, hearing problems, slowed growth, and anemia. Health effects of lead toxicity to pregnant women can include miscarriage, reduced fetus growth, and premature birth. Health effects of lead toxicity to humans include nervous system effects, cardiovascular effects, decreased kidney function, and reproductive problems. In extreme cases, ingestion of lead can result in seizures, coma, and even death.

In Illinois, the area bounded by the Granite City Township and Venice Township was designated as nonattainment for the lead NAAQS effective December 31, 2010, and the area surrounding the H. Kramer Foundry in Chicago was designated nonattainment for the lead NAAQS effective December 31, 2011. These nonattainment designations triggered requirements for Illinois to revise its State Implementation Plan ("SIP") for lead to address requirements in 40 CFR Parts 51 and 52.

The State of Illinois is required to identify potential sources of lead emissions that may cause or contribute to exceedance of the NAAQS, and develop a control strategy to reduce lead emissions to attain and maintain the NAAQS. Illinois is further required to submit to USEPA an implementation plan that includes: a description of control measures; a demonstration of the adequacy of those measures; lead emissions data and projected emissions data resulting from the plan; air quality data and projected air quality estimates resulting from the plan; and a control strategy demonstration showing that the plan will attain and maintain the NAAQS in a number of areas specific to the lead NAAQS requirements at 40 CFR 51.117.

In its analysis of the two lead NAAs, Illinois EPA determined that two significant sources of lead emissions, H. Kramer in the Chicago NAA and Mayco in the Granite City NAA, could be shown by dispersion modeling to cause exceedances of the NAAQS outside their respective property boundaries in the absence of background concentrations or any other source(s) in the area.

Emissions at the two applicable sources are currently regulated by limits on PM emissions. The proposed regulation would limit lead emissions directly. These lead emission limits and other source specific information have been subjected to dispersion modeling to ensure that the proposed regulation will result in attainment of the NAAQS in the respective NAAs.

1.1 Granite City Lead Nonattainment Area

On December 31, 2010, the area bounded by Granite City Township and Venice Township was designated as nonattainment for the lead NAAQS, and for the purpose of this document is referred to as the Granite City Lead Nonattainment Area (or Granite City NAA). The Granite City NAA contains a number of sources that could potentially contribute to an exceedance of the NAAQS for lead. Illinois EPA evaluated these sources to determine their lead emissions, their contribution to ambient levels of lead in the area, and possible control strategies to reduce lead emissions and ultimately attain and maintain the NAAQS in the lead NAA. Figure 1 shows an aerial view of the area, with the NAA boundaries highlighted, showing the locations of Mayco and the Granite City lead monitor.

Figure 1: Map of Granite City Lead Nonattainment Area

In its analysis of the Granite City NAA, Illinois EPA determined that one particular source in the area, Mayco, was capable of causing exceedances of the NAAQS in the absence of any other source in the area. Mayco is a secondary lead production facility and fabricator of a variety of lead products. As a result of the facility being dedicated solely to lead products, the concentration of lead in the PM emissions from the source is high relative to other sources in the area.

The Mayco facility produces a number of lead products including lead shot for ammunition, lead wool for use in applications to limit radiation with flexible materials containing the wool, and various products for naval applications. The source currently employs four fabric filter baghouses to control lead-containing PM emissions from its various operations.

The proposed regulation would limit lead emissions from all pollution control devices at the source. Lead emissions from three of the baghouses would be limited to 0.00010 grains per dry standard cubic foot ("gr/dscf"), and the fourth baghouse would be limited to 0.0010 gr/dscf. Additionally, the proposed regulation would require a total enclosure under negative pressure around the operations that cause the most significant uncaptured emissions for the control of fugitive emissions from these operations. A more detailed description of fugitive lead emission control measures can be found in Section 2.1.3 of this document.

The proposed limits were modeled by the Illinois EPA to verify that the limits, as proposed, would ensure that the NAAQS would not be exceeded beyond the property boundaries of the source.

1.2 Chicago Lead Nonattainment Area

On December 31, 2011, the area surrounding H. Kramer, bounded by Damen Ave. on the west, Roosevelt Rd. on the north, the Dan Ryan Expressway on the east, and the Stevenson Expressway on the south, was designated as nonattainment for the lead NAAQS, and for the purposes of this document is referred to as the Chicago Lead Nonattainment Area (or Chicago NAA). Figure 2 shows an aerial view of the area, with the NAA boundaries highlighted, and showing the locations of H. Kramer and the Perez School lead monitor.

Figure 2: Map of Chicago Lead Nonattainment Area

In its analysis of the Chicago NAA, Illinois EPA identified H. Kramer as the main source of lead emissions in the area, and also determined that this source was capable of causing exceedances of the NAAQS in the absence of any other source in the area.

The H. Kramer facility produces brass and bronze products that utilize lead in some of their alloys. The source is currently subject to a joint state and federal consent decree mandating the construction and operation of new pollution control equipment, among other requirements. The source consists of the South and North Foundries.

The North Foundry generally produces alloys and products containing very little or no lead, and so lead emissions from this building are minimal. In the North building, H. Kramer operates coreless induction furnaces controlled by a baghouse, and channel furnaces controlled by a wet scrubber. Emissions of lead from the exit points of both of these controls would be limited to 0.000010 gr/dscf by the proposed regulation.

The South Foundry produces brass and bronze products in two rotary furnaces. The brass and bronze alloys used for these products often include lead as a minor constituent. These furnaces are controlled by two new baghouses required by H. Kramer's recent consent decree. Emissions of lead from both of the new baghouses would be limited to 0.00010 gr/dscf by the proposed regulation. Additionally, the South Foundry would be required to operate a total enclosure under negative pressure for the control of fugitive emissions from this building. A more detailed description of fugitive lead emission control measures can be found in Section 2.1.3 of this document.

The proposed limits were modeled by the Illinois EPA to verify that the limits, as proposed, would ensure that the NAAQS would not be exceeded beyond the property boundaries of the source.

2.0 Proposed Regulation

The proposed regulation, Part 226, will reduce lead emissions from affected sources by requiring particulate control equipment for all lead kettles and furnaces charging lead-containing materials at the affected sources, setting limits for lead emissions, minimizing emissions from the most significant sources of fugitive lead emissions by requiring their operation inside a total enclosure under negative pressure, and by requiring housekeeping and cleaning requirements on a source-wide basis to further prevent fugitive emissions.

The lead emissions anticipated as a result of the adoption of the proposed regulation, along with the specific source configurations, have been subjected to dispersion modeling to ensure that the NAAQS for lead will be attained for the respective NAAs at all locations outside the property boundaries of the affected sources.

2.1 Lead Emission Limits

The numerical lead emission limits in the proposed regulation were determined by an analysis of each affected source's operation and configuration. Factors in these analyses included possible capture and control efficiencies of particulate control equipment, spatial configuration of the affected sources, emission release points, and sources of fugitive emissions. These factors were subjected to dispersion modeling to determine locations outside the property boundaries of the affected sources that would experience the greatest impact from source emissions. Modeled lead concentrations at these points of maximum impact must be less than 0.15 $\mu g/m^3$, averaged over the appropriate timeframe, in order to demonstrate an expected attainment of the lead NAAQS.

Along with the proposed measures to minimize fugitive emissions from the affected sources, the numerical limits in the proposed regulation reflect the Illinois EPA's analysis of lead emission control adequate to ensure continuous NAAQS compliance.

2.1.1 Lead Emission Limits Applicable to Mayco

The proposed regulation would require that all lead kettles at Mayco be controlled by a particulate emission control system. These systems, in general, are hoods or covers over the kettles that are ducted to a particulate filtering device such as a fabric filter baghouse or a cartridge filter system. The lead emission limits in the proposed regulation are for the exhaust from these control devices and are measured in gr/dscf.

The most significant sources of lead emissions at the facility are alloying and refining kettles and their associated operations. These operations include alloying and refining of scrap metals, lead, and other alloy elements in kettles that are operated at higher temperatures than other kettles. The kettles' covers are often open for a significant portion of the time that they are in use to allow for drossing and for the addition of elements in the alloying and refining process. Emissions of lead for a baghouse controlling alloying and refining kettles would be limited to 0.0010 gr/dscf. The proposed regulation would also require these operations to be conducted within a total enclosure under negative pressure to achieve a high capture efficiency of uncontrolled and fugitive emissions from these operations. The gas stream exiting the total enclosure would be required to be ducted to a particulate control device meeting a lead emission limit of 0.00010 gr/dscf.

The remaining lead kettles at Mayco are generally kept covered during operation and are operated at lower temperatures for the remelting of refined lead alloys. The proposed regulation would require that these kettles be covered, and for hoods to be in place where molten lead is released from these kettles. The proposed regulation would require that these covers and hoods be ducted to a control device meeting a lead emission limit of 0.00010 gr/dscf. This would require Mayco to install new equipment to control one currently uncontrolled kettle at their lead wool operation, and would prohibit them from operating another uncontrolled unit, the hot pour operation, unless control equipment meeting the lead emission limit is installed.

The proposal would also require additional fugitive emission control for activities including scrap sorting, quenching and mold cooling operations, and handling of lead-bearing materials. These activities would be required to be conducted while controlled with fugitive emission capture equipment or within a total enclosure under negative pressure. Emissions from these activities would be required to be ducted to control equipment meeting a lead emission limit of 0.00010 gr/dscf.

The emission limits and fugitive measures applicable to Mayco in the proposed regulation have been subjected to dispersion modeling to confirm that the NAAQS for lead will be attained at all locations outside of the facility's property boundaries.

2.1.2 Lead Emission Limits Applicable to H. Kramer

The proposed regulation would require that all furnaces at H. Kramer be controlled by a particulate emission control system. At H. Kramer, these systems generally consist of hoods for capture of emissions that are ducted to a fabric filter baghouse or wet scrubber. The lead emission limits in the proposed regulation are for the exhaust from these control devices and are measured in gr/dscf.

The most significant sources of lead emissions at H. Kramer are two rotary reverberatory furnaces located in the facility's South Foundry and used for the alloying of brass and bronze. The proposed regulation would require that these furnaces be equipped with a particulate emission capture system ducted to pollution control equipment meeting a lead emission limit of 0.00010 gr/dscf. These furnaces would also be required to be operated within a total enclosure under negative pressure to achieve a high capture efficiency of fugitive lead emissions. The gas stream exiting the total enclosure would be required to be ducted to a particulate control device meeting a lead emission limit of 0.00010 gr/dscf.

All furnaces at H. Kramer would be required to be equipped with a particulate emission capture system ducted to pollution control equipment. More specifically, induction furnaces located at the facility's North Foundry would be required to meet a lead emission limit of 0.000010 gr/dscf. All other furnaces would be required to meet a lead emission limit of 0.00010 gr/dscf.

The proposal would also require additional fugitive emission control for activities including scrap sorting, quenching and mold cooling operations, and handling of lead-bearing materials. These activities would be required to be conducted while controlled with fugitive emission capture equipment or within a total enclosure under negative pressure. Controlled or uncontrolled exhaust gas emissions from these activities would be required to meet a lead emission limit of 0.00010 gr/dscf.

H. Kramer is currently subject to a joint state and federal consent decree requiring a number of measures for control of lead emissions. The emission limits in the proposed regulation are consistent with expected control efficiencies called for by the consent decree requirements. The fugitive measures in the proposed regulation are more stringent than those called for by the consent decree. Consistent with the proposed regulation, stack and fugitive emissions from the source have been subjected to dispersion modeling to confirm that the NAAQS for lead will be attained at all points outside of the facility's property boundaries.

2.1.3 Fugitive Emission Requirements

In addition to the emission limits for each stack emission point at the affected sources, the proposed regulation includes requirements to minimize fugitive emissions from both affected sources. Fugitive emissions of lead are those not captured by hoods or covers on the emission units. Rather, fugitive emissions are those that can be released to the atmosphere through openings in the buildings that house the units, or emissions that are not captured and are deposited on the ground or other surfaces that can be disturbed and re-emitted later. While it is difficult to precisely quantify emission reductions from the fugitive emission requirements in the proposed regulation, Illinois EPA anticipates that these measures will result in significant lead emission reductions from the affected sources relative to current practices.

As described in the previous two sections, the units that are the most significant sources of fugitive emissions at both affected sources would be required to operate within a total enclosure that is under negative pressure. A total enclose under negative pressure means that the enclosure must be free of cracks, gaps, and openings that could allow fugitive emissions to escape, and that the air flow through any intentional openings in the enclosure must be into the enclosure. Any gas stream exiting the enclosure would be required to be controlled by particulate emission control equipment meeting a lead emission limit of 0.00010 gr/dscf. Additionally, all areas within the enclosure would be required to be cleaned after the emission unit ceases operation and before terminating the negative pressure.

Additional measures for reduction of fugitive emissions can be found in Section 226.170 of the proposed regulation in the requirements for a Lead Fugitive Dust Operating Plan. This plan would include requirements for the cleaning of buildings housing emission units, cleaning of plant roadways and other areas, and for the handling and storage of lead-containing materials.

2.2 Additional Requirements

The proposed regulation would also set forth emissions testing, monitoring, recordkeeping, and reporting requirements for affected sources. These are in addition to the general provisions required for the affected sources previously discussed, and are aimed at ensuring reductions in lead emissions are realized.

2.2.1 Emissions Testing

The proposed regulation would require initial stack testing for lead emissions on each affected control device prior to January 1, 2015, and subsequent testing once every five years. These stack tests are specifically for emissions of lead, and testing protocols are detailed in Section 226.175 of the proposed regulation.

2.2.2 Monitoring Requirements

The proposed regulation includes periodic monitoring requirements for pollution control devices and for total enclosures under negative pressure.

In addition to emission testing that would be required for control devices, the proposed regulation would require that control devices be equipped with bag leak detection systems and differential pressure monitoring systems to ensure lead emissions from control devices remain consistent with periodic emissions testing. Bag leak detection systems are capable of detecting excess particulate exiting a control device stack. Differential pressure monitors detect when a failure of the filtration medium may have occurred. Affected sources would be required to develop a Control Device Monitoring Plan ("CDMP") pursuant to Section 226.150 of the proposed regulation and submit the plan for approval by Illinois EPA.

The proposed regulation would also require affected sources to monitor total enclosures under negative pressure by monitoring either the flow rate of air entering the total enclosure, or by monitoring the differential pressure between inside and outside of the enclosure. In either case, the affected source would be required to develop and operate in accordance with a Continuous Parameter Monitoring Plan ("CPMP") for the enclosure, pursuant to Section 226.160 of the proposed regulation. The affected source would also be required to submit the CPMP for approval by Illinois EPA.

2.2.3 Recordkeeping and Reporting Requirements

The proposed regulation would require affected sources to keep records of: any cleanings or maintenance activities performed to maintain compliance with the Lead Fugitive Dust Operating Plan in Section 226.170; any significant changes in pressure differential across control devices or alarms associated with those changes according to the CDMP pursuant to Section 226.150; and data collected in order to comply with the CPMP and Sections 226.155 and 226.160.

The proposed regulation would require semi-annual reporting to the Illinois EPA that includes summaries of the above records, and any deviations detected from the above monitoring requirements. Deviations must also be reported to Illinois EPA within five days of their occurrence.

3.0 Anticipated Lead Emission Reductions

The proposed regulation would require that both affected sources install additional pollution control equipment, and that they operate under a fugitive dust plan to minimize fugitive lead emissions. Illinois EPA estimates that the proposed regulation will result in lead emission reductions of greater than 50% at both affected sources. In the case of each affected source, Illinois EPA has compared company-reported lead emissions based on stack testing to allowable lead emissions from the proposed regulation. Illinois EPA considers these emissions reduction estimates to be very conservative because it is unlikely that any of the affected units at these sources will be emitting at the full allowable rate.

3.1 Emission Reductions at Mayco

Reported emissions from Mayco were based on stack testing performed in 2012. Mayco reported lead emissions of 0.45178 tons or 903 pounds ("lbs") in 2012. Illinois EPA estimates that under the proposed regulation, lead emissions at Mayco will be reduced to less than 418 lbs per year, even if Mayco operates at the maximum rate, for a 53.7% reduction. The future year estimates are based on allowable emissions from all emissions points at the facility as well as estimates for fugitive emissions. Table 1 shows allowable emissions at Mayco under the proposed regulation in gr/dscf. For point sources, these emissions have been converted to g/s and lb/hr based on the flow rates of the specific pollution control device. For purposes of dispersion modeling, these emission rates are assumed for all hours of the year, or 8760 hours per year ("hr/year").

As noted above, the estimates for emission reductions are conservative because it is not likely that individual units will operate at the full allowable rate, and because the source is not operational 24 hours a day throughout the year. The source reported 4160 operating hours in 2012. These conservative estimates are necessary to conduct dispersion modeling to ensure that the proposed regulation demonstrates compliance with the NAAQS under the 8760 hour scenario at full allowable emission rates.

Table 1: Mayco Estimated Lead Emissions from Proposed Regulation

Modeling Unit ID	Source Description	Emissions (g/s)	Emissions (lb/hr)	Emissions (lb/year)
	POINT SOURCES			
MY9	Shot Dept. Baghouse Discharge - .0001 gr/dscf	0.0042	0.0033	29.0823
MY55	Cast-refine (Dross) baghouse - .001 gr/dscf	0.0506	0.0401	351.5179
MY49	Casting fugitives baghouse - .0001 gr/dscf	0.0042	0.0034	29.4716
MY5LW	Lead wool cartridge filter - 0.0001 gr/acfm	0.0011	0.0009	7.5087
	VOLUME SOURCES			
MV1	Volume 1 ; shot tower	5.58E-05	4.43E-05	0.3879
MV5	Volume 5 ; casting/dross	1.98E-05	1.57E-05	0.1377
MV6	Volume 6 ; 1 of 3 for lead wool	4.20E-07	3.33E-07	0.0029
MV7	Volume 7 ; 2 of 3 for lead wool	4.20E-07	3.33E-07	0.0029
MV8	Volume 8 ; 3 of 3 for lead wool	4.20E-07	3.33E-07	0.0029
MV9	Volume 9 ; hot pour bldg	3.48E-07	2.76-07	0.0024
MV10	First extrusion area volume	1.61E-06	1.28E-06	0.0112
MV11	Second extrusion area volume	1.61E-06	1.28E-06	0.0112
MV12	Third extrusion area volume	1.61E-06	1.28E-06	0.0112
MV13	Volume #1 of Brittania (BRZ)	5.33E-06	4.23E-06	0.0371
MV14	Volume #2 of Brittania (BRZ)	5.33E-06	4.23E-06	0.0371
MV15	Volume #3 of Brittania (BRZ)	5.33E-06	4.23E-06	0.0371
TOTAL				418.2620

3.2 Emission Reductions at H. Kramer

Emission reductions at H. Kramer were estimated in the same way as above for Mayco. Estimated future year lead emissions were based on limits in the proposed regulation and compared to facility-reported emissions from 2012 based on stack testing. H. Kramer reported lead emissions of 0.100 tons or 200 lbs in 2012. Illinois EPA estimates that under the proposed regulation, lead emissions at H. Kramer will be reduced to less than 100 lbs per year, a 50% reduction. Table 2 shows allowable emissions at H. Kramer under the proposed regulation in gr/dscf. For point sources, these emissions have been converted to g/s and lb/hr based on the flow rates of the specific pollution control device. For purposes of dispersion modeling, these emission rates are assumed for all hours, or 8760 hours per year.

As noted above, the estimates for emission reductions are conservative because it is not likely that individual units will operate at the full allowable rate, and because the source is not operational 24 hours a day throughout the year. The source reported 5160 operating hours in 2012. These conservative estimates are necessary to conduct dispersion modeling to ensure that the proposed regulation demonstrates compliance with the NAAQS under the 8760 hour scenario at full allowable emission rates.

Table 2: H. Kramer Estimated Lead Emissions from Proposed Regulation

Modeling Unit ID	Source Description	Emissions (g/s)	Emissions (lb/hr)	Emissions (lb/year)
	POINT SOURCES			
STACK4	Existing Baghouse at .00001 gr/dscf	3.39E-04	0.0003	2.3597
PCSCRB	Wet scrubber at .00001 gr/dscf	1.61E-04	0.0001	1.1225
R1COOL	Powered vent at .0001 gr/dscf	0.0016	0.0012	10.8980
R2COOL	Powered vent at .0001 gr/dscf	8.63E-04	0.0007	6.0000
INGOT	Powered vent at .00001 gr/dscf	2.90E-05	2.30E-05	0.2018
BGHSEA	New baghouse A at .0001 gr/dscf	0.0054	0.0043	37.7597
BGHSEB	New baghouse B at .0001 gr/dscf	0.0054	0.0043	37.7597
	VOLUME SOURCES			
VRECV	Receiving	7.06E-06	5.60E-06	0.0491
VBAGH	Baghouse maintenance	2.98E-04	0.0002	2.0709
VMAIN	Main building	1.76E-05	1.40E-05	0.1226
VLADL	Ladle repair	3.29E-05	2.61E-05	0.2286
VSHIP	Shipping	1.21E-04	9.62E-05	0.8427
VWARE	Warehouse	5.42E-05	4.30E-05	0.3767
THRM_EX	Thermal extrusion	2.83E-05	2.25E-05	0.1970
TOTAL				99.9889

4.0 Technical Feasibility

The emission limits, fugitive emission measures, and all other requirements in the proposed regulation are technically feasible for the affected sources. The numerical lead emission limits in the proposed regulation are achievable with commercially available particulate control equipment, and in some instances pollution control equipment currently operated at the affected sources is sufficient to meet the proposed limits.

Fugitive emission reduction measures in the proposed regulation, including total enclosures under negative pressure, other capture systems, and housekeeping measures, are common in similar industrial settings nationwide and are feasible and appropriate for the affected sources.

In the process of drafting the proposed regulation, Illinois EPA has engaged in extensive communication with the affected sources regarding the configuration of the sources and technical aspects of their emission units and pollution control equipment. The information conveyed in these communications was incorporated into Illinois EPA analyses of the measures necessary to demonstrate the anticipated attainment of the NAAQS in both lead nonattainment areas, and are reflected in the proposed regulation. Both sources have agreed that these requirements are technically feasible.

5.0 Economic Analysis

Both sources of lead emissions affected by the proposed regulation will be, or are already in the process of, making upgrades to current pollution control equipment to meet the proposed lead emission limits. Additionally, both affected sources will be, or already are, making improvements in building infrastructure, work practices, and recordkeeping practices that would be required by the proposed regulation to ensure reductions in fugitive emissions of lead from the sources.

Illinois EPA has made efforts to remain in communication with both affected sources during the process of drafting the proposed regulation. These communications have resulted in a greater understanding of these sources' operations by the Illinois EPA, and in a proposed regulation that the Illinois EPA anticipates will result in NAAQS attainment in both nonattainment areas in an economically reasonable manner. Additionally, Illinois EPA believes the proposed regulation to be economically reasonable because both sources affected by the proposed regulation have agreed that changes to equipment and operations necessary to comply with the regulation can be completed in an economically reasonable manner. At the time of this rulemaking, both sources have already begun to implement these changes in order to meet compliance requirements by the effective date of the proposed regulation.

H. Kramer is currently subject to a consent decree due to previous lead violations. The proposed regulation would codify much of what is required in the consent decree and, as such, those portions would pose no additional economic burden to H. Kramer. Additional requirements beyond the consent decree in the proposed regulation, such as fugitive emission measures and additional recordkeeping and reporting measures, are not expected to have significant economic impact relative to the consent decree requirements.

Mayco has applied to the Illinois EPA for a permit to begin construction on upgrades necessary to meet the requirements of the proposed regulation. Mayco's submittal of a construction permit application is just one indication of the cooperation that has taken place between the Illinois EPA and Mayco. This cooperation has yielded a proposed regulation that will ensure compliance with the lead NAAQS in a cost-effective manner.

Conclusion

The proposed regulation includes appropriate emission control measures to limit lead emissions from the affected sources, and is adequate to address the requirements of the CAA for the NAAQS for lead. These measures will achieve major reductions in lead emissions from the culpable sources by limiting stack emissions via control devices as well as from fugitive sources of lead.

If adopted, Part 226 will be submitted to USEPA as a SIP revision. Illinois EPA will demonstrate through dispersion modeling that the emission reductions from the proposed regulations are adequate to achieve and maintain the NAAQS for lead in both currently designated lead NAAs in Illinois. Further, the Illinois EPA will demonstrate that the testing, monitoring, recordkeeping, and reporting requirements in the proposed regulation are sufficient to ensure ongoing compliance with the NAAQS until these areas can be redesignated as being in attainment of the standard.

In drafting the proposed regulation, Illinois EPA has been in frequent communication with the affected sources in order to ensure that the emission control measures in the proposed regulation are technically feasible, and that these measures will achieve the necessary emission reductions in an economically reasonable manner at both sources.

Assessment of Fugitive Lead Emissions from the Electric Furnace Building

H. Kramer & Co.
Chicago, Illinois

June 26, 2012

TRC Environmental Corporation | H. Kramer & Co.
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Section 1
Objectives and Scope of the Evaluation

1.1 Objective

The objectives in conducting this evaluation were:

- To assess the potential for material quantities of fugitive lead emissions from the Electric Furnace Building.
- To estimate the emissions of lead and use air quality modeling to evaluate the impact, if any, at the ambient air monitoring stations.
- To identify and evaluate methods to reduce any meaningful fugitive emission potential to the extent feasible.

1.2 Scope

The scope of TRC's evaluation focused on the entire manufacturing facility and its operation. There are two separate foundries: the Rotary Furnace Building, with its two rotary furnaces, and the Electric Furnace Building, with its three coreless induction furnaces and two channel furnaces. This report covers the Electric Furnace Building, which consists of a semi-enclosed building space.

Section 2
Conclusions

1. Days with Melting of Non-Lead Alloys

On two days on which non-leaded alloys were melted and cast in the Electric Furnace Building, small concentrations of lead were detected in thermal exfiltration out of the roof and high side-walls and in the ingot cooling (steam) stack emissions. On one occasion, wind effects caused air exfiltration out one of the truck doors; however, no lead emissions occurred because the building space inside this door had no detectable lead concentration.

- During operation, the Electric Furnace Building was kept under a negative pressure, produced by the continuously operating, close-capture furnace exhaust systems and the intermittently operating ingot cooling exhaust fan. Thermal exfiltration out the roof and high sidewalls occurred because of a temperature difference above and below the roof. The fugitive lead emission rate was 1.7 mg/min.
- The lead emission rate associated with the ingot cooling fan was 0.181 mg/min. These calculations were based on TRC's measurements of:
    - The in-building concentration in the ingot cooling area during ingot pouring.
    - The airflow rate of the cooling tunnel exhaust.
    - Use of the above measurements as emissions to the outdoor air would assume that none of the lead is controlled in the cooling process or by the produced steam (a conservative assumption because the steam will scrub most of the lead before discharge).

2. Day with Melting of Lead Alloy

On a day in which a leaded alloy was melted and cast, lead emissions were found to occur in thermal exfiltration out of the roof and high side-walls and in the ingot cooling (steam) stack emissions. On the lead melting and casting day, the company specifically melted a lead alloy for this study. This alloy was only made twice during the first four months of 2012. The following lead emission rates were determined:

a. Thermal exfiltration: 26.9 mg/min.

b. Ingot cooling Stack: 18.1 mg/min.

3. Modeling of Fugitive Emissions

Ambient air quality modeling of all the fugitive emissions from the Electric Furnace Building shows that those emissions are:

a. Only a small fraction of the stack emissions from the facility.

b. The maximum 90 day rolling average over 2 and ¼ years of meteorological data from the modeled results is 0.002 μg/m³ at the Perez School monitor and 0.0005 μg/m³ at the Juarez School monitor. These are less than 1/75th of the NAAQS.

4. Modeling of All H Kramer Emissions

Modeling of all of the lead emissions from the H Kramer facility including the stacks, the South Foundry building fugitive emissions, the interconnected building fugitive emissions, and the Electric Furnace Building fugitive emissions was conducted. The result was a maximum 90 day rolling average of 0.042 μg/m³ at the Perez School monitor and 0.015 μg/m³ at the Juarez School monitor. This is less than 1/3rd of the NAAQS at the Perez School monitor and 1/10th of the NAAQS at the Juarez School monitor.

Section 3
Technical Approach and Methods

3.1 Overall Approach

This evaluation was undertaken by conducting the following task elements:

1. Touring the Electric Furnace facility during normal production and discussing processes involved in the melting and casting operation with operational and maintenance staff.
2. Assessing the in-building concentrations of lead within the Electric Furnace Building during the charging, melting and refining, and ingot pouring phases of the metal casting operations.
3. Conducting a ventilation analysis of the Electric Furnace Building, identifying any pathways through which indoor air could have been leaving the building.
4. Estimating the lead emission rate associated with any uncontrolled air discharges which were occurring from the Electric Furnace Building. These emissions are then modeled for their impact.
5. For the purpose of this study, H Kramer melted a leaded alloy even though that is a rare event (this alloy was made only twice in the electric furnaces in the first four months of 2012).

3.2 Fugitive Emission Assessment Methods

The measurement methods employed in this evaluation are summarized in Table 1. Factory calibrated instruments were used in this evaluation. At the time of the evaluation, TRC subjected these instruments to a calibration checking procedure which compared their readings to standard measurement methods. The results of these calibration checks are provided in Appendix A.

A calibration certificate for the airflow checking device used for the calibration of air sampling pumps is also included in Appendix A.

Section 4
Lead Profile within the Electric Furnace Building

4.1 Introduction

In-building air sampling was undertaken to characterize the lead content of the semi-enclosed electric furnace melting and casting operation. Air sampling was conducted on two days on which non-leaded alloys were melted and cast and on one day on which leaded alloy was melted and cast.

A plan view layout of this operation is presented in Figure 1. The semi-enclosed building space consisted of two joined areas with large interconnecting doorways: a Material Staging Area and a Furnace Room. The Material Storage Area was open to the outdoors (Door A) and to an adjacent indoor storage area (Door B). The Furnace Room was open to an indoor phos copper storage area (Door C and nearby Pedestrian Door D).

Two different measurement approaches were employed in this analysis:

1. Gathering of time-weighted-average (TWA) air samples at locations throughout the Electric Furnace Building as well as in adjacent indoor spaces, connected to the Electric Furnace Building by continuously open doors. The air samples were gathered on two no-lead days and one lead-day and were analyzed for total particulate matter (TPM) and lead content.
2. Gathering of real-time TPM measurements at a grid of locations throughout the Electric Furnace Building and creation from these readings of air quality contour maps representing air quality conditions on the two no-lead days and on the lead-day.

4.2 Area Concentrations of Total Particulate Matter (TPM) and Lead Content

Area samples were gathered mainly in the work zones at factory floor but also at two elevated locations. The samples were analyzed for total particulate matter and lead. The duration of the samples averaged 336 minutes and 301 minutes on the two no-lead days and 484 minutes on the lead day. The furnace activities conducted during those sampling periods included charging, melting metal treating, slagging and pouring of ingots from five different furnaces.

The results of the area sampling are summarized in Table 2, with a page of results for each sampling day. The locations of the samples are designated by letters in Figure 1. Not all of the area samples were gathered inside the Electric Furnace Building. Samples at Points A through C were gathered in indoor spaces just outside the internal building doors leading from the

Electric Furnace Building. At Point L inside the Electric Furnace Building, samples were gathered both in the work zone at factory floor and just under the roof.

Elevated Point N, located half way up the building height on the coreless induction melting platform, was sampled on both a no-lead day and a lead day. However, due to sampling cassette mounting difficulties, only one of the two samples at this elevated location was successfully recovered (*i.e.*, on the June 6 no-lead day).

Findings

1. The sampling results demonstrated the retention capability of the ventilation system within the Electric Furnace Building. On no-lead days, lead was not detected at any of the indoor sampling locations (Points A – C) outside of the Electric Furnace Building. On the lead-day, a low lead concentration of 0.0026 mg/m^3 was detected at Point B in the phos copper storage area.
2. Inside the Furnace Room, on no-lead days, detectible amounts of lead were measured in 60 % of the samples, ranging in concentration from 0.0029 to 0.0098 mg/m^3.
3. Inside the Furnace Room on the lead day, detectable amounts of lead were measured in all of the samples, ranging in concentration from 0.0095 to 0.120 mg/m^3 in the work zones. The east side of the Furnace Room had a higher range of lead concentrations than the west side. The west side range was 0.0095 to 0.020 mg/m^3. The east side range was 0.097 to 0.120 mg/m^3. At Point L in the northeast corner of the room, lead concentration nearly doubled from floor to ceiling, increasing from 0.097 to 0.190 mg/m^3.
4. Lead was not detected in the Material Staging Area of the Electric Furnace Building on no-lead days. On the lead day, lead was detected in this area, ranging in concentration from 0.018 to 0.021 mg/m^3 in the two samples.

4.3 Contour Maps of Total Particulate Matter (TPM)

Real time measurements of TPM were made at 50-inches above factory floor at 23 locations within the Electric Furnace Building and 2 locations in the connected phos copper storage area (see Figure 1). Using a contour mapping program, these readings were subsequently combined to create TPM profiles. These profiles were produced for all three days of the evaluation (Figures 2-4). On the third day, the method was extended to include profiles at elevations of 5, 10, and 15 feet above factory floor.

Findings

1. At factory floor, a definite tendency toward concentration of TPM in the northeast corner of the Electric Furnace Building was noted in all of the profiles.

2. On June 6, evaluation of profiles at different building heights demonstrated a definite pattern of elevated TPM concentration with building height. The average concentration at 15 feet high was 75 times higher than the average concentration at 5 feet.

An explanation for this finding can be made as follows: Fugitive process emissions, where they occur, contain both TPM and thermal energy. Consequently, the migration of TPM is initially toward the ceiling, driven by thermal buoyancy. The ventilation pattern of the facility is produced by air which is withdrawn through furnace hoods, whose suction inlets are located in the lower half of the overall building height. Thus, TPM must descend to the level of these suction openings to be evacuated. Hence, a concentration gradient exists with higher concentrations of TPM at elevated heights within the building.

Section 5
Ventilation Analysis of the Electric Furnace Building

5.1 Ventilation Mode of the Electric Furnace Building

The ventilation of the Electric Furnace Building may be classified as "exhaust-driven" ventilation. Exhaust-driven ventilation occurs when powered exhaust dominates the ventilation of a facility and when replacement air (makeup air) is primarily produced due to the negative pressure created inside the building by the exhaust. In the case of the Electric Furnace Building, the majority of the makeup air is infiltrated through three constantly open truck doorways and an open pedestrian door (Figures 1 and 5). The only powered supply air equipment in use during this evaluation was a fan which drew in outside air to cool the channel furnaces.

An air mass balance of the Electric Furnace Building, based on ventilation measurements made by TRC, is presented in Table 3. The total ventilation rate was determined to vary between standard 38,508 ft^3/min (SCFM) and 35,821 SCFM, depending on whether the ingot cooling fan was operating. This fan operated during the ingot pouring phase of the coreless induction furnace cycle.

5.2 Prevention of Exfiltration Due to Building Negative Pressure

The negative pressure in the Electric Furnace Building was low (*i.e.*, measured at 0.004 inches water column) because of the large area of open doorways in relation to the building ventilation rate. A summary of average measured indraft velocities through the doorways is presented in Table 4. These measurements were made on a no-lead day (June 6) and a lead day (June 5). The doorway openings were subdivided into equal areas and the velocities at the centroid of each area were measured and averaged (see Appendix C). It can be seen from this data, that the doors predominately provided infiltration air due to the negative pressure measured near factory floor throughout the building.

However, in one of the two door velocity assessments, exfiltration was evidenced at one door (exterior Door A on June 6) due to wind forces acting through interior Doors B, C, and D. These three interior doors connected the Electric Furnace Building to semi-enclosed warehouse space that had sufficient exterior openings to allow the wind pressure to create positive pressure at these internal doors leading to the Electric Furnace Building. This positive pressure in turn elevated the infiltration rate through these three internal doors to the extent that the negative pressure in the Electric Furnace Building was overcome, resulting in exfiltration through exterior Door A.

5.3 Ventilation Pattern within the Electric Furnace Building

Exhaust-driven ventilation typically produces an air quality profile of increasing air contaminant concentrations from the infiltration openings to the exhaust locations. That pattern is readily seen in the profiles of total particulate matter measured near factory floor and presented in Figures 2 and 3 and the top figure of Figure 4. The lead concentrations followed that same pattern as evidenced by the fact that lead percentage in the samples was consistent in the area samples on both the lead day and the no-lead day.

5.4 Exfiltration through the Roof and High Side Walls

Heat generated by the melting furnaces rises within the furnace room. Since there is no powered roof exhaust, a stratified temperature is thus created with the highest temperatures just under the roof. Air density is inversely proportional to temperature. Because the density of the heated air just under the roof is lower than the density of the outdoor air above the roof due to the temperature differences, a positive differential pressure is created at the roof barrier which allows air to exfiltrate by buoyant force through any openings in the roof and high-sidewalls of the building.

The temperature differences between indoor and outdoor roof level air were 32°F and 37°F for the two no-lead days and 37°F for the lead day. The buoyant air forces pushing up against the roof due to the air density differences overcame the overall negative pressure of 0.004 inches water column created by the exhaust-driven ventilation and produced exfiltration through roof and high sidewall openings.

Evidence of high level building exfiltration was seen during the three days of ventilation assessment. There is a pedestrian door leading to the roof in the northeast corner of the Furnace Room (Location L, Figure 1). That door has a cutout near the bottom of the door. Exfiltration velocities ranged from 133 to 450 ft/min through that door cutout during the course of the evaluation.

All roofs exhibit the potential for "breathing" (*i.e.*, infiltration and exfiltration) due to the presence of gaps, most of which are tiny and invisible to the naked eye, even under high sunlight conditions. This roof and upper building areas had visible openings at two locations: the door cutout mentioned above and gaps around a rooftop hatch access door.

The measured air mass balance assessment in Table 3 showed limited differences between the amounts of exhaust and makeup air which could be assigned to probable exfiltration.

However, there is a margin of error in conducting an air mass balance of this nature due to the effect which wind gusting has on velocity measurements through doorways. Using the velocity readings through the pedestrian door opening near the roof and the finding of approximate measured air balance within the facility, TRC judges that the high level exfiltration evidenced on the days of evaluation was probably in the range of 5,000 SCFM.

Section 6
Estimated Fugitive Lead Emissions from the Electric Furnace Building

6.1 Introduction

There were two sources of fugitive lead emissions from the Electric Furnace Building found during this evaluation:

1. Thermal exfiltration through openings in the high sidewalls and roof of the building.
2. In plant air drawn into the ingot cooling tunnel and discharged outdoors.

Calculations of fugitive lead emission rates from of these sources are presented in the following subsections. In each case, estimates have been made for potential lead emissions for both the lead-day (June 5) and the no-lead-days (June 4 and 6).

6.2 Fugitive Lead Emission Rate from Thermal Exfiltration

During this evaluation, TRC detected that the in plant pressure differential with the outdoors was always positive at roof level (see Section 5.4). Positive differential pressure was associated with buoyant air forces caused by indoor roof-level air being sufficiently warmer than outdoor air to overcome the negative pressure of the building space.

Thermal Exfiltration: Fugitive Lead Calculations

Given: Area Sample L (Elevated), Figure 1 and ventilation assessment discussion of Section 5.4

Lead concentration on the lead-day = 0.19 mg/m^3 (Table 2)

Measured velocity through a building opening in the high side-wall at Area Sample Location L was 300 ft/min on June 5.

Calculated maximum airflow rate through this opening with an estimated opening size of 3.3 ft^2:

$$3.3\ \text{ft}^2 \times 300\ \text{ft/min} = 990\ \text{ft}^3/\text{min}$$

The pedestrian door opening (described above) was estimated to be about 20% of the total area of the roof and high sidewall openings. This estimate appears appropriate because of the near balance condition of the Electric Furnace Building between measured exhaust rate and measured infiltration (Table 3). Should thermal exfiltration have been higher than 5,000 SCFM, a greater difference between exhaust and infiltration would have been expected.

$$5{,}000\ \text{ft}^3/\text{min} \times 0.19\ \text{mg/m}^3 \times 1\text{m}^3/35.31\ \text{ft}^3 = 26.9\ \text{mg/min}$$

Using the average lead concentrations at this same location just below roof level (Area Sample L, elevated, in Table 2) comprised of the two non-lead days results in the following calculation of fugitive lead emissions:

$$5{,}000\ \text{ft}^3/\text{min} \times 0.0121\ \text{mg/m}^3 \times 1\text{m}^3/35.31\ \text{ft}^3 = 1.7\ \text{mg/min}$$

6.3 Fugitive Lead Emission Rate from Ingot Cooling

During this evaluation, TRC detected a potential for fugitive lead emissions from the Electric Furnace Building from the powered ingot cooling ventilation system. This cooling fan operated only during ingot pouring activities. Airflow rates were measured through this ventilation system with the fan operating but without the cooling water (therefore no steam).

The following assumptions were made in this determination:

1. The lead concentration in the vicinity of the cooling tunnel constituted available airborne lead which the powered ventilation system could discharge from the facility.
2. The effect of steam contact with airborne particles containing lead likely results in a reduction of the lead concentration of the potential emissions (scrubbing effect). The following calculation does not account for steam scrubbing and is, therefore, conservative.

Ingot Cooling Stack: Fugitive Lead Calculations

Given: Area Samples F, G, H and I, Figure 1

Average lead concentration of the samples on lead-day (June 5) = 0.0123 mg/m^3 (Table 2)

Exhaust rate = 2,687 SCFM (Appendix B)

Lead emission rate on the lead day = 2,687 ft^3/min x 0.0123 mg/m^3 x 1m^3/35.31 ft^3 = 0.936 mg/min

The average concentration of total particulate matter (TPM) was highest on the non-lead-day (June 6). To be conservative in the evaluation of fugitive lead emissions, the lead emission level was increased to account for the potential for higher TPM emissions. On June 6, the average TPM concentration at these area sampling points was 1.94 times the average TPM concentration at the same points on the lead-day. Had this TPM concentration occurred on the lead-day when the percentage of lead was measured at 2% of the total TPM, the fugitive lead emissions would be raised by 94% to 1.81 mg/min.

Using data at Area Sampling Points F and H on June 6, the ratio of lead percentage between lead-days and non-lead days was 2.0/0.2 = 10. Consequently, the no-lead counterpart to the 1.81 mg/min lead emissions rate for lead-days is 0.181 mg/min.

Section 7

Modeling of Estimated Fugitive Lead Emissions

Modeling was performed of the effect of the fugitive emissions from the Electric Furnace Building at the ambient air quality monitoring sites at the Perez School and the Juarez School. In the modeling, the time of day of the fugitive emissions was taken into account. A summary of the model input values is shown in Table 5.

The results of the model analysis were evaluated in two different ways.

First, the model results were run for the 15 specific days when the measured data at the Perez School monitor exceeded 0.15 μg/m³ (the daily measured data at the Juarez School monitor has never exceeded 0.15 μg/m³). These model comparisons are presented in Figure 6. The fugitive contributions are nearly undetectable. It is clear that the fugitive emissions are a small part of the measured concentrations. This is true despite the assumptions made regarding the fugitive emission sources which significantly over estimate the emissions, *i.e.*, that the ingot steam cooler does nothing to reduce the emissions of indoor air going through the cooler, that non-detects are assumed to be at the detection threshold, and that the fugitive emissions are all transported to the outside air. Modeling of the combined stack and fugitive emissions can also be compared to the measured data for the 15 highest measured days. These results are shown in Figure 7.

Second, the NAAQS of 0.15 μg/m³ for lead is based on the 90 day average of lead concentrations in the air. The results of this modeling shows that the maximum 90 rolling average over the 2 and 1/4th years of meteorological data for the Electric Furnace Building fugitive emissions is 0.002 μg/m³ for the Perez School monitor and 0.0005 μg/m³ for the Juarez School monitor. Also shown below are the modeled contributions of all sources at H Kramer. These values include both the stack emissions and the overestimated fugitive emissions. These modeled concentrations are less than 1/3rd of the NAAQS at both monitoring stations.

Model Results in μg/m³ for January 2010 through March 2012

	Perez School:			Juarez School:		
	Stacks	Fugitives	Total	Stacks	Fugitives	Total
Maximum of 90 Day Averages	0.036	0.002	0.042	0.013	0.0005	0.015

Tables

Table 1
Field Measurement Methods
(see Appendix A for instrument calibration data)

Parameter	Instrumentation	Notes
Real-Time Concentrations of Total Particulate Matter	Thermo Electron Corp. Model PDR 1200 data RAM (scattered light optical method).	A 5 micrometer PVC filter in a 37 millimeter cassette mounted downstream of the optical chamber allowed calibration of the optics to the actual aerosol which was sampled. Air quality profiles were produced from the assessment data gathered throughout the workplace using a contour mapping program.
Area Time-Weighted Average Lead Samples	Calibrated MSA sampling pump using same filter and the same calibration technique as in the notes for real-time sampling, above. In this case, gravimetric analysis was followed by determination of lead content.	Lead was analyzed using NIOSH Method 7303 (inductively coupled plasma). Filter blanks were employed for quality control purposes.
Duct Airflow and Static Pressure	Pitot Tube and Dwyer Magnehelic Gauges, Models 2002 and 2020.	Existing sampling ports in ductwork were used and, where needed, new holes were drilled. Multi-point traverses were made in each case, corrected for airflow temperature.
Building Differential Pressure	Dwyer Magnehelic Gauge, Model 2300-0	Requires rigid true vertical monitoring to be accurate.
Temperature Readings	Cole-Parmer Model No. 3312-21 Psychrometer (wet and dry bulb fluid filled thermometers).	Readings taken simultaneously with real-time particulate matter readings during vertical profiling.
Indraft through Doorways	TSI VelociCalc, Model 8360	Turbulence in vicinity of doors necessitated recording of velocity ranges at each assessment point. These ranges were averaged to determine the airflow rate through the doorway.

TABLE 2
INDOOR AIR SAMPLING RESULTS SUMMARY - JUNE 4, 2012 No-Lead Day
H KRAMER - CHICAGO, ILLINOIS
ELECTRIC FURNACE FOUNDRY

Sample I.D.	Sample Description	Sample Location on Figure 1	Sample Location Description	Notes	Sample Length (Min.)	Analyte	Units	Result	%Lead in Total Weight
77225	Area Sample	A	Phos Copper Storage Area	Collected on 6/4/2012	328	Total Weight	mg/m^3	<0.080	-
						Lead	mg/m^3	<0.0026	
77224	Area Sample	B	Phos Copper Storage Area	Collected on 6/4/2012	328	Total Weight	mg/m^3	<0.081	-
						Lead	mg/m^3	<0.0027	
77226	Area Sample	C	Storage	Collected on 6/4/2012	325	Total Weight	mg/m^3	<0.080	-
						Lead	mg/m^3	<0.0026	
77220	Area Sample	D	Staging	Collected on 6/4/2012	344	Total Weight	mg/m^3	0.7	-
						Lead	mg/m^3	<0.0025	
77219	Area Sample	E	Staging	Collected on 6/4/2012	347	Total Weight	mg/m^3	0.45	-
						Lead	mg/m^3	<0.0025	
77222	Area Sample	F	Furnace Building	Collected on 6/4/2012	331	Total Weight	mg/m^3	0.88	-
						Lead	mg/m^3	<0.0026	
77223	Area Sample	G	Furnace Building	Collected on 6/4/2012	329	Total Weight	mg/m^3	0.45	-
						Lead	mg/m^3	<0.0026	
77221	Area Sample	H	Furnace Building	Collected on 6/4/2012	332	Total Weight	mg/m^3	0.94	-
						Lead	mg/m^3	<0.0027	
77215	Area Sample	I	Furnace Building	Collected on 6/4/2012	335	Total Weight	mg/m^3	0.68	-
						Lead	mg/m^3	<0.0026	
77213	Area Sample	J	Furnace Building	Collected on 6/4/2012	329	Total Weight	mg/m^3	2.1	0.1%
						Lead	mg/m^3	0.0030	
77214	Area Sample	K	Furnace Building	Collected on 6/4/2012	332	Total Weight	mg/m^3	2.1	0.1%
						Lead	mg/m^3	0.0029	
77218	Area Sample	L	Furnace Building	Collected on 6/4/2012	333	Total Weight	mg/m^3	2.0	0.2%
						Lead	mg/m^3	0.0031	
77216	Area Sample	L	Furnace Building (Elevated)	Collected on 6/4/2012	386	Total Weight	mg/m^3	4.2	0.1%
						Lead	mg/m^3	0.0049	
77217	Area Sample	M	Furnace Building	Collected on 6/4/2012	328	Total Weight	mg/m^3	1.8	-
						Lead	mg/m^3	<0.0027	

Notes

1. All samples collected at 5' elevation, unless otherwise noted

TABLE 2
INDOOR AIR SAMPLING RESULTS SUMMARY - JUNE 5, 2012 Lead Day
H KRAMER - CHICAGO, ILLINOIS
ELECTRIC FURNACE FOUNDRY

Sample I.D.	Sample Description	Sample Location on Figure 1	Sample Location Description	Notes	Sample Length (Min.)	Analyte	Units	Result	%Lead in Total Weight
77241	Area Sample	B	Phos Copper Storage Area	Collected on 6/5/2012	470	Total Weight	mg/m^3	0.14	2%
						Lead	mg/m^3	0.0026	
77243	Area Sample	C	Storage	Collected on 6/5/2012	472	Total Weight	mg/m^3	0.064	-
						Lead	mg/m^3	<0.0019	
77237	Area Sample	D	Staging	Collected on 6/5/2012	473	Total Weight	mg/m^3	0.87	2%
						Lead	mg/m^3	0.021	
77236	Area Sample	E	Staging	Collected on 6/5/2012	480	Total Weight	mg/m^3	0.7	3%
						Lead	mg/m^3	0.018	
77239	Area Sample	F	Furnace Building	Collected on 6/5/2012	471	Total Weight	mg/m^3	0.51	2%
						Lead	mg/m^3	0.0098	
77240	Area Sample	G	Furnace Building	Collected on 6/5/2012	468	Total Weight	mg/m^3	0.63	2%
						Lead	mg/m^3	0.0095	
77238	Area Sample	H	Furnace Building	Collected on 6/5/2012	480	Total Weight	mg/m^3	0.46	2%
						Lead	mg/m^3	0.0098	
77232	Area Sample	I	Furnace Building	Collected on 6/5/2012	475	Total Weight	mg/m^3	1.2	2%
						Lead	mg/m^3	0.020	
77230	Area Sample	J	Furnace Building	Collected on 6/5/2012	482	Total Weight	mg/m^3	3.4	3%
						Lead	mg/m^3	0.097	
77231	Area Sample	K	Furnace Building	Collected on 6/5/2012	488	Total Weight	mg/m^3	4.0	3%
						Lead	mg/m^3	0.12	
77235	Area Sample	L	Furnace Building	Collected on 6/5/2012	497	Total Weight	mg/m^3	3.8	3%
						Lead	mg/m^3	0.097	
77233	Area Sample	L	Furnace Building (Elevated)	Collected on 6/5/2012	558	Total Weight	mg/m^3	8.1	2%
						Lead	mg/m^3	0.19	
77234	Area Sample	M	Furnace Building	Collected on 6/5/2012	478	Total Weight	mg/m^3	2.7	4%
						Lead	mg/m^3	0.10	
77242	Area Sample	N	Furnace Building (Elevated)	Collected on 6/5/2012	541	Total Weight	mg/m^3	NA	-
						Lead	mg/m^3		

Notes

1. All samples collected at 5' elevation, unless otherwise noted
2. The inlet of sample 77242 was found to have shifted to an orientation which would have allowed falling particles to enter the media, and thus was not analyzed.

TABLE 2
INDOOR AIR SAMPLING RESULTS SUMMARY - JUNE 6, 2012 No-Lead Day
H KRAMER - CHICAGO, ILLINOIS
ELECTRIC FURNACE FOUNDRY

Sample I.D.	Sample Description	Sample Location on Figure 1	Sample Location Description	Notes	Sample Length (Min.)	Analyte	Units	Result	%Lead in Total Weight
77258	Area Sample	B	Phos Copper Storage Area	Collected on 6/6/2012	291	Total Weight	mg/m^3	0.11	-
						Lead	mg/m^3	<0.0030	
77260	Area Sample	C	Storage	Collected on 6/6/2012	292	Total Weight	mg/m^3	<0.091	-
						Lead	mg/m^3	<0.0030	
77254	Area Sample	D	Staging	Collected on 6/6/2012	292	Total Weight	mg/m^3	1.1	-
						Lead	mg/m^3	<0.0030	
77252	Area Sample	E	Staging	Collected on 6/6/2012	304	Total Weight	mg/m^3	0.90	-
						Lead	mg/m^3	<0.0031	
77257	Area Sample	F	Furnace Building	Collected on 6/6/2012	292	Total Weight	mg/m^3	1.8	0.2%
						Lead	mg/m^3	0.0034	
77256	Area Sample	G	Furnace Building	Collected on 6/6/2012	292	Total Weight	mg/m^3	0.62	-
						Lead	mg/m^3	<0.0030	
77255	Area Sample	H	Furnace Building	Collected on 6/6/2012	293	Total Weight	mg/m^3	2.0	0.2%
						Lead	mg/m^3	0.0037	
77248	Area Sample	I	Furnace Building	Collected on 6/6/2012	297	Total Weight	mg/m^3	1.0	-
						Lead	mg/m^3	<0.0029	
77246	Area Sample	J	Furnace Building	Collected on 6/6/2012	300	Total Weight	mg/m^3	3.5	0.3%
						Lead	mg/m^3	0.0088	
77247	Area Sample	K	Furnace Building	Collected on 6/6/2012	303	Total Weight	mg/m^3	3.7	0.2%
						Lead	mg/m^3	0.0069	
77253	Area Sample	L	Furnace Building	Collected on 6/6/2012	292	Total Weight	mg/m^3	3.2	0.2%
						Lead	mg/m^3	0.0056	
77250	Area Sample	L	Furnace Building (Elevated)	Collected on 6/6/2012	347	Total Weight	mg/m^3	6.7	0.1%
						Lead	mg/m^3	0.0098	
77251	Area Sample	M	Furnace Building	Collected on 6/6/2012	299	Total Weight	mg/m^3	3.5	0.2%
						Lead	mg/m^3	0.0054	
77259	Area Sample	N	Furnace Building (Elevated)	Collected on 6/6/2012	326	Total Weight	mg/m^3	6.5	0.1%
						Lead	mg/m^3	0.0068	

Notes

1. All samples collected at 5' elevation, unless otherwise noted

Table 3
Ventilation Air Mass Balance of the Electric Furnace Building

Type	Ventilation Source	Airflow Rate SCFM	Notes
Exhaust	Baghouse 4 on three Coreless Induction Furnaces	24,182	See Appendix B
	Venturi Scrubber on two Channel Furnaces	11,639	See Appendix B
	Ingot cooling fan	2,687	See Appendix B
	Total:	**38,508**	
Supply Air	Air Infiltrated into Four Building Openings	28,781 – 33,999	See Table 4 and Appendix C
	Channel furnace cooling fan	4,000	Estimated, not measured
	Total:	**32,781 – 37,999**	

Table 4
Velocities Through Doorways Leading into the Electric Furnace Building

Door[1]	Date	Ventilation Direction[2]	Airflow Rate SCFM
A	June 5, 2012 Lead Day	I	13,563
B		I	6,124
C		I	11,350
D		I	2,962
		Total	**33,999**
A	June 6, 2012 No-Lead Day	E	**- 15,946**[3]
B		I	22,032
C		I	19,660
D		I	3,035
		Total	**28,781**

Notes:

(1) See Figure 1 for locations

(2) I = infiltration; E = exfiltration

(3) Exfiltration through this door caused by wind pressure through the other doors.

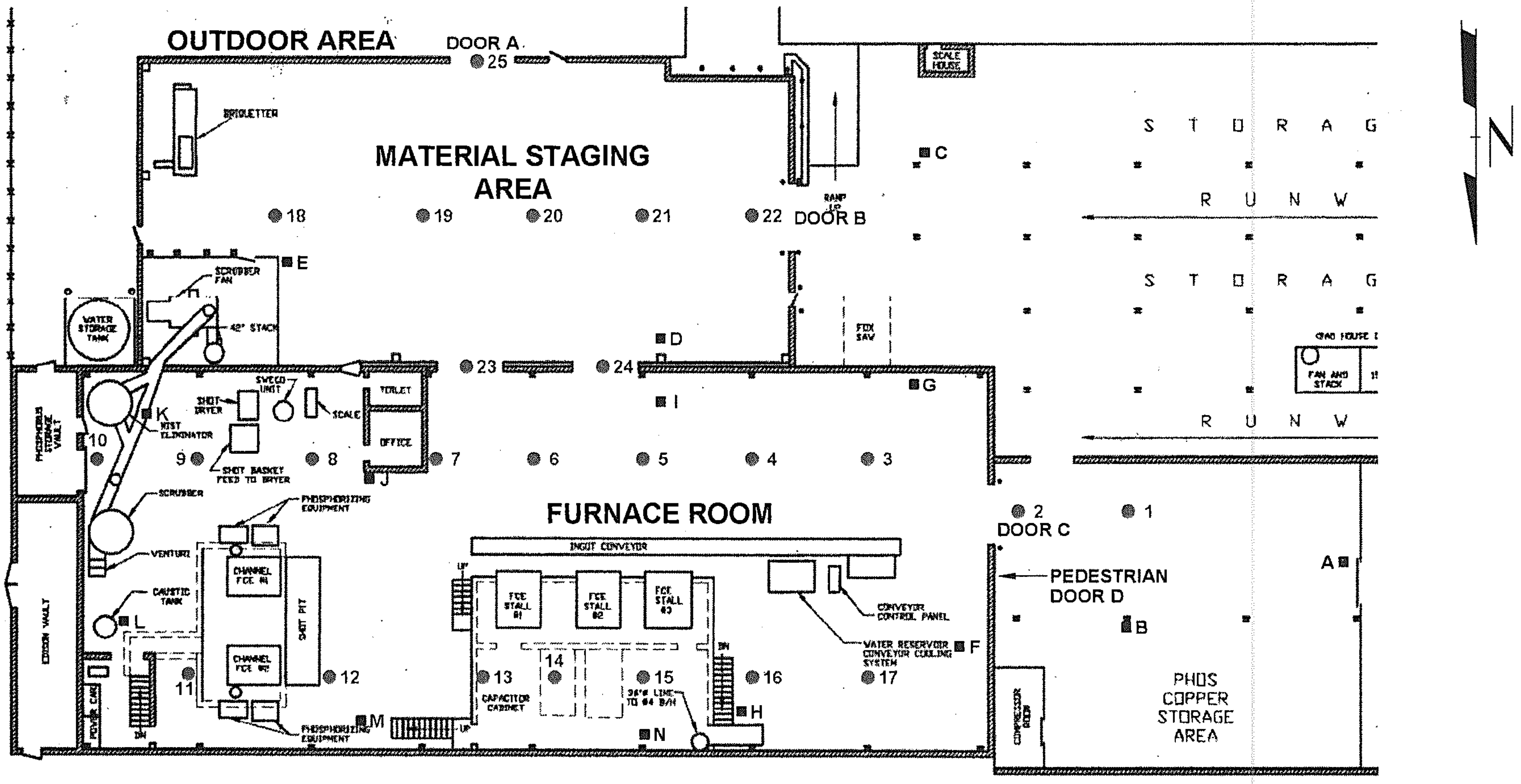
TABLE 5: Model Source Data

Mode		Sampled Emissions (lbs/hour)	Sampled Emissions (grams/sec)	Time Adjustment	Annual Emissions (grams/sec)	Configuration	Exit Flow (acfm)	Exit Diameter (meters)
Electric Furnace Ingot Cooler	Normal Emissions	0.000007	0.000007	1.00000	0.0000066	Horizontal Stack	2687	0.61
	Lead Pouring Emissions	0.000664	0.000664	0.00274	0.0000018	Horizontal Stack	2687	0.61
Furnace Building Roof	Normal Emissions	0.000062	0.000062	1.00000	0.0000624	Volume		
	Lead Pouring Emissions	0.000988	0.000988	0.00274	0.0000027	Volume		

Figures

PLOT DATA

Drawing Name:	J:\H Kramer\185796\185796.0000-01e.dwg	Dwg Size:	0.54 Mb	Attached Xref's:	
Operator Name:	KONIAR, JOHN	Plot Date:	June 22, 2012	Attached Images:	
Drawing Plot Scale:	0.386863	Plot Time:	11:34 AM	Layout:	FIGURE 1



PARTIAL FLOOR PLAN

0 24 48

SCALE: 1"=24'

LEGEND

● **GRID SAMPLE LOCATION**

■ **AREA SAMPLE LOCATION**

TRC

150 North Patrick Blvd.
Suite 180
Brookfield, WI 53045
Phone: 262.879.1212

PROJECT:

H. KRAMER & CO.
VENTILATION STUDY
CHICAGO, ILLINOIS

SHEET TITLE:

ELECTRIC FURNACE BUILDING
SAMPLING LOCATIONS

DRAWN BY:	J KONIAR
APPROVED BY:	B SCHOLZ
PROJ. NO.	185796.0000.0000
FILE NO.	185796.0000-01e.dwg
DATE:	JUNE 2012

FIGURE #1

PLOT DATA
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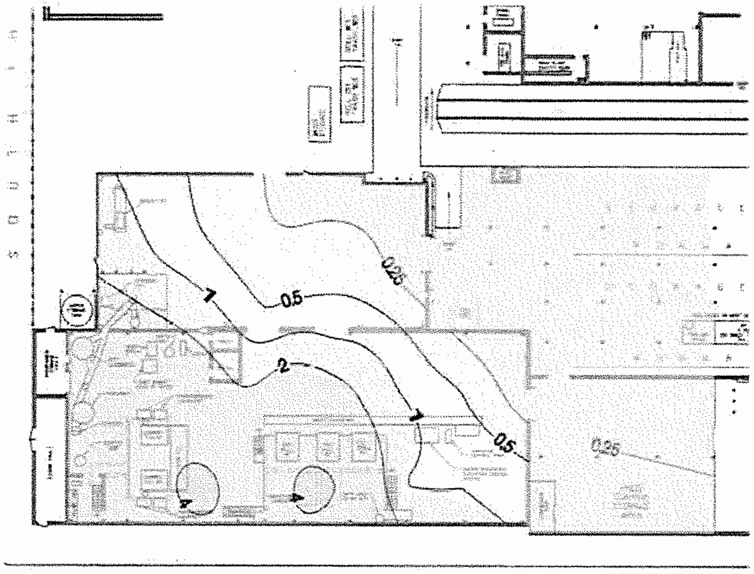
Operator Name: PYLKAS, ERIC
Drawing Plot Scale: 0.386863
Dwg Size: 0.31 Mb
Plot Date: June 22, 2012
Plot Time: 9:36 AM
Attached Xrefs: Electric Foundry Base;
Attached Images:
Layout: Model

LEGEND

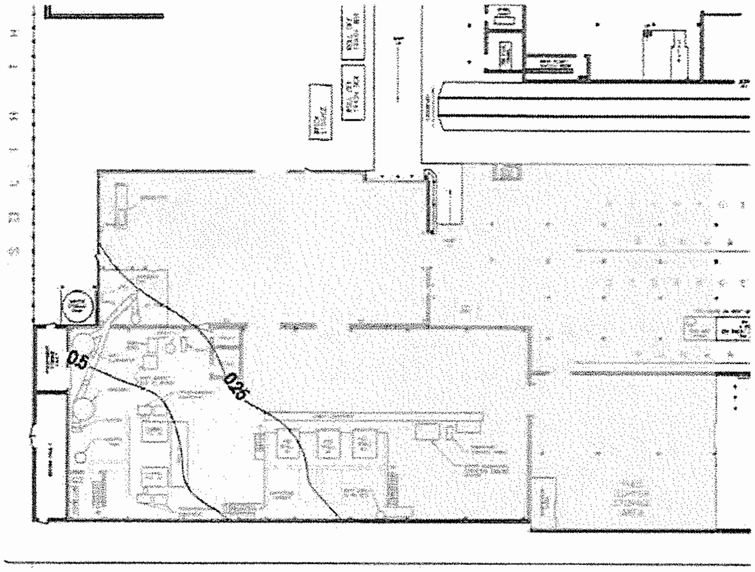
▨	>4.00 mg/m³
▨	2.00–4.00 mg/m³
▨	1.00–2.00 mg/m³
▨	0.50–1.00 mg/m³
▨	0.25–0.50 mg/m³
▨	<0.25 mg/m³

NOTES

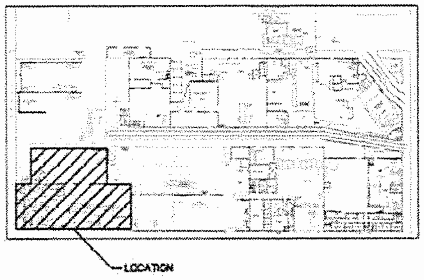
1. READINGS COLLECTED FROM 10:49 TO 11:22 AND 13:27 TO 13:56 ON 6/4/2012 BY TRC ENVIRONMENTAL.
2. BASE DRAWING PROVIDED BY H KRAMER



RUN 1 (PRE-LEAD) - AVERAGE 1.69 mg/m³



RUN 2 (PRE-LEAD) - AVERAGE 0.22 mg/m³



TRC
150 North Patrick Blvd.
Suite 180
Brookfield, WI 53045
Phone: 262.879.1212

PROJECT: **H KRAMER**
CHICAGO, ILLINOIS

SHEET TITLE: **INDOOR AIR ASSESSMENT**
ELECTRIC FURNACE (PRE-LEAD)
TOTAL PARTICULATE READINGS - JUNE 2012

DRAWN BY:	EJP
APPROVED BY:	
PROJ. NO.	185796.0000.0000
FILE NO.	185796.0000-09.dwg
DATE:	JUNE 2012

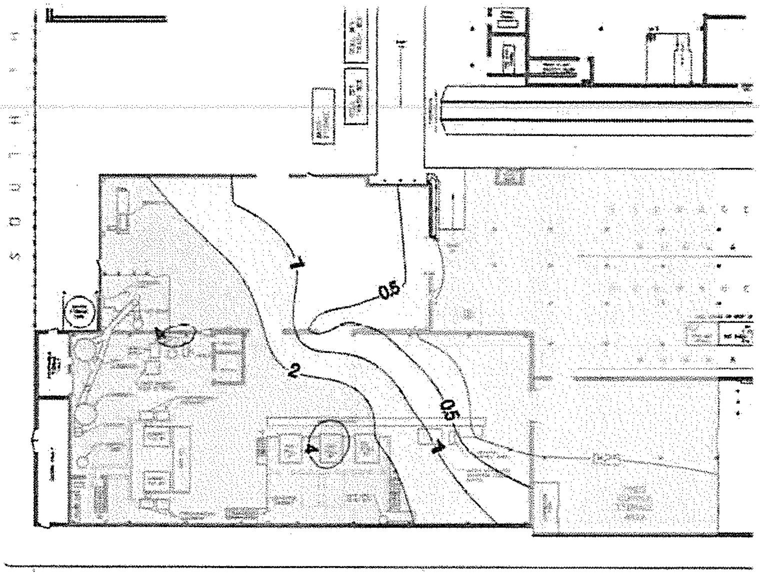
FIGURE 2

LEGEND

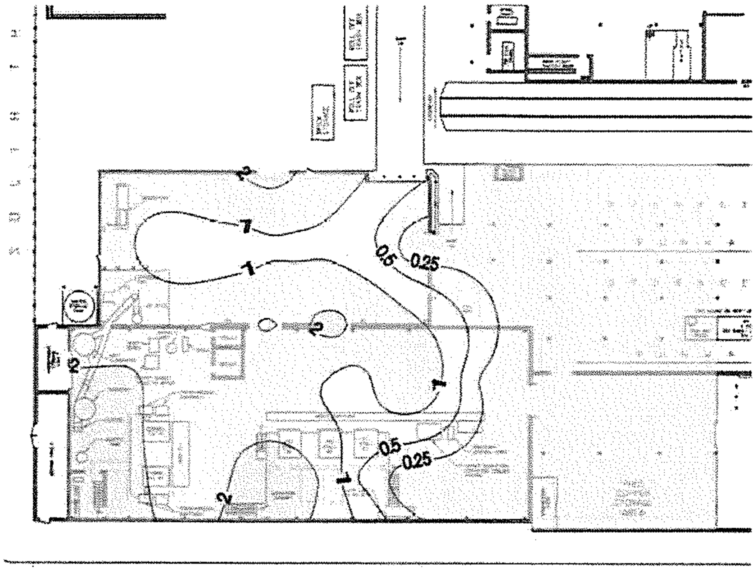
▨	>4.00 mg/m³
▨	2.00–4.00 mg/m³
▨	1.00–2.00 mg/m³
▨	0.50–1.00 mg/m³
▨	0.25–0.50 mg/m³
▨	<0.25 mg/m³

NOTES

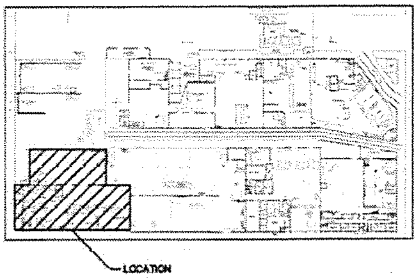
1. READINGS COLLECTED FROM 13:51 TO 14:20 AND 14:33 TO 15:05 ON 6/05/2012 BY TRC ENVIRONMENTAL
2. BASE DRAWING PROVIDED BY H KRAMER



RUN 3 (LEAD) - AVERAGE 1.23 mg/m³



RUN 4 (LEAD) - AVERAGE 1.22 mg/m³



TRC
150 North Patrick Blvd.
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Brookfield, WI 53045
Phone: 262.879.1212

PROJECT:
H KRAMER
CHICAGO, ILLINOIS

SHEET TITLE:
INDOOR AIR ASSESSMENT
ELECTRIC FURNACE (LEAD)
TOTAL PARTICULATE READINGS - JUNE 2012

DRAWN BY:	EJP
APPROVED BY:	
PROJ. NO.	185796.0000.0000
FILE NO.	185796.0000-09.dwg
DATE:	JUNE 2012

FIGURE 3

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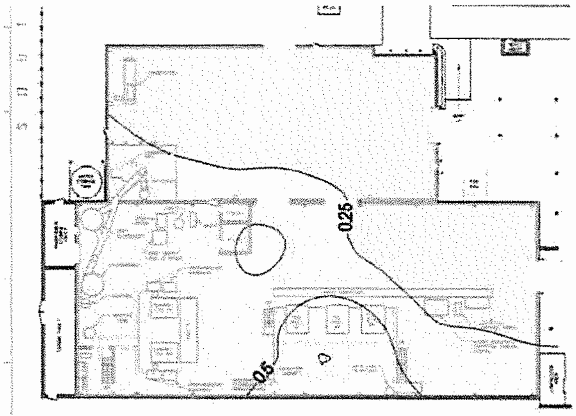
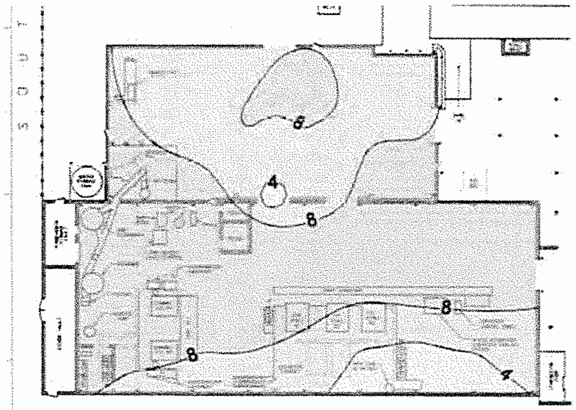
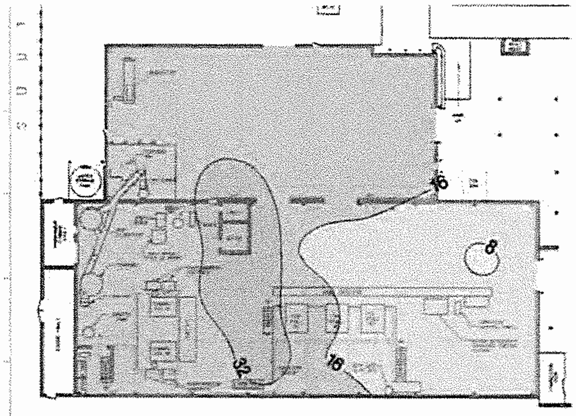
Dwg Size: 0.31 Mb
Plot Date: June 22, 2012
Plot Time: 9:34 AM
Attached Xrefs:
Attached Images:
Layout:
Electric Foundry Base;
Model



RUN 7 - (POST-LEAD) (5' ELEVATION) - AVERAGE 0.31 mg/m³



RUN 6 - (POST-LEAD) (10' ELEVATION) - AVERAGE 8.73 mg/m³



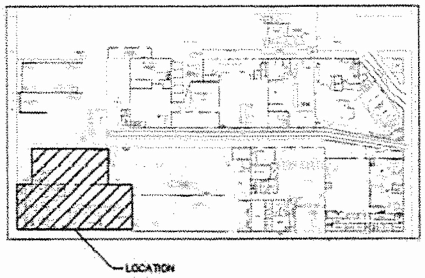
RUN 5 - (POST-LEAD) (15' ELEVATION) - AVERAGE 23.35 mg/m³

LEGEND

- ▨ 32.00+ mg/m³
- ▨ 16.00–32.00 mg/m³
- ▨ 8.00–16.00 mg/m³
- ▨ 4.00–8.00 mg/m³
- ▨ 2.00–4.00 mg/m³
- ▨ 1.00–2.00 mg/m³
- ☐ 0.50–1.00 mg/m³
- ▨ 0.25–0.50 mg/m³
- ▨ <0.25 mg/m³

NOTES

1. READINGS COLLECTED FROM 12:30–12:59 (5'), 9:20–9:56 (10'), AND 8:33–9:07 (15') ON 6/6/2012 BY TRC ENVIRONMENTAL
2. BASE DRAWING PROVIDED BY H KRAMER



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Drawing Plot Scale: 0.386863
Dwg Size: 0.21 Mb
Plot Date: June 22, 2012
Plot Time: 9:41 AM
Attached Xrefs: Electric Foundry Base;
Attached Images:
Layout: Model

TRC
150 North Patrick Blvd.
Suite 180
Brookfield, WI 53045
Phone: 262.879.1212

PROJECT:
H KRAMER
CHICAGO, ILLINOIS

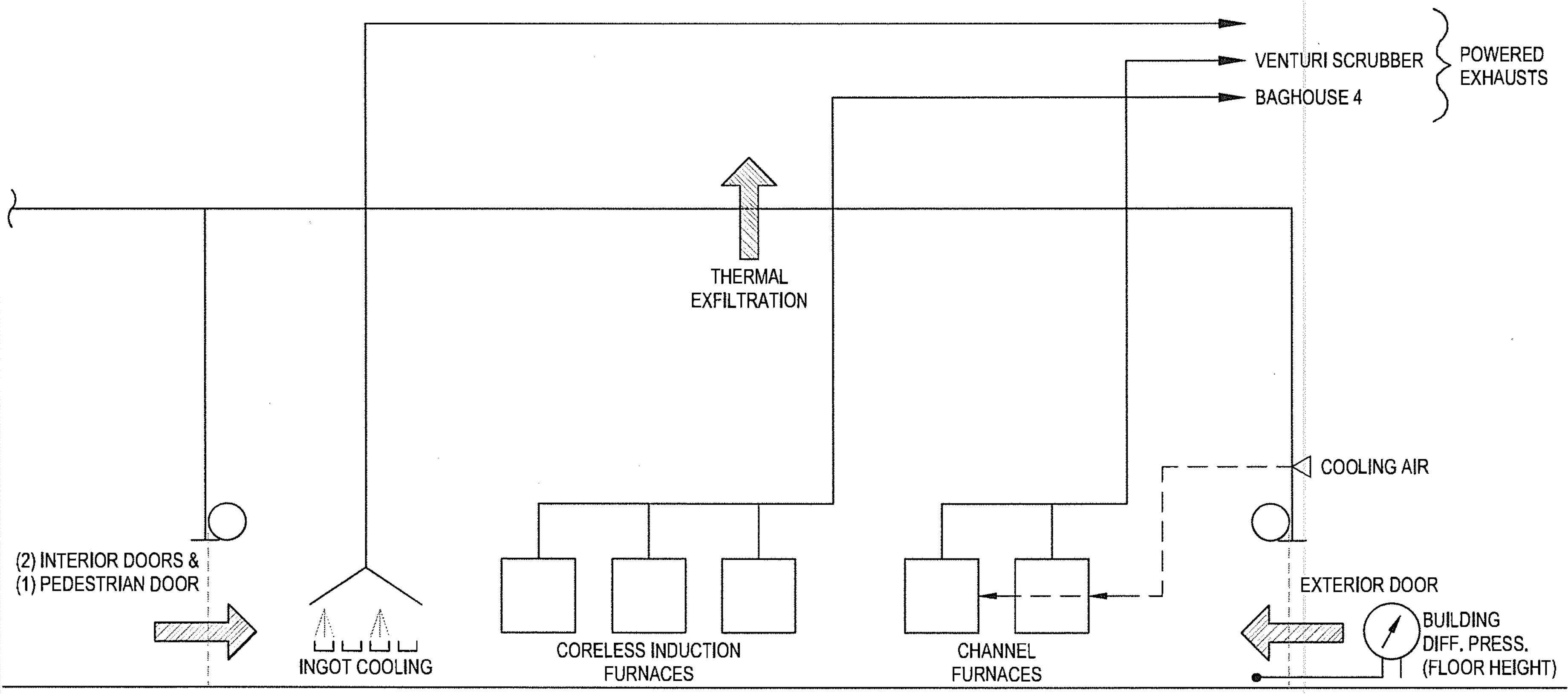
SHEET TITLE:
INDOOR AIR ASSESSMENT
ELECTRIC FURNACE (POST-LEAD)
TOTAL PARTICULATE READINGS - JUNE 2012

DRAWN BY:	EJP
APPROVED BY:	
PROJ. NO.	185796.0000.0000
FILE NO.	185796.0000-10.dwg
DATE:	JUNE 2012

FIGURE 4

PLOT DATA

Drawing Name:	J:\H Kramer\185796\185796.0000-02.dwg	Dwg Size:	0.48 Mb	Attached Xref's:	
Operator Name:	KONIAR, JOHN	Plot Date:	June 21, 2012	Attached Images:	
Drawing Plot Scale:	0.386863	Plot Time:	10:42 AM	Layout:	FIGURE 5



150 North Patrick Blvd.
Suite 180
Brookfield, WI 53045
Phone: 262.879.1212

PROJECT:

H. KRAMER & CO. VENTILATION ASSESSMENT
CHICAGO, ILLINOIS

SHEET TITLE:

ELECTRIC FURNACE BUILDING VENTILATION SCHEME
JUNE, 2012

DRAWN BY:	J KONIAR
APPROVED BY:	B SCHOLZ
PROJ. NO.	185796.0000.0000
FILE NO.	185796.0000-02.dwg
DATE:	MAY 2012

FIGURE #5

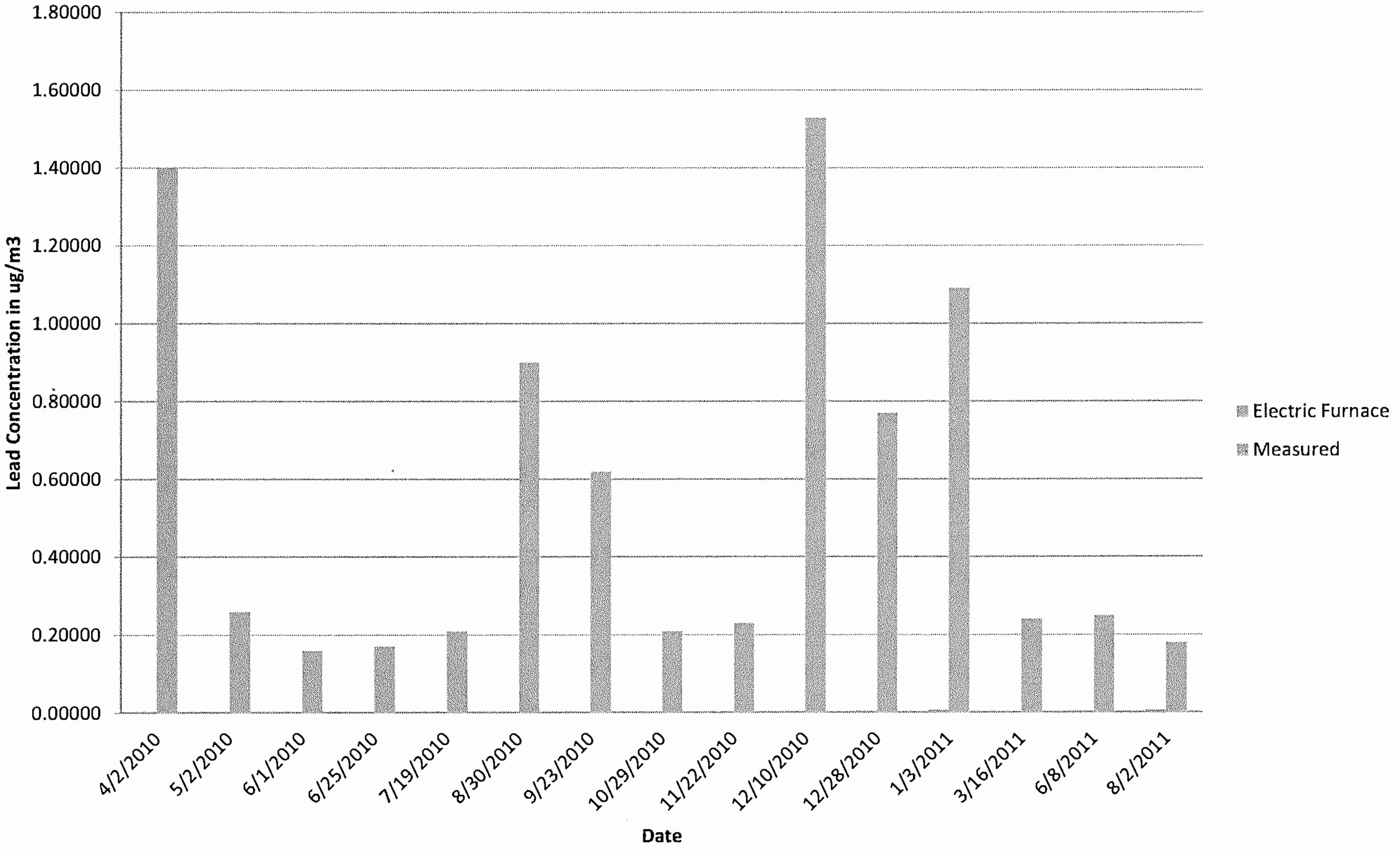


Figure 6: Modeled Electric Furnace Building Fugitive Emissions Compared to Measured Concentrations at the Perez Monitor for 15 Days Above 0.15 µg/m³

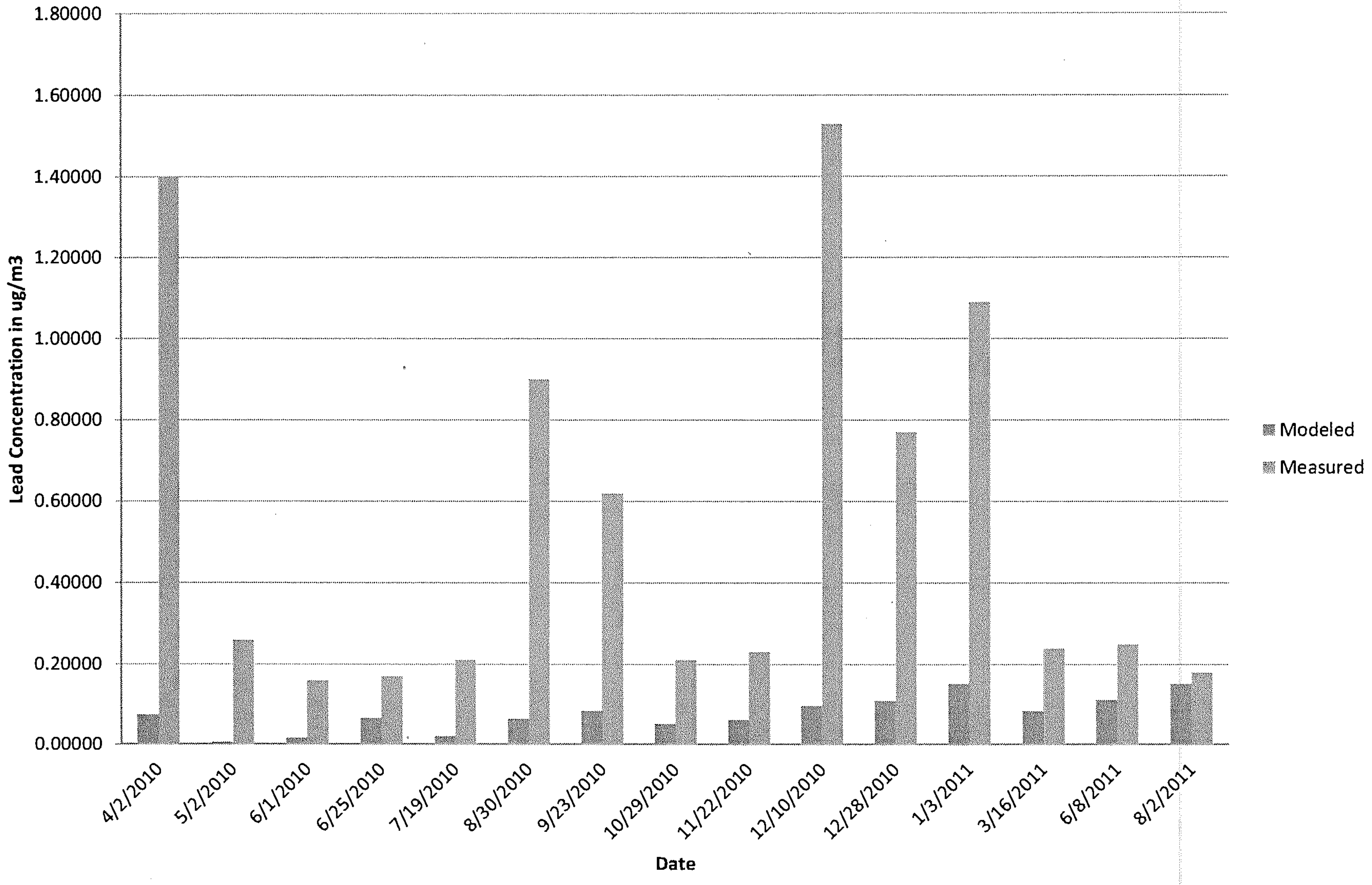
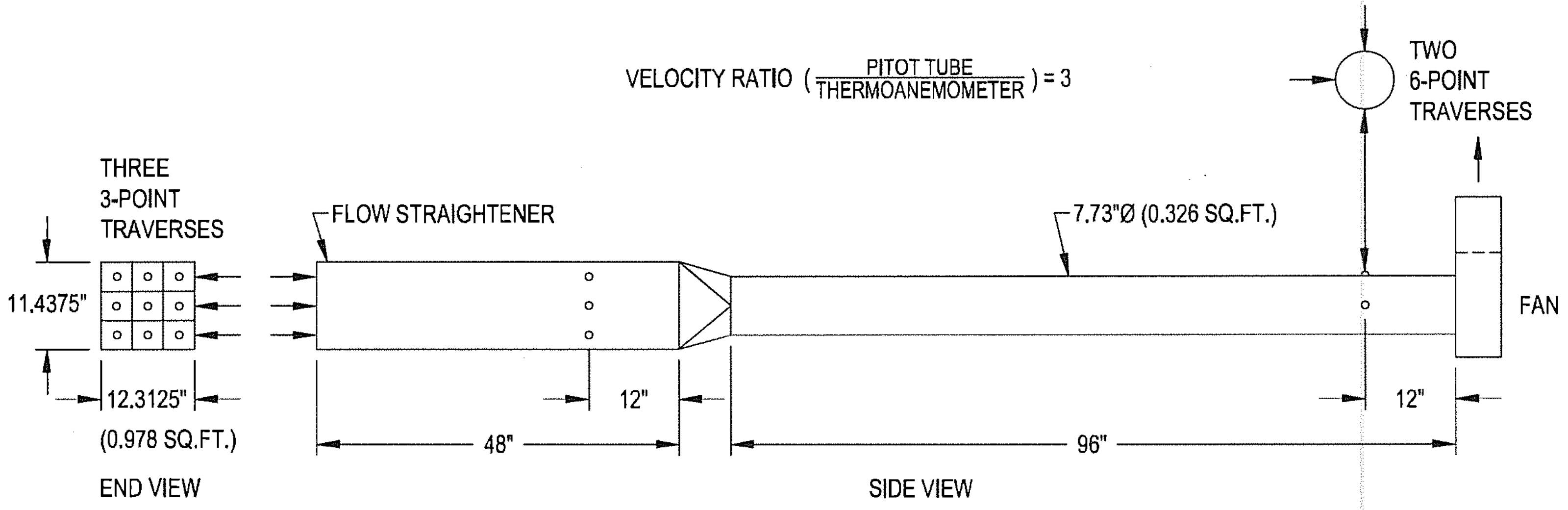


Figure 7: Modeling of All Stacks and Fugitives Compared to Measured Concentrations at the Perez Monitor for 15 Days above 0.15 μg/m^3

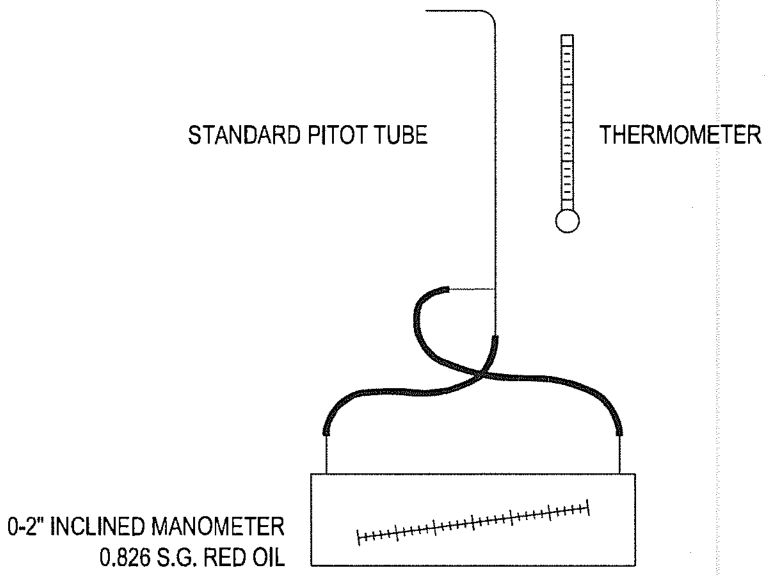
Appendix A
Equipment Calibrations

PLOT DATA

Drawing Name:	J:\H Kramer\185796\185796.0000-00.dwg	Dwg Size:	0.49 Mb	Attached Xref's:		
Operator Name:	KONIAR, JOHN	Plot Date:	June 1, 2012	Attached Images:		
Drawing Plot Scale:	0.386863	Plot Time:	9:58 AM	Layout:	FIGURE A-1	



NOTE:
ALL TRAVERSE POINTS AT
CENTROIDS OF EQUAL AREAS.



FAN SPECIFICATION:
NEW YORK BLOWER JUNIOR
FAN- 411 CFM@0.5 SP AND 70°F.
SHOP No. B12087-100.

TRC
150 North Patrick Blvd.
Suite 180
Brookfield, WI 53045
Phone: 262.879.1212

PROJECT:

THERMOANEMOMETER CALIBRATION CHECKING METHOD

SHEET TITLE:

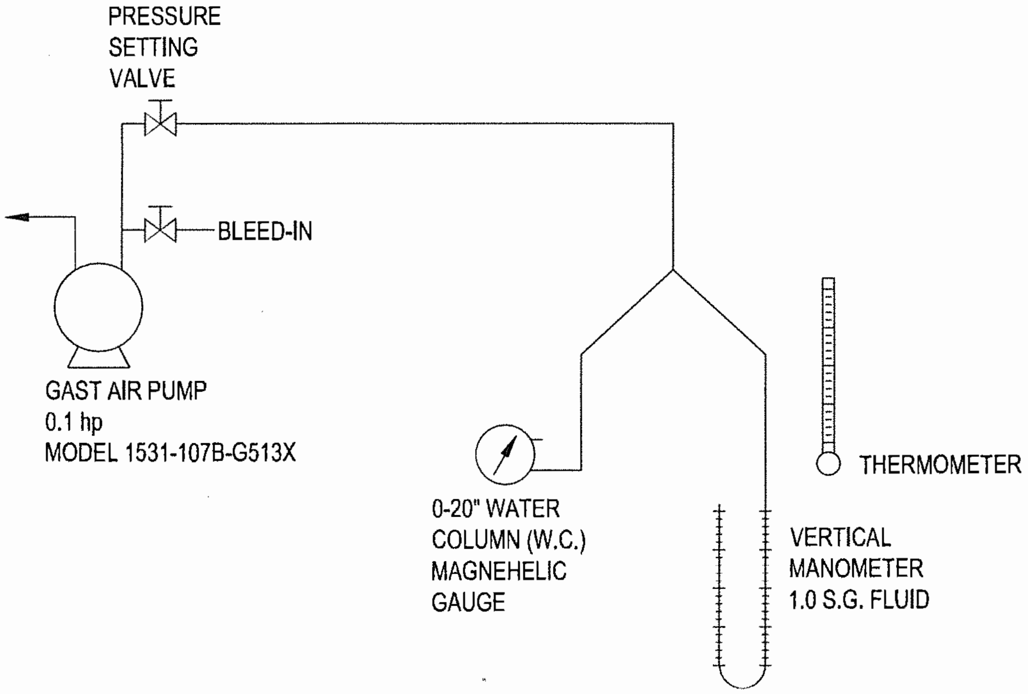
WIND TUNNEL CALIBRATION SETUP A

DRAWN BY:	J KONIAR
APPROVED BY:	B SCHOLZ
PROJ. NO.	185796.0000.0000
FILE NO.	185796.0000-00.dwg
DATE:	MAY 2012

FIGURE #A-1

PLOT DATA

Drawing Name:	J:\H Kramer\185796\185796.0000-00.dwg	Dwg Size:	0.49 Mb	Attached Xref's:	
Operator Name:	KONIAR, JOHN	Plot Date:	June 1, 2012	Attached Images:	
Drawing Plot Scale:	0.386863	Plot Time:	9:57 AM	Layout:	FIGURE A-2



TRC

150 North Patrick Blvd.
Suite 180
Brookfield, WI 53045
Phone: 262.879.1212

PROJECT:

DIFFERENTIAL PRESSURE GAUGE CALIBRATION CHECKING METHOD

SHEET TITLE:

PRESSURE PUMP CALIBRATION SETUP B

DRAWN BY:	J KONIAR
APPROVED BY:	B SCHOLZ
PROJ. NO.	185796.0000.0000
FILE NO.	185796.0000-00.dwg
DATE:	MAY 2012

FIGURE #A-2

Figure A - 3

Thermoanemometer Calibration Check by TRC
TSI Model 8360 VelociCalc
H. Kramer Project
April, 2012

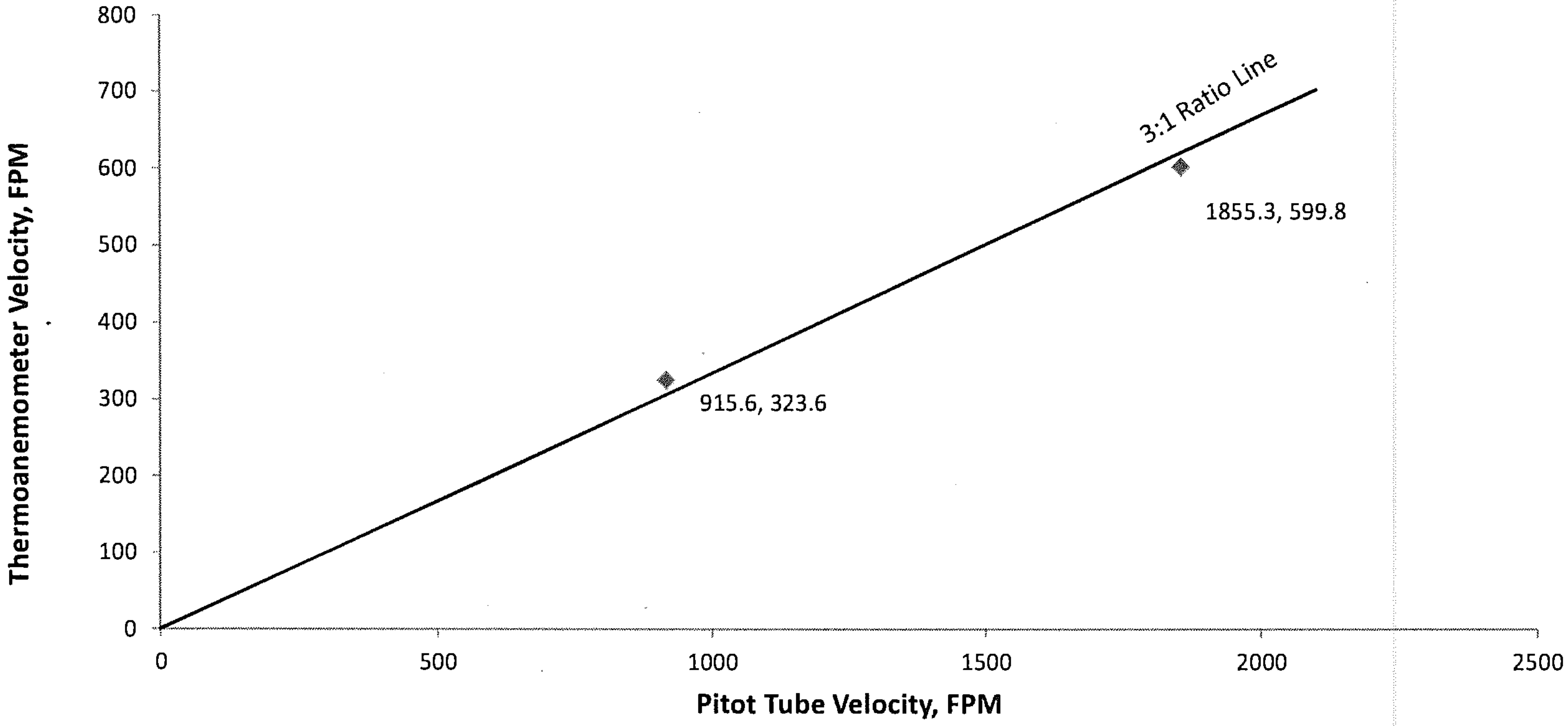
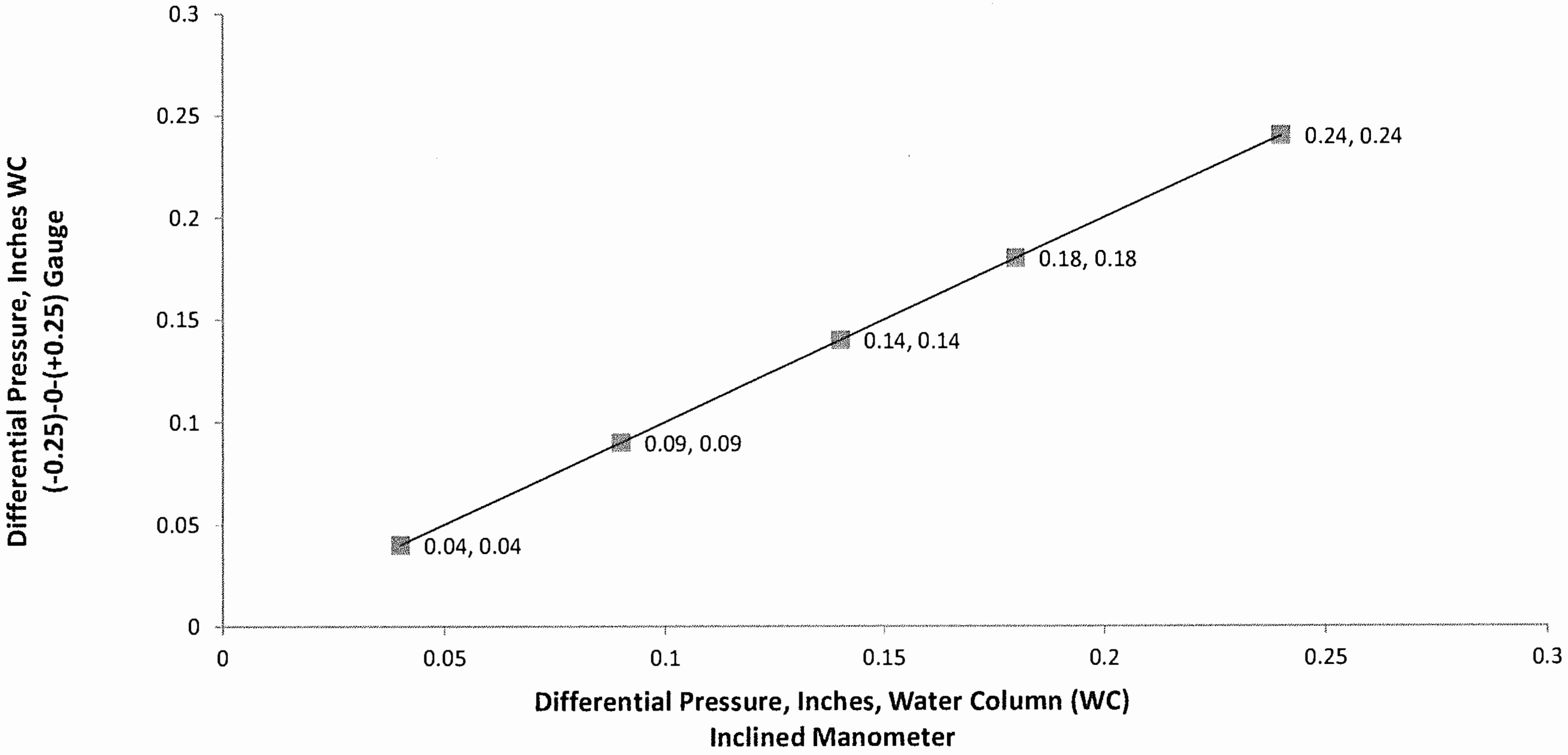
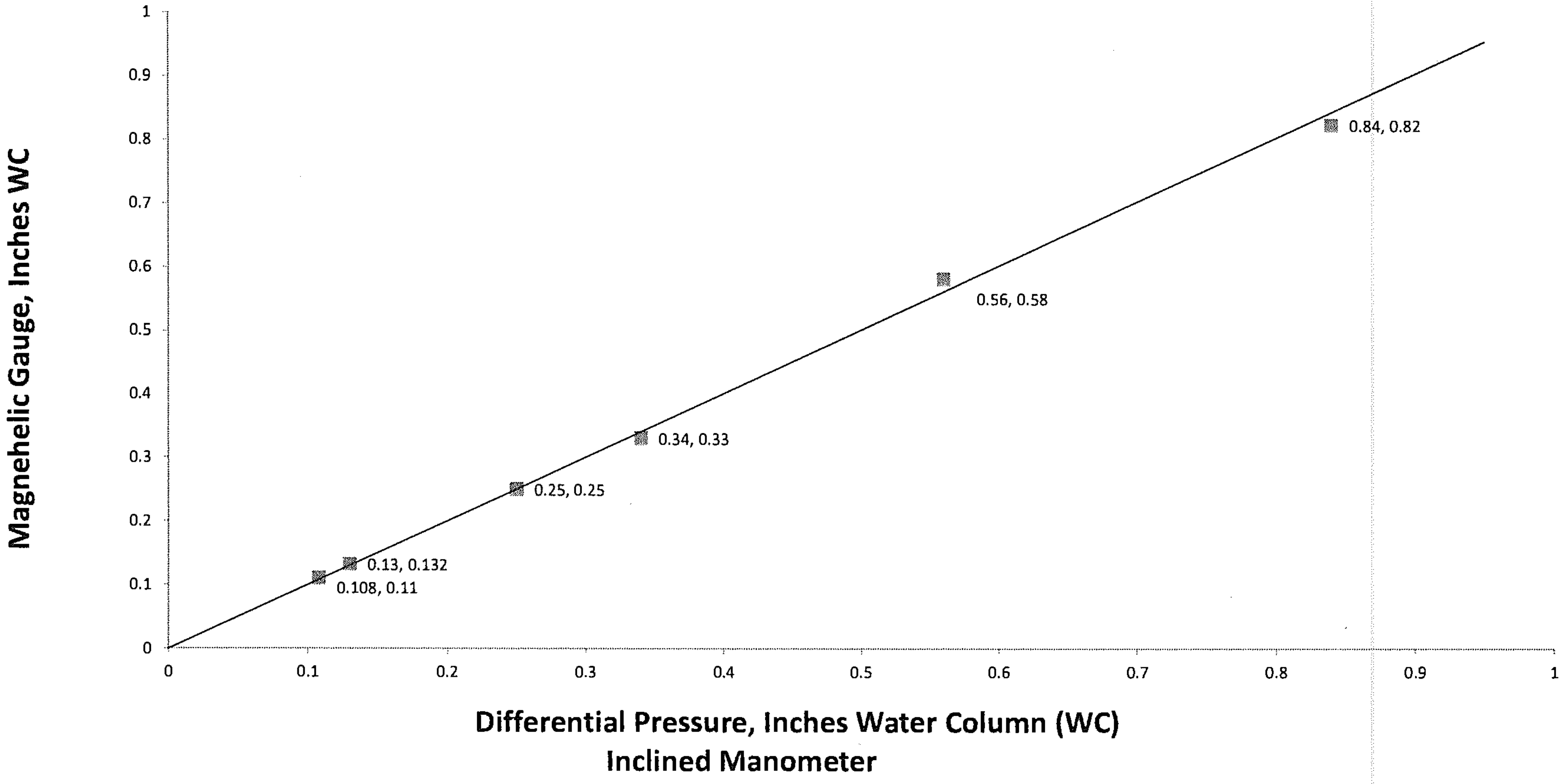


Figure A - 4
Building Differential Pressure Gauge Calibration Check by TRC for H. Kramer Project
April, 2012



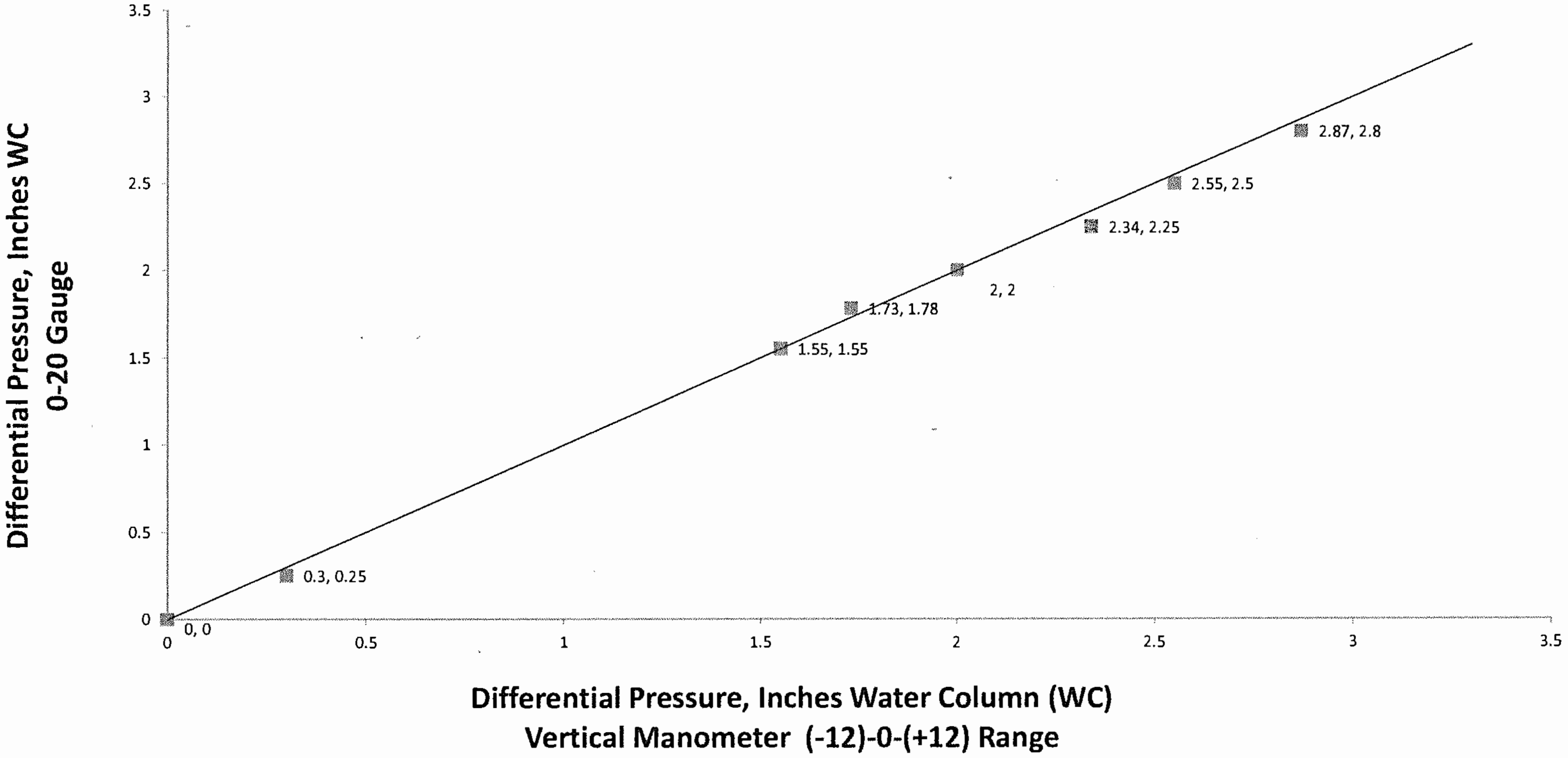
\\ntapabrookfield\MLW-VOL1\-\WPMLW\PJT2\185796\0000\Figure A-4

Figure A - 5
Pitot Tube Differential Pressure Gauge Calibration Check by TRC for H. Kramer Project
April, 2012



Both Instruments have 0-2 inches WC scales

Figure A - 6
Differential Pressure Gauge Calibration Check by TRC
for H. Kramer Project
April, 2012



\\ntapabrookfield\MLW-VOL1\-\WPMLW\PJT2\185796\0000\Figure A-6

Certificate of Calibration

A.P. BUCK, INC. mini-BUCK CALIBRATOR™

Serial No: 030356 **Date Calibrated :** 7-13-11 **Next Calibration due date :** 7-13-12

Model No : ☐ M-1 ☐ M-5 ☑ M-30 ☐ M-30B

Applicable Measurement Standards

Description	MFR.	Model	Serial #	N. I. S. T.
☐ 100ml Burette	Kimble	17027F-100	1220	SPECIAL17027F
☐ 1000ml Burette	Kimble	17081	0002	ASTM E542
☐ 1000ml Burette	Kimble	17081	0003	ASTM E542
☑ 1000ml Burette	Kimble	17081	1003	ASTM E542
☐ 1000ml Burette	Kimble	17081	1004	ASTM E542
☐ 1000ml Burette	Kimble	17081	2087	ASTM E542
☐ Stopwatch	Fisher	14-649-5	72495994	EL015
☑ Stopwatch	Fisher	14-649-5	230268455	EL015

AMBIENT CONDITIONS: Temperature 74±3° F Relative Humidity 50±10%

This instrument as received on 7-11-11 at A.P. Buck Inc.'s facility was found to be:

☑ Unable to calibrate as received due to condition of unit .
☐ Within specification of ± 0.5% of the display reading .
☐ Not in specification by ____ . _____ % High.____ . _____ % Low of the display

The instrument listed above has been adjusted to nominal, utilizing a 1,000ml burette, and an electronic digital stop watch, which are traceable to the National Institute of Standards & Technology (NIST). The accuracy of the instruments used to perform calibration is greater than 4 to 1. The A.P. Buck, Inc. Calibration system is in compliance with ANSI Z540-1 and IEC guide 25.

☑ Unit within specifications after calibration.

Calibration was conducted with A.P. Buck, Inc. Calibration Procedure APB-1 Rev. 6.2 with a constant flow pump using the Bubble-meter method. A.P. Buck, Inc. guarantees the accuracy and repeatability of ± 0.5% for any display reading as described under the instruction manual "Principles of Operation". Responsibilities shall in no event, nor for any cause whatsoever, exceed the price charged for the calibration represented by this certification.

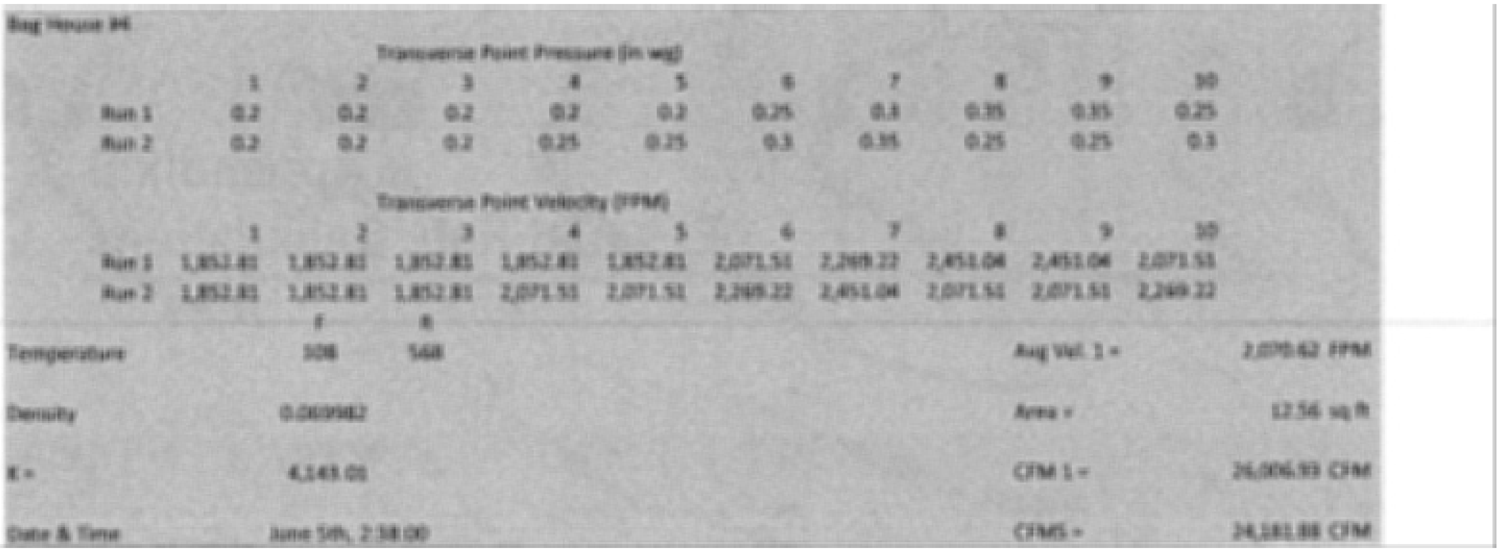
QA APPROVAL BY: Pedro A Vargas

Information contained in this document should not be reproduced in any form without the written consent of A.P. Buck Inc. It is for reference only and cannot be used as a form of endorsement by any private or governmental regulatory body.

A.P. BUCK, INC.
7101 Presidents Drive, Suite 110
Orlando, FL 32809
Phone: 407-851-8602 · Fax: 407-851-8910

BUCK
A.P. BUCK, INC.

Appendix B
Exhaust Rate Calculations



Bag House #4

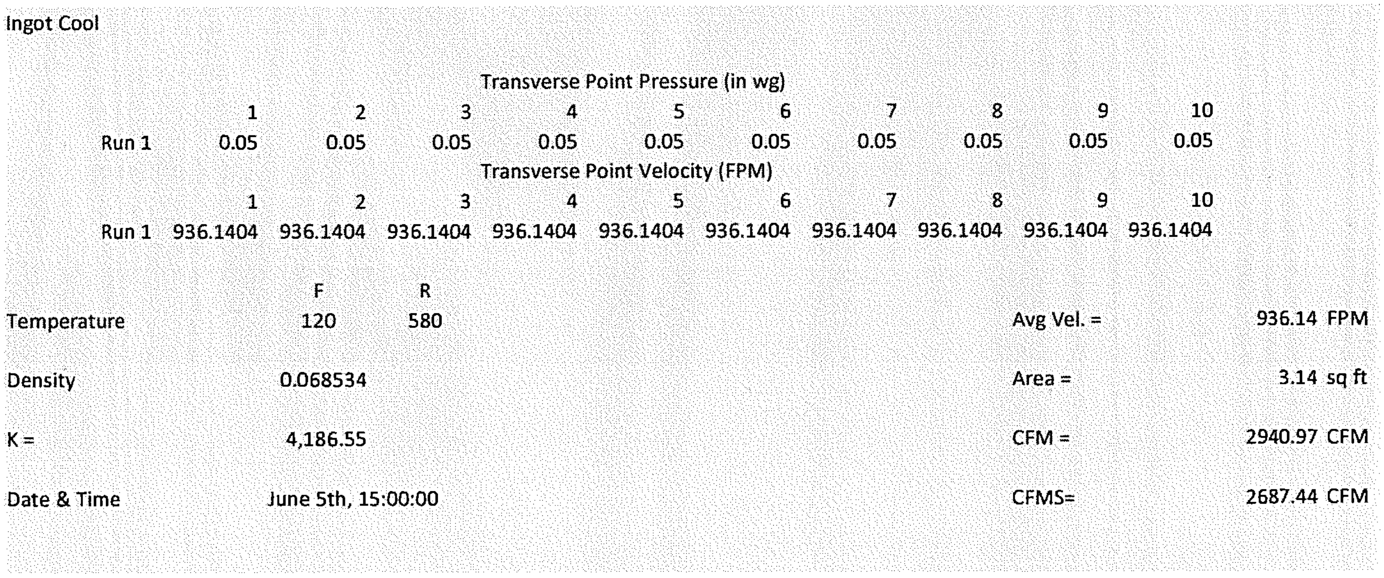
Transverse Point Pressure (in wg)

	1	2	3	4	5	6	7	8	9	10
Run 1	0.2	0.2	0.2	0.2	0.2	0.25	0.3	0.35	0.35	0.25
Run 2	0.2	0.2	0.2	0.25	0.25	0.3	0.35	0.25	0.25	0.3

Transverse Point Velocity (FPM)

	1	2	3	4	5	6	7	8	9	10
Run 1	1,852.81	1,852.81	1,852.81	1,852.81	1,852.81	2,071.51	2,269.22	2,451.04	2,451.04	2,071.51
Run 2	1,852.81	1,852.81	1,852.81	2,071.51	2,071.51	2,269.22	2,451.04	2,071.51	2,071.51	2,269.22

	F	R		
Temperature	108	568	Avg Vel. 1 =	2,070.62 FPM
Density	0.069982		Area =	12.56 sq ft
K =	4,143.01		CFM 1 =	26,006.93 CFM
Date & Time	June 5th, 2:38:00		CFMS =	24,181.88 CFM



Ingot Cool

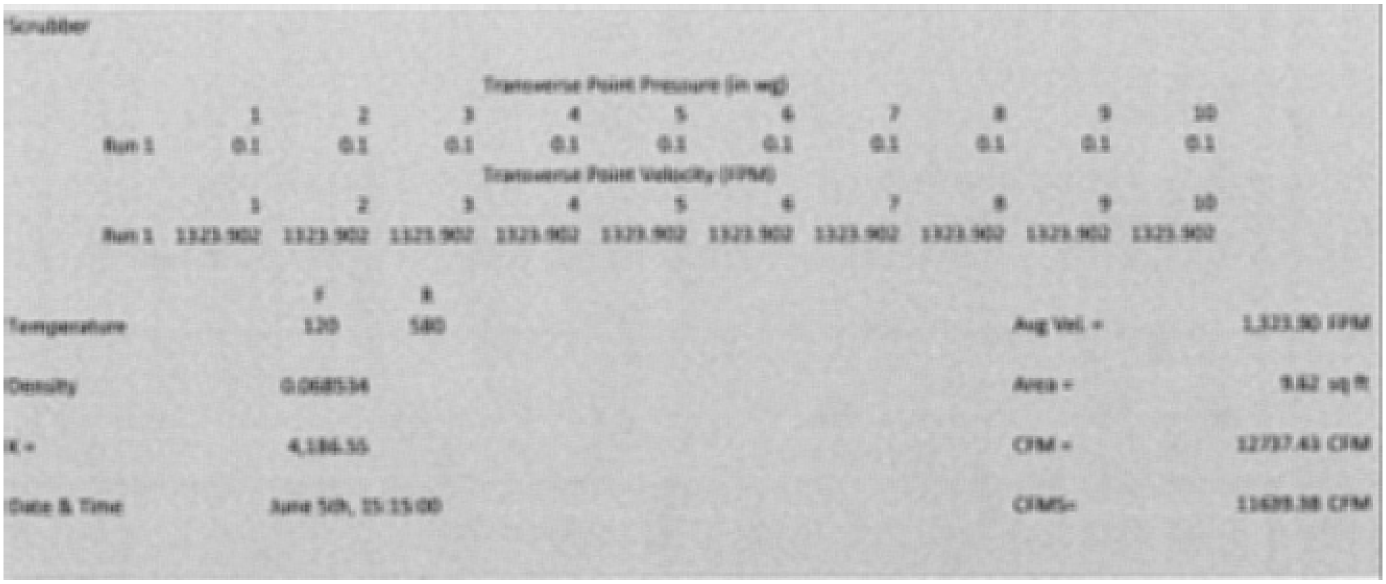
Transverse Point Pressure (in wg)

	1	2	3	4	5	6	7	8	9	10
Run 1	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05

Transverse Point Velocity (FPM)

	1	2	3	4	5	6	7	8	9	10
Run 1	936.1404	936.1404	936.1404	936.1404	936.1404	936.1404	936.1404	936.1404	936.1404	936.1404

	F	R		
Temperature	120	580	Avg Vel. =	936.14 FPM
Density	0.068534		Area =	3.14 sq ft
K =	4,186.55		CFM =	2940.97 CFM
Date & Time	June 5th, 15:00:00		CFMS=	2687.44 CFM



Scrubber

Transverse Point Pressure (in wg)

	1	2	3	4	5	6	7	8	9	10
Run 1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1

Transverse Point Velocity (FPM)

	1	2	3	4	5	6	7	8	9	10
Run 1	1323.902	1323.902	1323.902	1323.902	1323.902	1323.902	1323.902	1323.902	1323.902	1323.902

	F	R		
Temperature	120	580	Avg Vel. =	1,323.90 FPM
Density	0.068534		Area =	9.62 sq ft
K =	4,186.55		CFM =	12737.43 CFM
Date & Time	June 5th, 15:15:00		CFMS=	11639.38 CFM

Appendix C
Door Infiltration Velocities

TRC 150 N Patrick Blvd, Suite 180, Brookfield, WI 53045 • www.TRCsolutions.com SHEET _____ OF _____

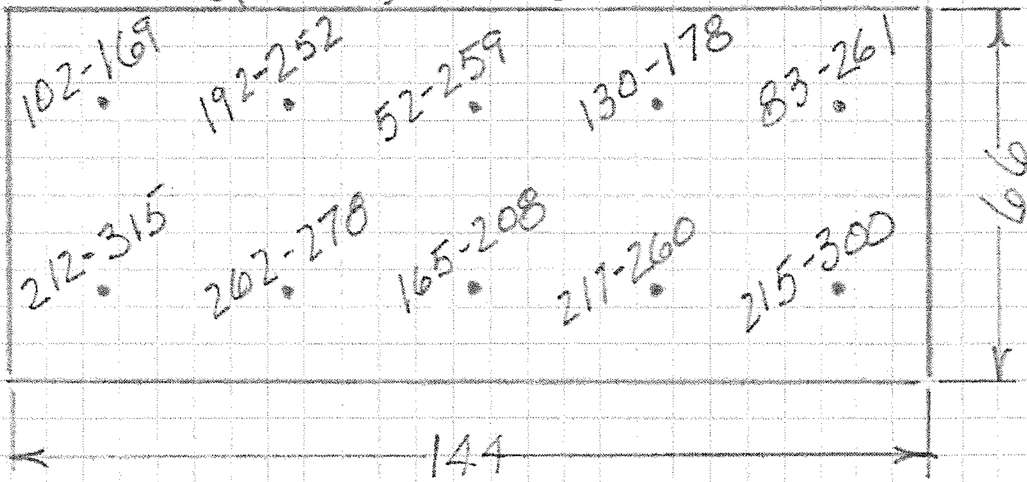
PROJECT/PROPOSAL/LOCATION NAME: H. KRAMER-ELEC. FURN. BLDG		**PROJECT/PROPOSAL NUMBER**
SUBJECT: VELOCITIES THROUGH DOORWAYS		
PREPARED BY: R. SCHOLZ	**DATE:** JUNE 5, 2012	**FINAL** ☐
CHECKED BY:	**DATE:**	**REVISION** ☐

LEAD DAY - JUNE 5, 2012

DOOR A

$A = 66\ FT^2$ $V_{AVE} = 205.5$

Q = 13,563 SCFM

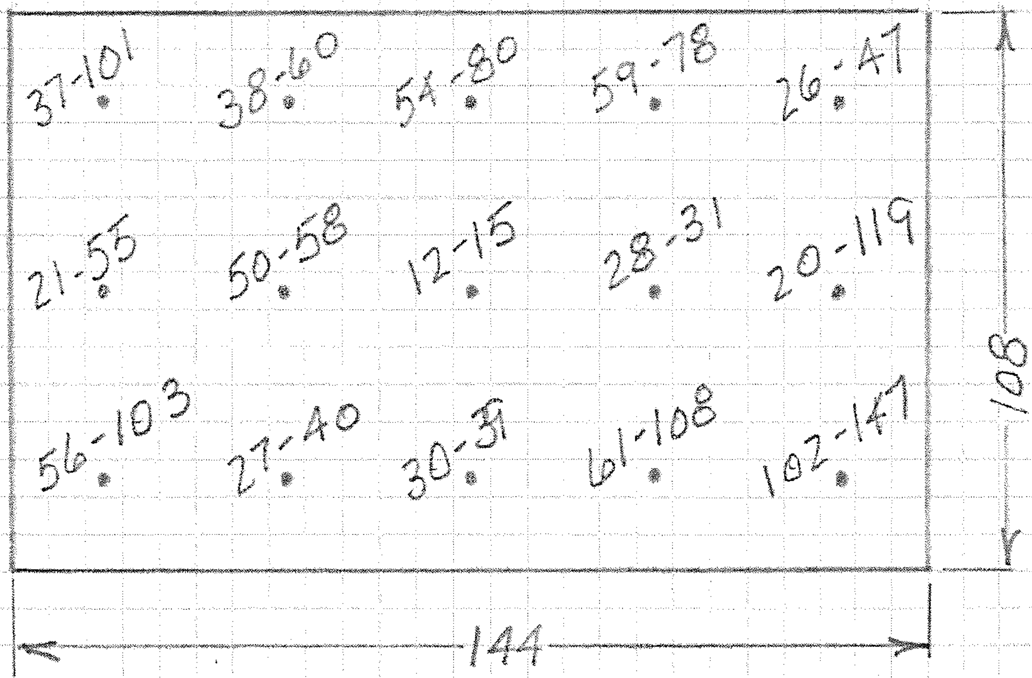


102-169	192-252	52-259	130-178	83-261
212-315	202-278	165-208	217-260	215-300

DOOR B

$A = 108\ FT^2$ $V_{AVE} = 56.7$ FPM

Q = 6124 SCFM



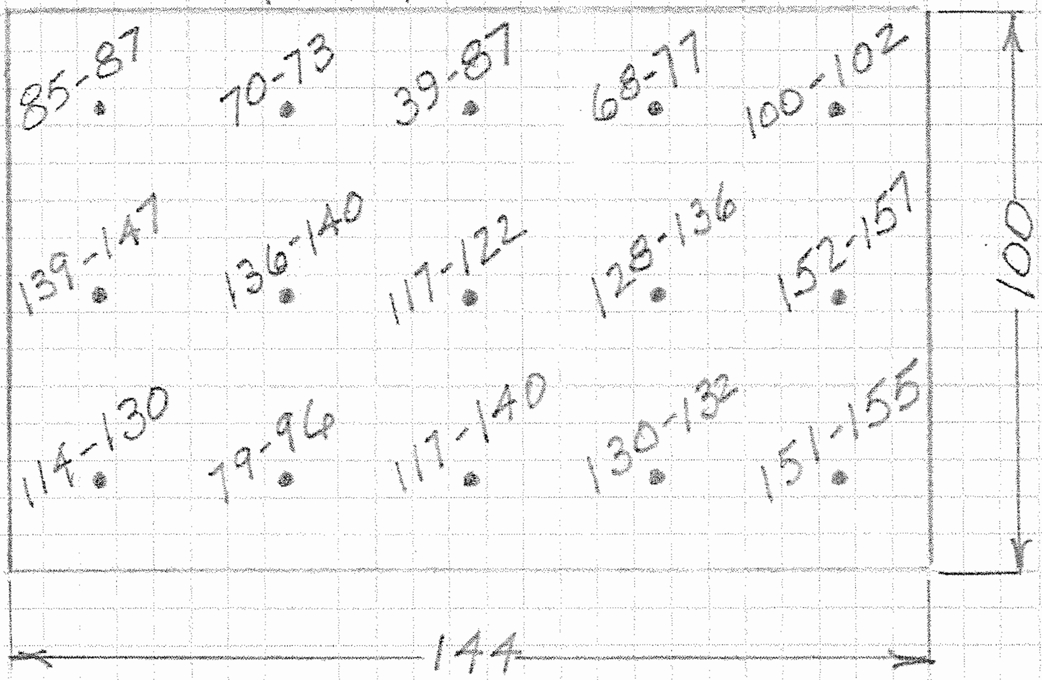
37-101	38-60	54-80	59-78	26-47
21-55	50-58	12-15	28-31	20-119
56-103	27-40	30-39	61-108	102-147

Project/Proposal/Location Name: H. KRAMER- ELEC. FURN. BLDG		**Project/Proposal Number**
Subject: VELOCITIES THROUGH DOORWAYS		
Prepared By: R. SCHOLZ	**Date:** JUNE 5, 2012	**FINAL** ☐
Checked By:	**Date:**	**REVISION** ☐

LEAD DAY - JUNE 5, 2012

DOOR C A = 100 FT^2 V_{AVE} = 113.5 FPM

Q = 11,350 SCFM

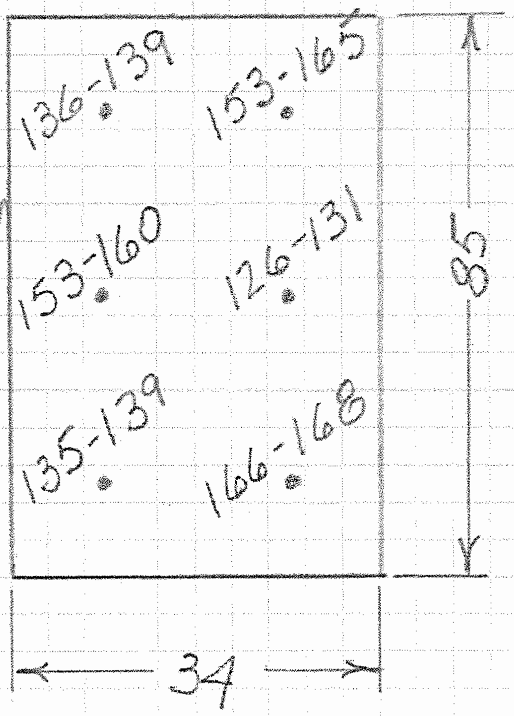


DOOR D

A = 20.07 FT^2

V_{AVE} = 147.6 FPM

Q = 2,962 SCFM

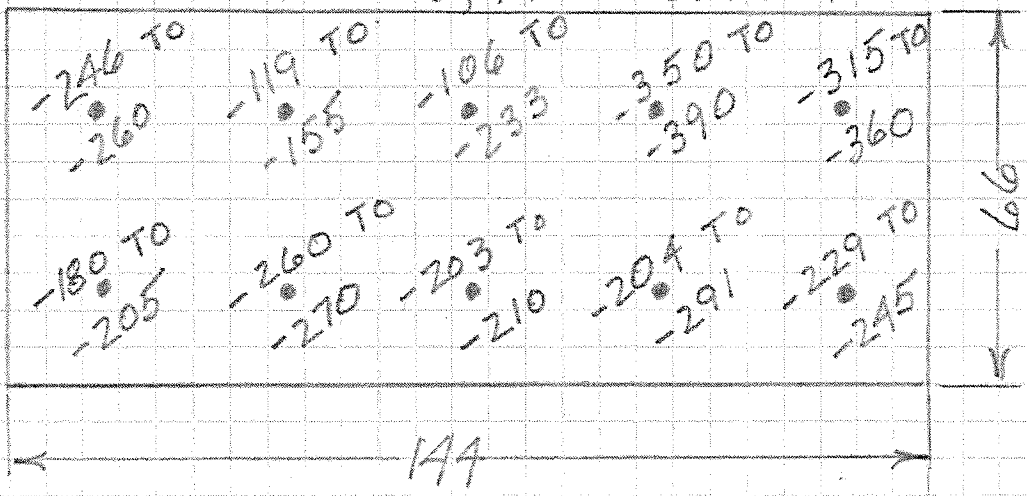


Project/Proposal/Location Name: H. KRAMER-ELEC. FURN. BLDG.
Project/Proposal Number
Subject: VELOCITIES THROUGH DOORWAYS
Prepared By: R. SCHOLZ
Date: JUNE 6, 2012
Final ☐
Checked By:
Date:
Revision ☐

NO-LEAD DAY - JUNE 6, 2012

DOOR A A = 66 FT^2 V_{AVE} = -241.6

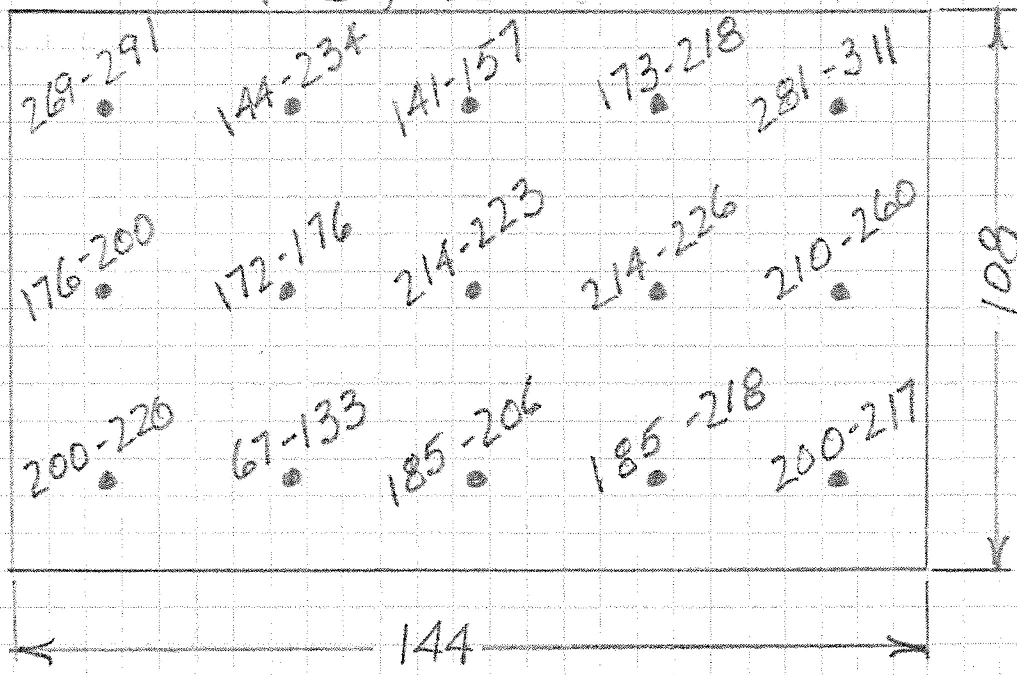
Q = -15,946 SCFM



-246 TO -260	-119 TO -155	-106 TO -233	-350 TO -390	-315 TO -360
-180 TO -205	-260 TO -270	-203 TO -210	-204 TO -291	-229 TO -245

DOOR B A = 108 FT^2 V_{AVE} = 204.0

Q = 22,032 SCFM



269-291	144-234	141-157	173-218	281-311
176-200	172-176	214-223	214-226	210-260
200-220	67-133	185-206	185-218	200-217

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SHEET ______ OF ______

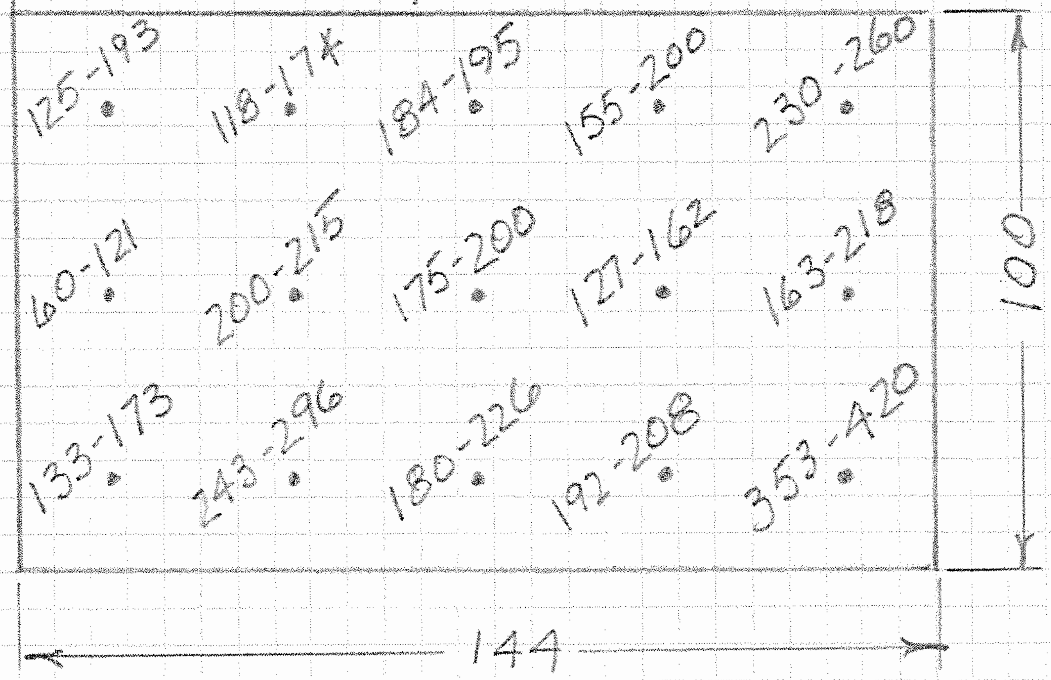
PROJECT/PROPOSAL/LOCATION NAME: H. KRAMER - ELEC. FURN. BLDG.		**PROJECT/PROPOSAL NUMBER**
SUBJECT: VELOCITIES THROUGH DOORWAYS		
PREPARED BY: R. SCHOLZ	**DATE:** JUNE 6, 2012	**FINAL** ☐
CHECKED BY:	**DATE:**	**REVISION** ☐

NO-LEAD DAY - JUNE 6, 2012

DOOR C

A = 100 FT^2 V_{AVE} = 196.6 FPM

Q = 19,660 SCFM

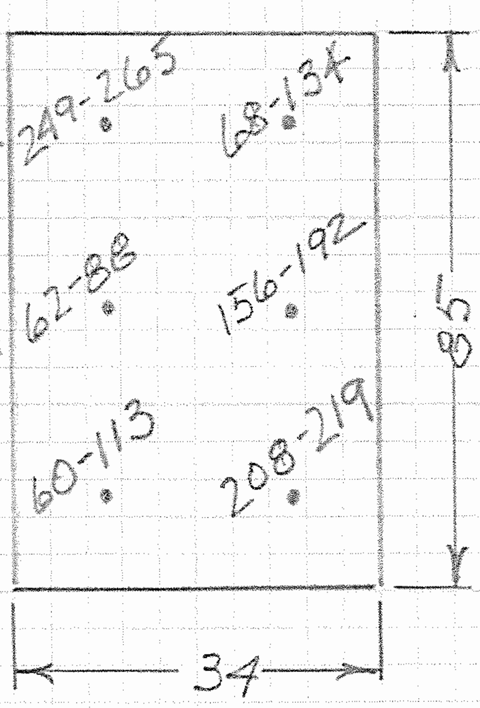


DOOR D

A = 20.07 FT^2

V_{AVE} = 151.2 FPM

Q = 3,035 SCFM



Assessment of Fugitive Lead Emissions from the South Foundry Building

H. Kramer & Co.
Chicago, Illinois

June 2012

TRC Environmental Corporation | H. Kramer & Co.
Final
\\NTAPABROOKFIELD\MLW-VOL1\-\WPMLW\PJT2\185796\0000\185796 SOUTH FOUNDRY REPORT JUNE 2012\R185796 0000-001 FINAL.DOCX

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Section 1
Objectives and Scope of the Evaluation

1.1 Objective

The objectives in conducting this evaluation were:

- To assess the potential for material quantities of fugitive lead emissions from the South Foundry building.
- To estimate the emissions of lead and use air quality modeling to evaluate the impact, if any, at the ambient air monitoring stations.
- To identify and evaluate methods to reduce any meaningful fugitive emission potential to the extent feasible.

1.2 Scope

The scope of TRC's evaluation focused on the entire manufacturing facility and its operation. There are two separate foundries: the South Foundry, with its two rotary furnaces, and the Electric Furnace Building. In the interconnected building space are located shipping and receiving, maintenance, offices, warehouses and other non-casting production areas. The South Foundry building is in reality a part of a larger building. However, because the South Foundry is kept under an isolating ventilation condition, and because the connections between the South Foundry and the rest of the building are very limited and controlled, the South Foundry is a separate ventilation entity. This report covers the South Foundry and the interconnected building space. A separate report will cover the Electric Furnace Building.

Section 2
Conclusions

1. **During the course of TRC's evaluation of the South Foundry ventilation, no leakage of lead- contaminated air was occurring through any door openings or leaks in the South Foundry building.**

   – During operation, the South Foundry building was kept under a constant negative pressure, produced by the continuously operating, close-capture furnace exhaust systems and the intermittently operating ingot cooling exhaust fans. This negative pressure in turn created infiltration air velocities which counteracted any tendency for air to exit the building through door openings and leaks.

2. **Steam from two locations is periodically exhausted to the outside air. Steam exhaust carries with it indoor air, which may contain and transport lead to the outdoors.**

   – TRC estimated the rate of lead entering the ingot cooling tunnels of the South Foundry. During ingot pouring TRC monitored 49 milligrams-per-minute of lead from the Rotary Furnace 1 Line and 22.5 milligrams-per-minute of lead from the Rotary Furnace 2 Line entering the cooling tunnels. These calculations were based on TRC's measurements of:

     - The in-building concentration in the ingot cooling areas during ingot pouring.
     - The airflow rate of the cooling tunnel exhausts.
     - Use of the above measurements as emissions to the outdoor air would assume that none of the lead is controlled in the cooling process or by the produced steam (a conservative assumption because the steam will scrub most of the lead before discharge).

3. **TRC measured lead concentrations near 6 operations outside of the South Foundry Building active area (this is the interconnected building mentioned above). These are all indoors in separate enclosures and the concentrations are minimal at these locations. A majority of the samples were non-detect. For purposes of being conservative, samples below the detection level were assumed to be at the detection level.**

4. **Ambient air quality modeling of all of the fugitive emissions identified shows that the fugitive emissions are:**

   A. Only a small fraction of the stack emissions.

   B. The maximum 90 day rolling average over 2 and ¼ years of meteorological data from the modeled results (fugitive emissions only) is 0.006 μg/m³ at the Perez School monitor and 0.003 μg/m³ for the Juarez School monitor. These results are less than 1/25th of the NAAQS.

C. The stacks, the South Foundry Building and the potential lead sources in the interconnected building all together were modeled as 0.041 μg/m³ at the Perez School monitor and 0.014 μg/m³ at the Juarez School monitor. This is less than 1/3rd of the NAAQS.

Section 3
Technical Approach and Methods

3.1 Overall Approach

This evaluation was undertaken by conducting the following task elements:

1. Touring the South Foundry facility during normal production and discussing processes involved in the melting and casting operation with operational and maintenance staff.
2. Assessing the in-building concentrations of lead within the South Foundry, which were isolated within the building during the charging, melting and refining, and ingot pouring phases of the metal casting operations.
3. Conducting a ventilation analysis of the South Foundry, identifying any pathways through which indoor air could have been leaving the building.
4. Estimating the lead emission rate associated with any uncontrolled air discharges which were occurring from the South Foundry. These emissions are then modeled for their impact.

3.2 Fugitive Emission Assessment Methods

The measurement methods employed in this evaluation are summarized in Table 1. Factory calibrated instruments were used in this evaluation. At the time of the evaluation, TRC subjected these instruments to a calibration checking procedure which compared their readings to standard measurement methods. The results of these calibration checks are provided in Appendix A.

A calibration certificate for the airflow checking device used for the calibration of air sampling pumps is also included in Appendix A.

Section 4
Profile of Lead Concentration in the Background Air inside the South Foundry

4.1 Background Samples for Total Particulate Matter (TPM) and Lead Content

The purpose of the air sampling was to characterize the lead content of the South Foundry in-building air so that fugitive lead emission rates could be determined for any uncontrolled exfiltration of air detected from that building.

Measurements were taken during all parts of the rotary furnace production cycle. Based on total particulate levels, the pouring phase produced the highest levels, followed closely by the refining phase. Table 2 presents results of air samples gathered during the pouring shift (first shift) on April 24 and 26. Results are presented in terms of total particulate matter (TPM) and lead content. The locations (using letters) where these samples were taken are identified in Figure 1. On Figure 1, the locations (using numbers) are also shown for locations where real-time measurements were made of total particulate matter (TPM) throughout the South Foundry. Contour maps of the distribution of particulate matter are shown in Figures 2 through 4 for each of the furnace phases, *i.e.*, charging, melting, and refining and pouring. Based on total particulate levels, the pouring phase produced the highest levels, followed closely by the refining phase. TPM levels during charging were the lowest measured.

4.2 Thermal Effects on Concentrations of Total Particulate Matter (TPM) and Temperature

Figures 5 and 6 are vertical profiles (concentrations and temperature based on height above the Foundry floor). At two locations (near Rotary Furnace 1 and Rotary Furnace 2), real-time TPM measurements were made along with temperature readings. The data shows the impact of thermal stratification on TPM concentrations.

An explanation for this finding can be made as follows: Fugitive process emissions, where they occur, contain both TPM and thermal energy. Consequently, the migration of TPM is initially toward the ceiling, driven by thermal buoyancy. The ventilation pattern of the facility is produced by air which is withdrawn through furnace hoods, whose suction inlets are located in the lower half of the overall building height. Thus, TPM must descend to the level of these suction openings to be evacuated. Hence, a concentration gradient exists with higher concentrations of TPM at elevated heights within the building.

Section 5
Ventilation Analysis of the South Foundry

5.1 Ventilation Mode of the South Foundry

The ventilation of the South Foundry may be classified as "exhaust-driven" ventilation. Exhaust-driven ventilation occurs when powered exhaust dominates the ventilation of a facility and when replacement air (makeup air) is drawn into the facility due to the negative pressure created by the exhaust. In the case of the South Foundry, all of the makeup air is infiltrated through two fast acting truck doors, a pedestrian door and through building inflow leaks. The intensity of the negative pressure within the building at any point in time is dependent on the openness of the building at that time.

An air mass balance for the South Foundry, based on airflow readings taken by TRC on April 18, 2012, is shown schematically in Figure 7. There are six separate exhaust fans which together create the negative pressure in the South Foundry. All six of these fans are associated with close capture exhaust hoods. The four furnace-related hoods operate continuously, around the clock. The two ingot cooling hoods only operate during ingot casting each day. Pouring into ingot molds occurs almost entirely on first shift (*i.e.*, 7:00 am to 3:00 pm). Thus, there are two principal exhaust rates that create negative pressure in the South Foundry (Table 3). During pouring, 147,185 standard-cubic-feet-per-minute (SCFM) was being exhausted from the South Foundry. During the other two shifts of production (*i.e.*, furnace charging and metal refining), 124,342 SCFM was exhausted from the South Foundry.

TRC studied the various operating scenarios to determine the effect of negative pressure on fan performance. The exhaust rate from the South Foundry varied principally on the basis of the number of powered exhaust fans operating. The exhaust rate did not vary to any appreciable extent based on door openings. The combination of door openings and leaks generated levels of negative pressure up to about one-fourth of one-inch negative pressure. In contrast, the six powered exhaust fans drew air at much elevated negative pressures to accommodate pressure drops as air passed into capture hoods and was drawn through ductwork and filters. The small building negative pressure changed overall fan static pressure, and consequently changed airflow rate, an insignificant amount.

This expected finding was confirmed by taking exhaust measurements on the Rotary 1 ingot cooling line ventilation fan with the doors to the South Foundry both open and closed (Appendix B). The negative pressure capabilities of the powerful, centrifugal fans were much higher than the capabilities of the in-line cooling fans and thus the building negative pressure had even less potential for affecting airflow rate through these fans. Small fluctuations in building negative pressure due to door openings had a much lower impact on these fans.

5.2 Creation of Infiltration through Building Negative Pressure

At a relatively constant total building exhaust rate, building infiltration varied principally with the total area of openings into the building. Openings consisted of door openings as well as small cracks and gaps in the building itself. Table 4 presents a breakdown of infiltration rates for the two types of building openings at the different door opening conditions. The measurement data from which the infiltration rates (through open doors) were gathered are presented in Appendix C.

Based on TRC observations, there are no significant building leaks. Only a few places could be seen where sunlight appeared indoors through small cracks and gaps. Even with this significant amount of building sealing, there is still infiltration potential. This finding was not unexpected because all buildings "breathe". It is not feasible to create essentially leak-free conditions in industrial buildings. The "breatheability" of the South Foundry is not an impediment to effectively prevent fugitive emissions. In fact, if there were no potential for air infiltration it would create a danger to the workers in the building.

5.3 Evidence of Control of Fugitive Emissions from the South Foundry Building

Evidence of the efficacy of the negative pressure control was the fact that at no time did the building differential pressure ever fall to zero or to a negative value. Table 5 presents building differential pressure data for the various door opening conditions with and without the ingot cooling fans operating. This data was gathered near the factory floor. Building differential pressure readings gathered at roof level showed the same basic levels. The lowest building differential pressure readings occurred with both doors open, a condition which a time study showed occurred only 0.6% of the time (see Table 5 and Figure 8).

Section 6
Estimated Fugitive Lead Emissions from the South Foundry

6.1 Determination of a Fugitive Lead Emission Rate

During this evaluation, TRC detected a potential for fugitive lead emissions from the South Foundry only from two powered ingot cooling ventilation systems. These two cooling fans operated during ingot pouring on first shift. Airflow rates were measured through these ventilation systems with the fans operating but without the cooling water (therefore no steam).

The following assumptions were made in this determination:

1. The lead concentration in the vicinity of each cooling tunnel constituted available airborne lead which the powered ventilation system could discharge from the facility.
2. The effect of steam contact with airborne particles containing lead likely results in a reduction of the lead concentration of the potential emissions (scrubbing effect).

Assuming the source to be exclusively Item 1 above, (*i.e.*, from background air in the vicinity), the calculation rate is as follows:

Rotary 1 Ingot Cooling Stack

Given: Area Sample B, Figure 1

Lead concentration = 0.12 mg/m^3 (Table 2)

Exhaust rate = 14,431 SCFM (Appendix B, average of three flows)

Lead emission rate = 14,431 ft^3/min x 0.12 mg/m^3 x 1m^3/35.31 ft^3 = 49.0 mg/min

Rotary 2 Ingot Cooling Stack

Given: Area Sample F, Figure 1

Lead concentration = 0.11 mg/m^3 (Table 2)

Exhaust rate = 7,948 SCFM (Appendix B)

Lead emission rate = 7,948 ft^3/min x 0.11 mg/m^3 x 1m^3/35.31 ft^3 = 24.8 mg/min

Section 7

Estimated Fugitive Lead Emissions from Ancillary Operations in Interconnected Building

There are 6 independent ancillary operations which were studied. Each of them is in a separate enclosed building area of the South Foundry complex. See Figure 9 for their locations. Samples were taken of the indoor air in those building areas as close as possible to the operation itself. No study was performed of the ventilation rates of the enclosed areas. Because these areas, when mechanically ventilated, do not have any controls, for purposes of the emissions analysis it is assumed that these concentrations will be exhausted from the buildings areas without any reduction in concentration. The operations are described as follows:

A. Receiving: The receiving area handles the incoming scrap and inputs to the refining process. This is a first shift only (7 am to 3 PM) operation. There were 5 samples taken and 3 of those samples were non-detects. Even assuming that the non-detects were at the detection threshold, the potential emissions are very small.

B. Maintenance: The maintenance operations also occur only during first shift. The one sample was a non-detect, again but was assumed to be at the detection threshold.

C. Ladle Repair: The ladle repair area is for lining the ladles prior to reuse. This area also includes ingot staging. Again, this is a first shift activity. There were 5 samples of which 2 were non-detects.

D. Shipping: This is also a first shift activity. There were 2 samples which were both detects.

E. Warehouse: This is also a first shift activity. There were 5 samples and all were non-detects, but were assumed to be at the detection threshold.

F. Removal of Bag House Dust: Every other day, during the first shift, the baghouse dust is transferred from its bin into super sacks for disposal. There were two samples taken during this operation and both were above the detection limit. It was determined that there was a seal in the damper which was not seating properly that led to these detections. The issue with the seal does not represent normal conditions and this equipment will be replaced with the installation of the new bag houses. Nevertheless, the emission rate for modeling used the results from the two collected samples.

The results of these tests are summarized in Table 6 with calculations of the lead emission generation rates which are to the indoor environment.

Section 8
Modeling of Estimated Fugitive Lead Emissions

Modeling was performed of the effect of the fugitive emissions at the ambient air quality monitoring sites at the Perez School and the Juarez School. In the modeling, the time of day of the fugitive emissions was taken into account. A summary of the model input values is shown in Table 7.

The results of the model analysis were evaluated in two different ways.

First, the model results were run for the 15 specific days when the measured data at the Perez School monitor exceeded 0.15 μg/m³ (the daily measured data at the Juarez School monitor has never exceeded 0.15 μg/m³). These model comparisons are presented in Figure 10. It is clear that the fugitive emissions are a small part of the measured concentrations. This is true despite the assumptions made regarding the fugitive emission sources which significantly over estimate the emissions,
i.e., that the ingot steam coolers do nothing to reduce the emissions of indoor air going through the coolers, that non-detects are assumed to be at the detection threshold, and that the ancillary operations emissions are all transported to the outside air. Modeling of the combined stack and fugitive emissions can also be compared to the measured data for the 15 highest measured days. These results are shown in Figure 11.

Second, the NAAQS of 0.15 μg/m³ for lead is based on the 90 day average of lead concentrations in the air. The results of this modeling shows that the maximum 90 rolling average over the 2 and 1/4th years of meteorological data for the fugitive emissions is 0.006 μg/m³ for the Perez School monitor and 0.003 μg/m³ for the Juarez School monitor. Also shown below are the modeled contributions of the baghouse stacks and then the total with both sets of sources. These values include both the stack emissions and the overestimated fugitive emissions. These modeled concentrations are less than 1/3rd of the NAAQS at both monitoring stations.

Model Results in μg/m³ for January 2010 through March 2012

	Perez School:			Juarez School:		
	Stacks	Fugitives	Total	Stacks	Fugitives	Total
Maximum of 90 Day Averages	0.038	0.006	0.041	0.013	0.003	0.014

Tables

Table 1
Field Measurement Methods
(see Appendix A for instrument calibration data)

Parameter	Instrumentation	Notes
Real-Time Concentrations of Total Particulate Matter	Thermo Electron Corp. Model PDR 1200 data RAM (scattered light optical method).	A 5 micrometer PVC filter in a 37 millimeter cassette mounted downstream of the optical chamber allowed calibration of the optics to the actual aerosol which was sampled. Air quality profiles were produced from the assessment data gathered throughout the workplace using a contour mapping program.
Area Time-Weighted Average Lead Samples	Calibrated MSA sampling pump using same filter and the same calibration technique as in the notes for real-time sampling, above. In this case, gravimetric analysis was followed by determination of lead content.	Lead was analyzed using NIOSH Method 7303 (inductively coupled plasma). Filter blanks were employed for quality control purposes.
Duct Airflow and Static Pressure	Pitot Tube and Dwyer Magnehelic Gauges, Models 2002 and 2020.	Existing sampling ports in ductwork were used and, where needed, new holes were drilled. Multi-point traverses were made in each case, corrected for airflow temperature.
Building Differential Pressure	Dwyer Magnehelic Gauge, Model 2300-0	Requires rigid true vertical monitoring to be accurate.
Temperature Readings	Cole-Parmer Model No. 3312-21 Psychrometer (wet and dry bulb fluid filled thermometers).	Readings taken simultaneously with real-time particulate matter readings during vertical profiling.
Indraft through Doorways	TSI VelociCalc, Model 8360	Turbulence in vicinity of doors necessitated recording of velocity ranges at each assessment point. These ranges were averaged to determine the airflow rate through the doorway.

TABLE 2
INDOOR AIR SAMPLING RESULTS SUMMARY - APRIL 2012
H KRAMER - CHICAGO, ILLINOIS
Area A - South Foundry

Sample I.D.	Sample Description	Sample Location on Figure 1	Sample Location Description	Notes	Sample Length (Min.)	Analyte	Units	Result	%Lead in Total Weight
75755	Area Sample	A	Inside R1 chain, South	Collected on 4/24/2012 during pouring	496	Total Weight	mg/m^3	1.4	7%
						Lead	mg/m^3	0.095	
75756	Area Sample	B	Inside R1 chain, North	Collected on 4/24/2012 during pouring	492	Total Weight	mg/m^3	1.3	9%
						Lead	mg/m^3	0.12	
75757	Area Sample	C	Outside south wall of office, west of R1	Collected on 4/24/2012 during pouring	502	Total Weight	mg/m^3	1.2	8%
						Lead	mg/m^3	0.10	
75758	Area Sample	D	Inside R2 chain, Northeast	Collected on 4/24/2012 during pouring	492	Total Weight	mg/m^3	1.3	8%
						Lead	mg/m^3	0.10	
75759	Area Sample	E	Outside R2 control room	Collected on 4/24/2012 during pouring	479	Total Weight	mg/m^3	2.0	12%
						Lead	mg/m^3	0.23	
75760	Area Sample	F	Inside R2 chain, South	Collected on 4/24/2012 during pouring	496	Total Weight	mg/m^3	1.1	10%
						Lead	mg/m^3	0.11	
75769	Area Sample	G	North of R1, near slag storage. Elevation: 20'	Collected on 4/24/2012 during pouring	495	Total Weight	mg/m^3	1.6	10%
						Lead	mg/m^3	0.16	
78636	Area Sample	H	Outside north wall of office, east of R2 dump area. Elevation: 15'	Collected on 4/26/2012 during pouring	215	Total Weight	mg/m^3	1.9	7%
						Lead	mg/m^3	0.14	
75771	Area Sample	H	Outside north wall of office, east of R2 dump area. Elevation: 10'	Collected on 4/24/2012 during pouring	402	Total Weight	mg/m^3	1.2	10%
						Lead	mg/m^3	0.12	
75761	Area Sample	H	Outside north wall of office, east of R2 dump area. Elevation: 5'	Collected on 4/24/2012 during pouring	368	Total Weight	mg/m^3	1.2	8%
						Lead	mg/m^3	0.097	
78640	Area Sample	H	Outside north wall of office, east of R2 dump area. Elevation: 5'	Collected on 4/26/2012 during pouring	215	Total Weight	mg/m^3	1.4	8%
						Lead	mg/m^3	0.110	
75762	Area Sample	I	Outside of R2 chain, East side. Elevation: 25'	Collected on 4/24/2012 during pouring	105	Total Weight	mg/m^3	3.6	13%
						Lead	mg/m^3	0.480	
78634	Area Sample	B	R1 Launderer	Collected on 4/26/2012 during pouring	233	Total Weight	mg/m^3	1.1	7%
						Lead	mg/m^3	0.078	
78635	Area Sample	D	R2 Furnace, South	Collected on 4/26/2012 during pouring	207	Total Weight	mg/m^3	1.7	8%
						Lead	mg/m^3	0.130	
78637	Area Sample	F	R2 Water Bath	Collected on 4/26/2012 during pouring	209	Total Weight	mg/m^3	1.8	8%
						Lead	mg/m^3	0.140	
78638	Area Sample	C	R1 Furnace West Side	Collected on 4/26/2012 during pouring	218	Total Weight	mg/m^3	1.4	9%
						Lead	mg/m^3	0.120	
78639	Area Sample	A	R1 Furnace East Side	Collected on 4/26/2012 during pouring	230	Total Weight	mg/m^3	2.3	6%
						Lead	mg/m^3	0.130	
78641	Area Sample	E	R2 Pouring, North Side	Collected on 4/26/2012 during pouring	199	Total Weight	mg/m^3	1.6	16%
						Lead	mg/m^3	0.250	

Notes

1. All samples collected at 5' elevation, unless otherwise noted

Table 3

Exhaust Rates of Powered Exhaust Ventilation from H. Kramer South Foundry Airflow Rate Measurements, April 18, 2012 (Appendix C)

A. Air Mass Balance During Charging and Refining

Process	SCFM	Control
Rotary 1 Canopy	26,984	Baghouse 5
Rotary 2 Canopy	39,566	Baghouse 1
Combined Rotary Furnace Flues	17,810	Baghouse 2
	39,982	Baghouse 6
	124,342	

B. Air Mass Balance During Ingot Casting

Process	SCFM	Control
Rotary 1 Canopy	26,984	Baghouse 5
Ingot Cooling	14,895	
Rotary 2 Canopy	39,566	Baghouse 1
Ingot Cooling	7,948	
Combined Rotary Furnace Flues	17,810	Baghouse 2
	39,982	Baghouse 6
	147,185	

Table 4

Sources and Amounts of Building Infiltration at Different Door Opening Conditions and With All Six Powered Exhaust Systems Operating
April 18, 2012

Total exhaust rate, SCFM	**147,185 SCFM**		
	Infiltration (SCFM)		
	Doors:		**Building Inflow**
	Interior	**Exterior**	
A. Doors closed (0.180 – 0.190 inches water column BDP, 70° F)	0	0	147,185
B. Both doors open	43,520	60,895	42,770
C. Interior door open	68,680	0	78,505
D. Exterior door open	0	88,920	58,265

Table 5
Time Profile of Truck Door Openings Time Segment During Pouring Shift
April 24, 2012

Time	Duration Open (seconds)	Which Door?	Reason?	Notes
13:10	10	E	F	
13:10	10	E	F	
13:13	15	I	F	
13:13	10	E	U	
13:13	20	I	F	
13:14	10	E	U	
13:15	20	I	F	
13:16	20	E	P	
13:16	12	E	F	
13:17	15	E	U	
13:18	20	I	P	
13:18	20	I	F	
13:18	25	I	F	
13:19	20	I	F	
13:19	20	I	P	
13:21	20	I	U	
13:22	12	E	P	
13:22	10	E	U	
13:23	20	E	F & P	
13:25	20	E	P	
13:27	10	E	F	
13:31	20	E	F	
13:32	15	E	F	
13:32	30	I	F	Overlap for 10 seconds
13:33	20	E	U	
13:34	45	E	F & P	
13:35	10	E	P	
13:36	15	I	P	
13:36	20	I	F	
13:37	15	E	F	
13:38	40	E	F	
13:39	10	E	P	
13:39	30	I	U	
13:40	20	E	U	

Key:

F = Forklift
P = Pedestrian
U = Unknown
I = Interior Door
E = Exterior Door

Percentage of Time that Doors Were Open	
Time that Internal Door Open:	15.28%
Time that External Door Open:	19.67%
Time that Both Doors Were Open at the Same Time:	0.56%
Total Time that a Door was Open:	34.39%

Other Observations/Notes:

There is a door for pedestrians next to internal mandoor
From 14:40-15:09, the internal door was open.
Date of these observations is Tuesday, 4/24/2012.

Table 6
Estimation of Potential Fugitive Lead Emission Rate to the Outdoors from Non-Foundry Areas
H Kramer - Chicago, Illinois

Building	***Lead Concentration Measurements***		***Estimation of Effective Ventilation Rate***		***Estimation of Potential Fugitive Lead Emission Rate to the Outdoors***	
	No. of Samples	**Ave. Lead Concentration^{6} (mg/m^{3})**	**Minimum^{1,2,3} (m^{3}/min)**	**Maximum^{1,2,3} (m^{3}/min)**	**Minimum^{1,4} (mg/min)**	**Maximum^{1,4} (mg/min)**
Receiving	5	0.004	30	181	0.1	0.7
Baghouses 2 & 6 (During Removal of Collected Dust)	2	0.093	55	330	5.1	30.7
Maintenance	1	0.008	38	228	0.3	1.8
Ladle Repair (During Repair and Ingots Staging)	5	0.0077	73	439	0.6	3.4
Shipping	2	0.025	83	499	2.1	12.5
Warehouse	5	0.003	310	1,860	0.9	5.6

Notes:

1. Assumption of 0.5 air changes per hour (minimum) and 3.0 air changer per hour (maximum). ***Minimum = 0.5 Maximum = 3.0***
2. A mixing factor of 5 (Poor Mixing) assumed for use in calculating effective ventilation rate. ***Mixing (K) Factor = 5***
3. Estimation of ventilation rate is calculated using the following equation:
   *Effective Ventilation Rate = Building Volume * Air Changes per Minute / Mixing Factor*
4. Estimation of fugitive lead emission rate is calculated using the following equation:
   *Fugitive Lead Emission Rate = Average Lead Concentration * Effective Ventilation Rate*
5. Building Heights estimated off of field measurements (receiving, baghouse, ladle repair) or through assumptions (maintenance, shipping, warehouse same height as ladle repair).
6. Non-detects were used (at the detection threshold) in the calculation of average lead concentrations. The breakdown of non-detects per building is documented below:
   Ladle Lining - 2 Non-Detect Samples
   Shipping - 0 Non-Detect Samples
   Maintenance - 1 Non-Detect Sample
   Warehouse - 5 Non-Detect Samples
   Receiving - 3 Non-Detect Samples
   Baghouse - 0 Non-Detect Samples

Table 7
Model Source Data

Fugitive Sources	*Building Geometry*			lbs/hour	g/sec	Configuration	Exit Flow (acfm)	Exit Diameter (m)	Hours	Time of Day
	Building Height (m)	Building Area (m^2)	Building Volume (m^3)							
Receiving	5.0	3,610	18,050	0.000056	0.000441	Building			8	7AM-3PM
Baghouses 2 & 6 (During Removal of Collected Dust)	11.6	2,842	32,967	0.002364	0.018742	Building			1.5	9AM-10:30AM
Maintenance	9.1	2,503	22,777	0.000140	0.001114	Building			8	7AM-3PM
Ladle Repair (During Repair and Ingots Staging)	9.1	4,823	43,889	0.000261	0.002066	Building			8	7AM-3PM
Shipping	9.1	5,487	49,932	0.000962	0.007631	Building			8	7AM-3PM
Warehouse	9.1	20,439	185,995	0.000430	0.003411	Building			8	7AM-3PM
Rotary 1 cooler				0.00648	0.05135	Horizontal Stack	14513	0.762	5	8AM-1PM
Rotary 2 cooler				0.00297	0.023579	Horizontal Stack	7993	0.762	5	8AM-1PM

Figures

PLOT DATA
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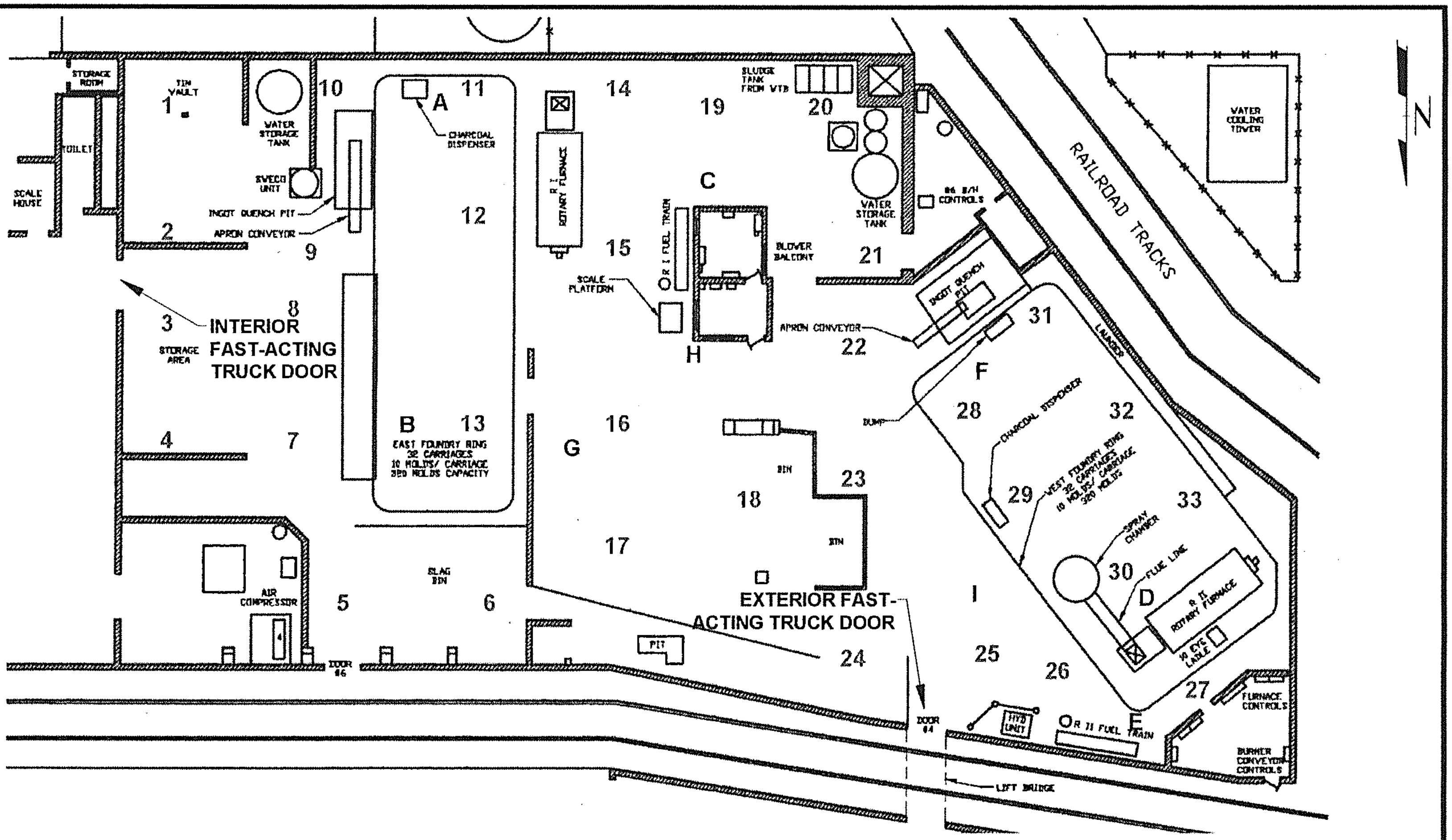
Attached Xref's:
Attached Images:
Layout: FIGURE 1



PARTIAL FLOOR PLAN

0 19 38
SCALE: 1"=19'

LEGEND

1 GRID SAMPLE LOCATION
A AREA SAMPLE LOCATION

PROJECT:
H. KRAMER & CO.
VENTILATION STUDY
CHICAGO, ILLINOIS

SHEET TITLE:
SOUTH FOUNDRY SAMPLING LOCATIONS

DRAWN BY: J KONIAR	SCALE	PROJ NO.	185796.0000.0000
CHECKED BY: B SCHOLZ	AS NOTED	FILE NO.	185796.0000-01a.dwg
APPROVED BY: APPR	DATE PRINTED	**FIGURE 1**	
DATE: MAY 2012			

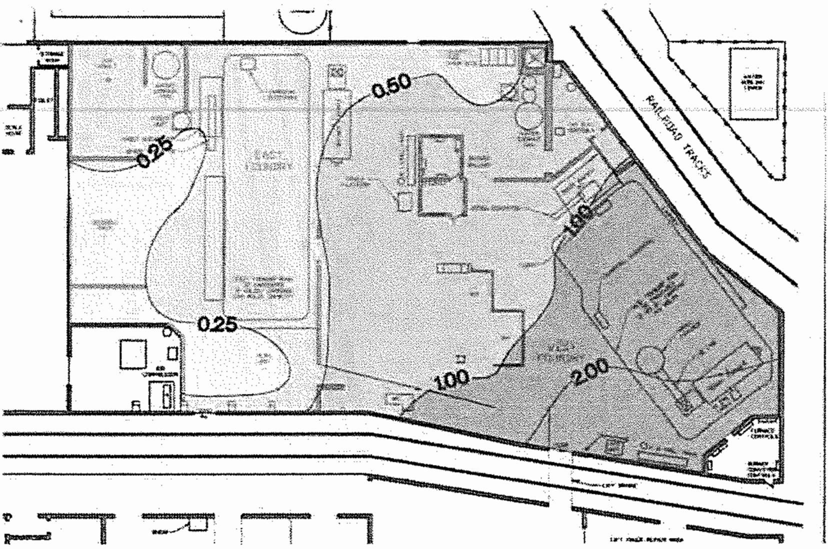
TRC
150 North Patrick Blvd.
Suite 180
Brookfield, WI 53045
Phone: 262.879.1212

LEGEND

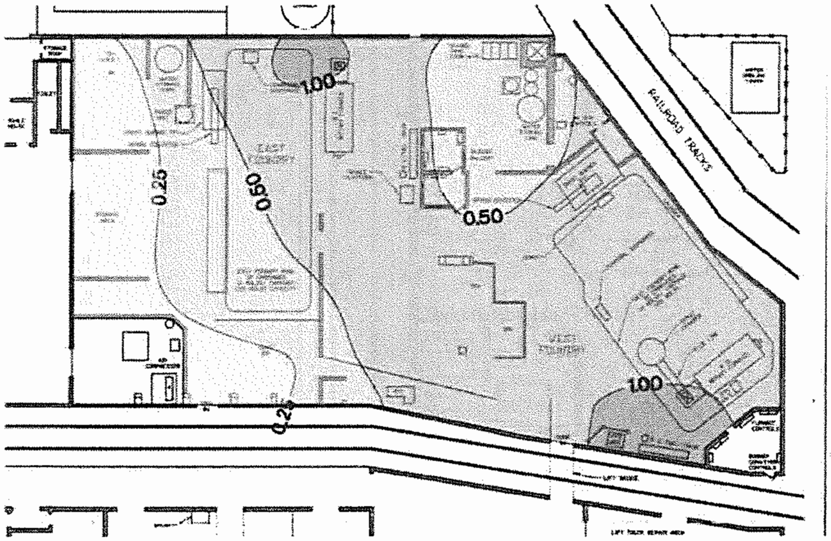
▨	>4.00 mg/m³
▨	2.00–4.00 mg/m³
▨	1.00–2.00 mg/m³
▨	0.50–1.00 mg/m³
▨	0.25–0.50 mg/m³
☐	<0.25 mg/m³

NOTES

1. READINGS COLLECTED FROM 12:46 TO 13:59 ON 4/24/2012 AND 12:08 TO 12:41 ON 4/26/2012 BY TRC ENVIRONMENTAL
2. BASE DRAWING PROVIDED BY H KRAMER



POURING RUN 1 - AVERAGE 0.841 mg/m³



POURING RUN 2 - AVERAGE 0.573 mg/m³

TRC

150 North Patrick Blvd.
Suite 180
Brookfield, WI 53045
Phone: 262.879.1212

PROJECT:
H KRAMER
CHICAGO, ILLINOIS

SHEET TITLE:
INDOOR AIR ASSESSMENT
EAST / WEST FURNACE DURING POURING
TOTAL PARTICULATE READINGS - APRIL 2012

DRAWN BY:	EJP
APPROVED BY:	
PROJ. NO	185796.0000.0000
FILE NO.	185796.0000-08.dwg
DATE:	MAY 2012

FIGURE 2

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Plot Date: May 30, 2012
Plot Time: 3:44 PM
Attached Xrefs:
Attached Images: H Kramer Floor Plan; South Foundry Surfer Base;
Layout: Model

LEGEND

▨	>4.00 mg/m³
▨	2.00–4.00 mg/m³
▨	1.00–2.00 mg/m³
▨	0.50–1.00 mg/m³
▨	0.25–0.50 mg/m³
☐	<0.25 mg/m³

NOTES

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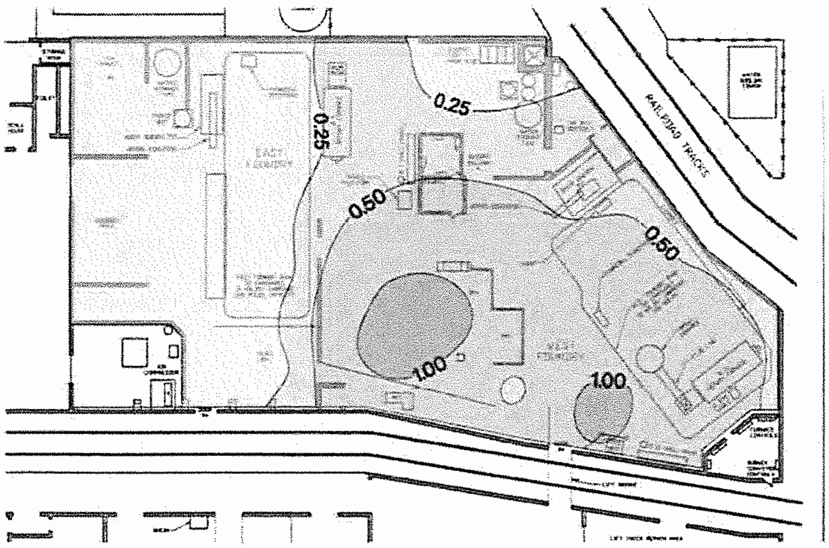
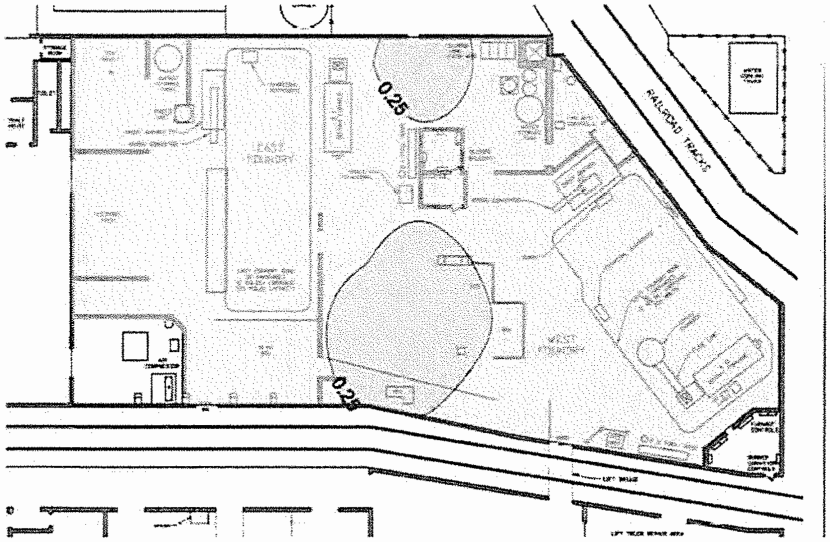
2. BASE DRAWING PROVIDED BY H KRAMER



CHARGING RUN 1 - AVERAGE 0.429 mg/m³



CHARGING RUN 2 - AVERAGE 0.151 mg/m³

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Attached Images: H Kramer Floor Plan; South Foundry Surfer Base;
Layout: Model

TRC
150 North Patrick Blvd.
Suite 180
Brookfield, WI 53045
Phone: 262.879.1212

PROJECT:
H KRAMER
CHICAGO, ILLINOIS

SHEET TITLE:
INDOOR AIR ASSESSMENT
EAST / WEST FURNACE DURING CHARGING
TOTAL PARTICULATE READINGS - APRIL 2012

DRAWN BY:	EJP
APPROVED BY:	
PROJ. NO	185796.0000.0000
FILE NO.	185796.0000-08.dwg
DATE:	MAY 2012

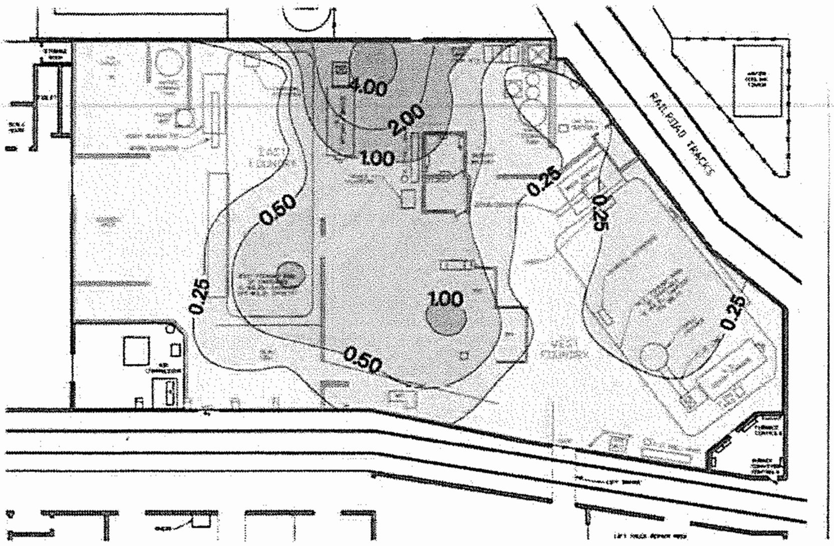
FIGURE 3

LEGEND

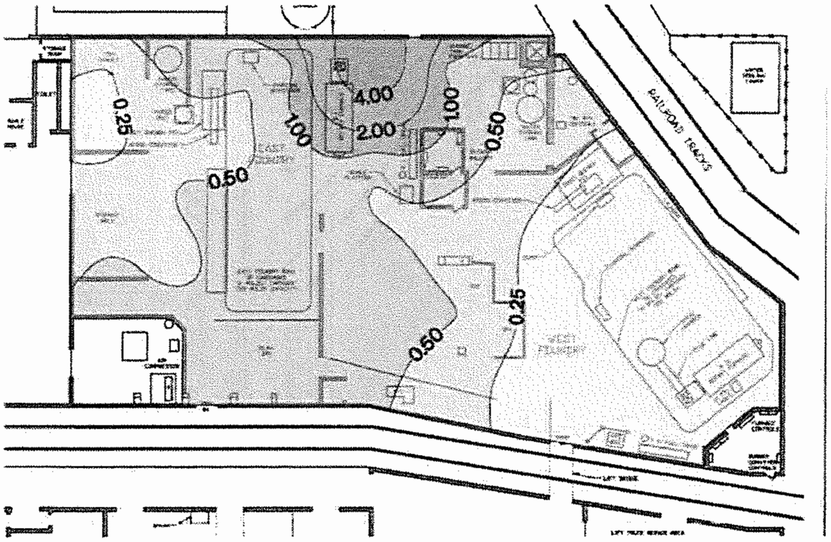
- ▨ >4.00 mg/m³
- ▨ 2.00–4.00 mg/m³
- ▨ 1.00–2.00 mg/m³
- ▨ 0.50–1.00 mg/m³
- ▨ 0.25–0.50 mg/m³
- ☐ <0.25 mg/m³

NOTES

1. READINGS COLLECTED FROM 1:22 TO 1:50 AND 2:15 TO 2:53 ON 4/26/2012 BY TRC ENVIRONMENTAL.
2. BASE DRAWING PROVIDED BY H KRAMER



REFINING RUN 1 - AVERAGE 0.473 mg/m³



REFINING RUN 2 - AVERAGE 0.595 mg/m³

PLOT DATA
Drawing Name: J:\H Kramer\185796\185796.0000-08.dwg
Operator Name: PYLKAS, ERIC
Drawing Plot Scale: 0.386863
Dwg Size: 0.52 Mb
Plot Date: May 30, 2012
Plot Time: 3:44 PM
Attached Xrefs:
Attached Images: H Kramer Floor Plan; South Foundry Surfer Base;
Layout: Model

TRC
150 North Patrick Blvd.
Suite 180
Brookfield, WI 53045
Phone: 262.879.1212

PROJECT:
H KRAMER
CHICAGO, ILLINOIS

SHEET TITLE:
INDOOR AIR ASSESSMENT
EAST / WEST FURNACE DURING REFINING
TOTAL PARTICULATE READINGS - APRIL 2012

DRAWN BY:	EJP
APPROVED BY:	
PROJ. NO	185796.0000.0000
FILE NO.	185796.0000-08.dwg
DATE:	MAY 2012

FIGURE 4

Figure 5

H Kramer - South Foundry

Vertical Profiles of Airborne Particulate Matter and Temperature - Rotary 1

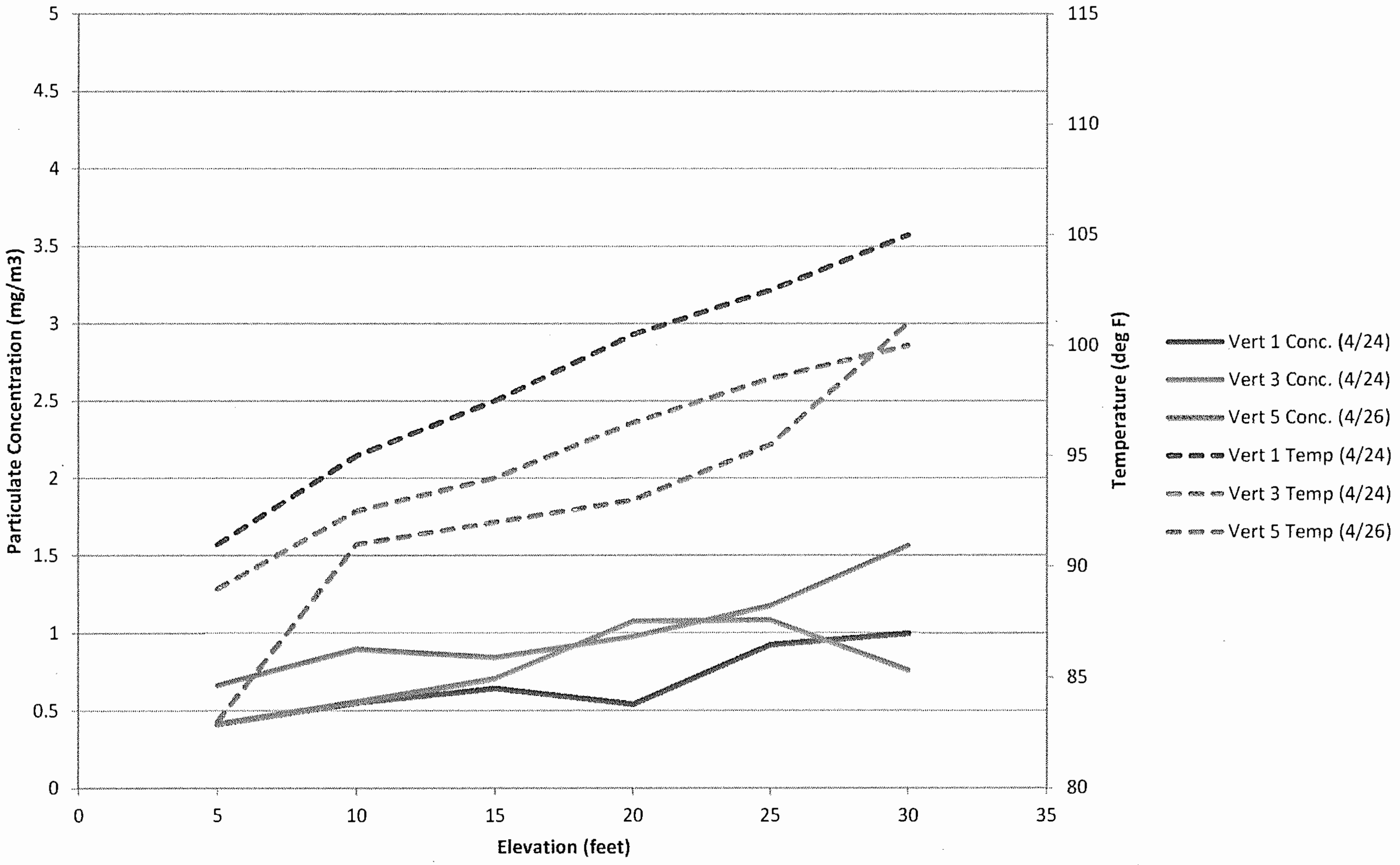
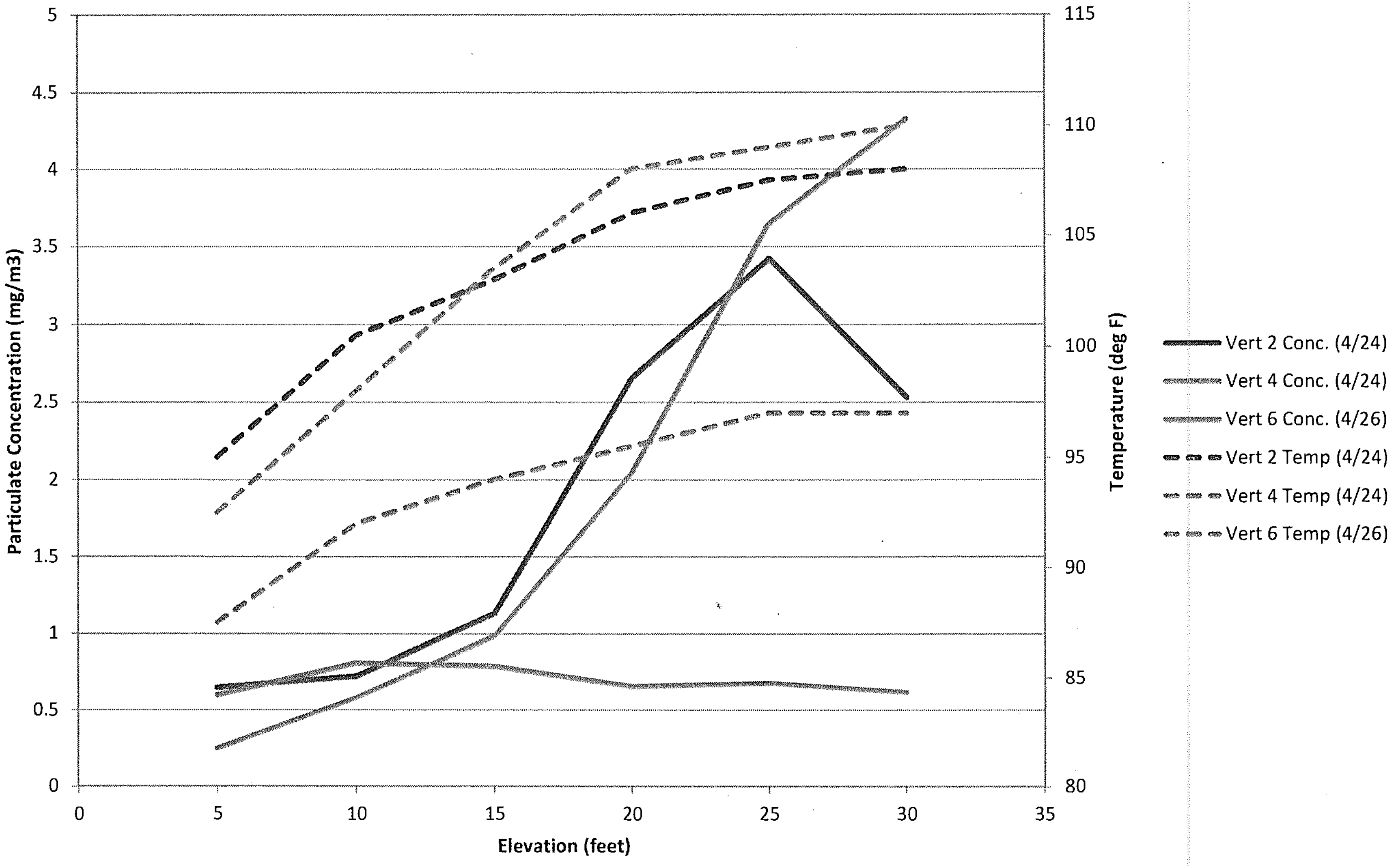


Figure 6

H Kramer - South Foundry

Vertical Profiles of Airborne Particulate Matter and Temperature - Rotary 2

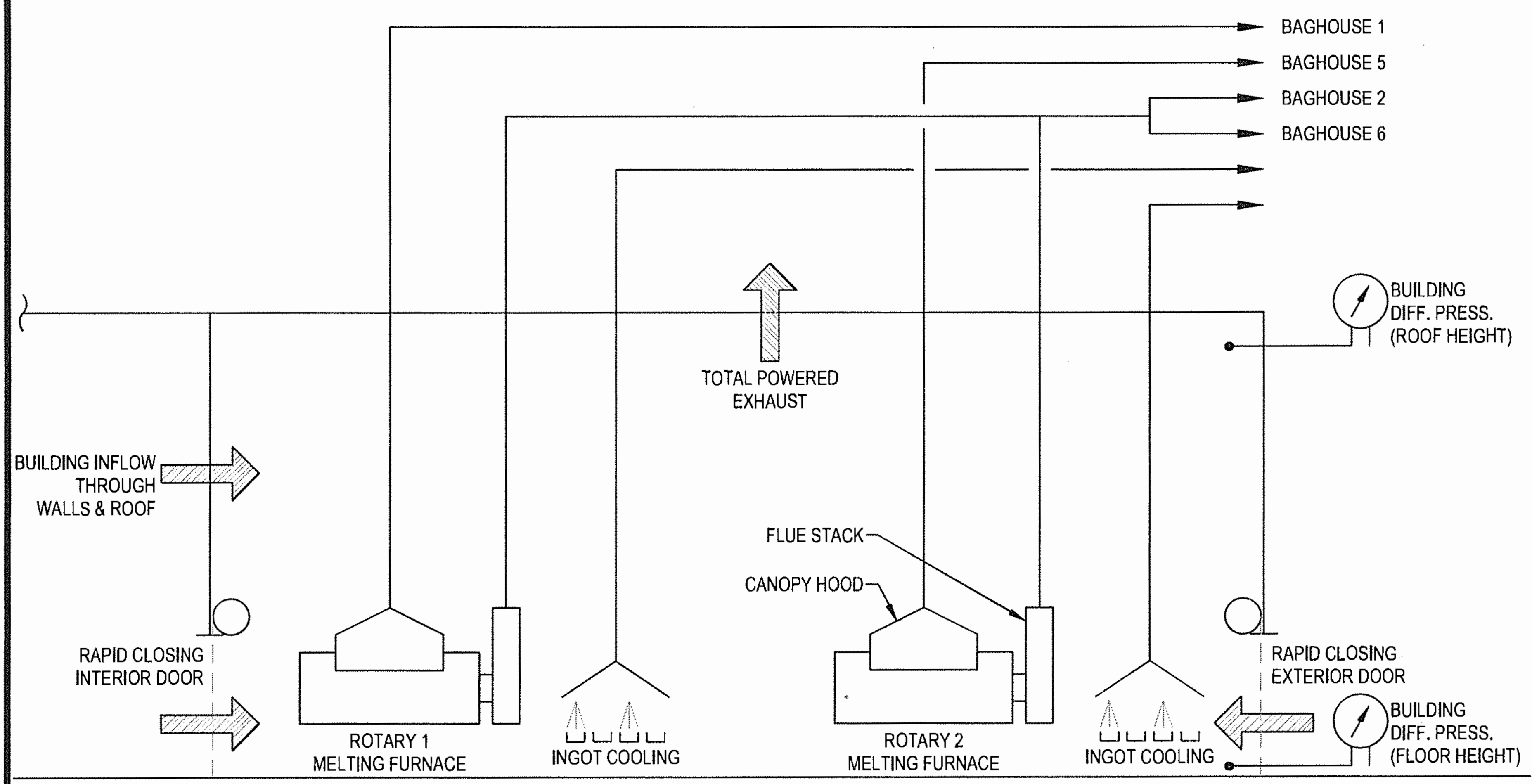


PLOT DATA

Drawing Name: J:\H Kramer\185796\185796.0000-02.dwg
Operator Name: KONIAR, JOHN
Drawing Plot Scale: 0.386863

Dwg Size: 0.44 Mb
Plot Date: June 5, 2012
Plot Time: 9:31 AM

Attached Xref's:
Attached Images:
Layout: FIGURE 7



TRC
150 North Patrick Blvd.
Suite 180
Brookfield, WI 53045
Phone: 262.879.1212

PROJECT:

H. KRAMER & CO. VENTILATION ASSESSMENT
CHICAGO, ILLINOIS

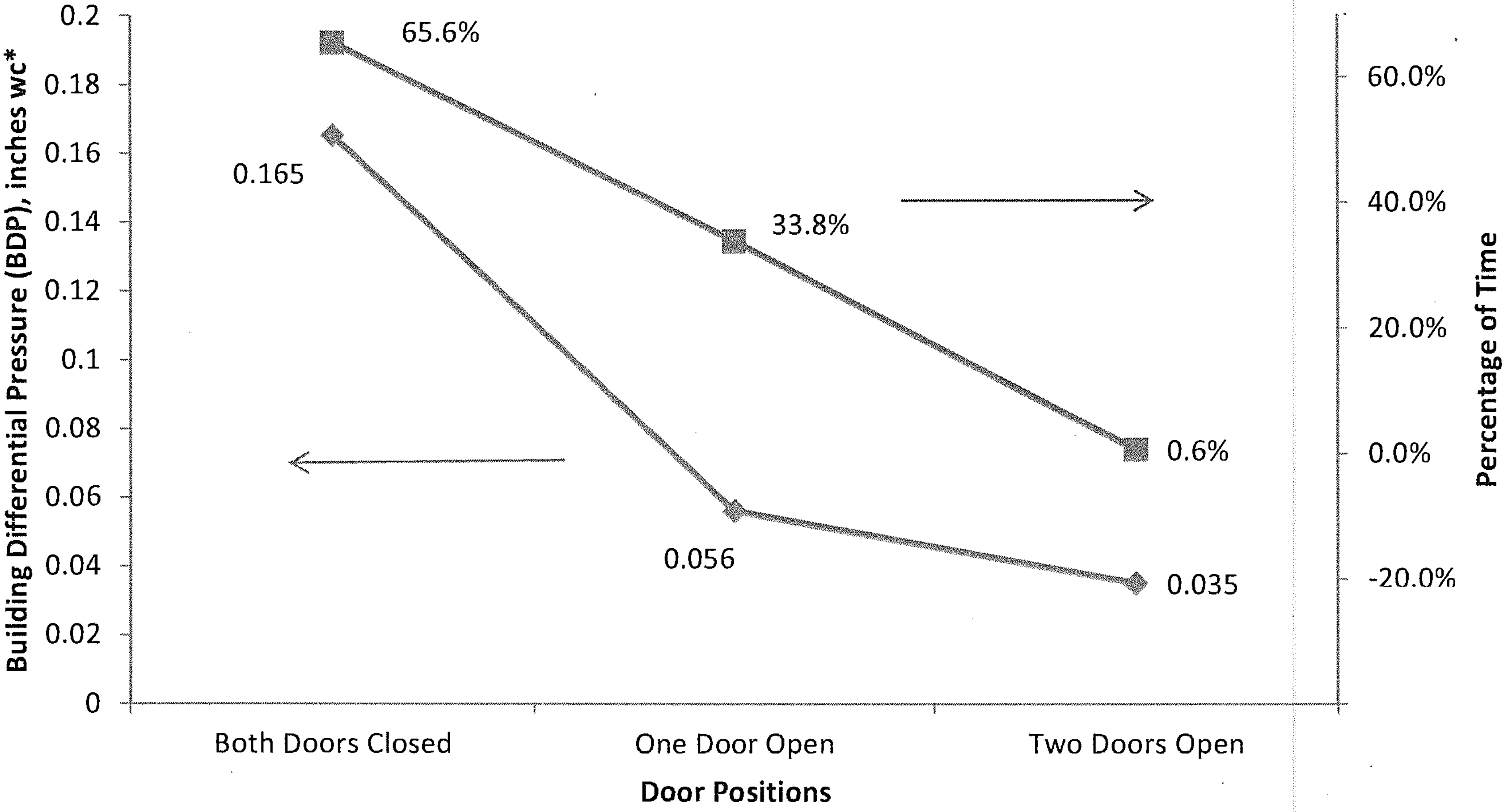
SHEET TITLE:

SOUTH FOUNDRY VENTILATION SCHEME APRIL, 2012

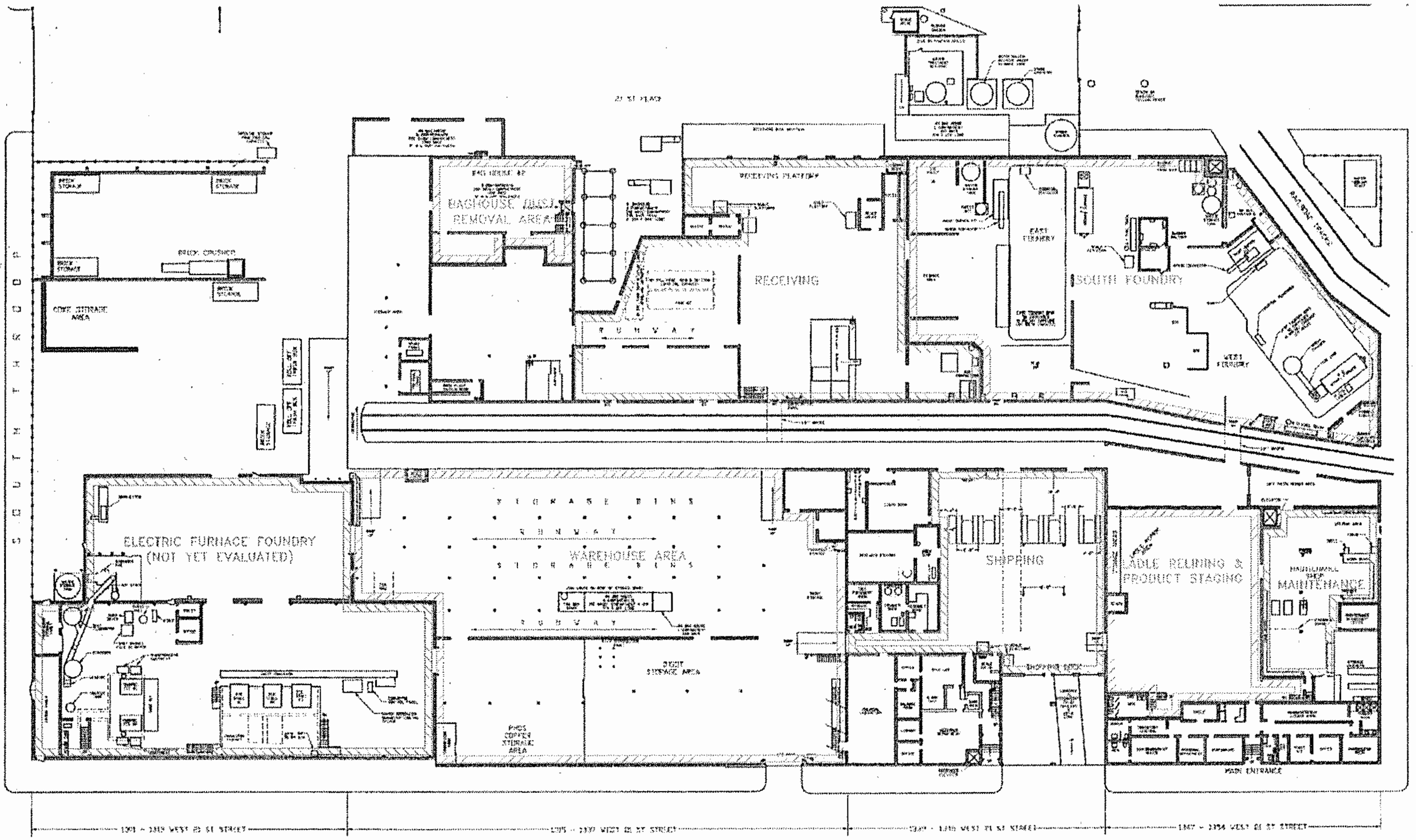
DRAWN BY:	J KONIAR
APPROVED BY:	B SCHOLZ
PROJ. NO.	185796.0000.0000
FILE NO.	185796.0000-02.dwg
DATE:	MAY 2012

FIGURE #7

Figure 8
Relationship Between Building Differential Pressure and Door Openings in South Foundry
May 9, 2012



*wc = water column



OVERALL FLOOR PLAN

0 48 96
SCALE: 1"=48'

PROJECT
H. KRAMER & CO.
VENTILATION STUDY
CHICAGO, ILLINOIS

SHEET TITLE
OVERALL FACILITY PLAN

DRAWN BY:	J KONAR	SCALE	PROJ NO. 185796.0000.0000
CHECKED BY:	B SCHOLZ	AS NOTED	FILE NO. 185796.0000-01.dwg
APPROVED BY:		DATE PRINTED	**OVERALL PLAN**
DATE:	MAY 2012		

TRC
150 North Patrick Blvd,
Suite 180
Brookfield, WI 53045
Phone: 262.879.1212

PLOT DATA
Drawing Name: J:\H Kramer\185796\185796.0000-01.dwg
Operator Name: KONAR, JOHN
Drawing Plot Scale: 0.386863
Dwg Size: 0.54 Mb
Plot Date: May 15, 2012
Plot Time: 11:02 AM
Attached Xrefs:
Attached Images:
Layout: OVERALL PLAN

FIGURE 10

Modeled Fugitive Emissions Compared to Measured Concentrations at the Perez Monitor for 15 days above 0.15 µg/m³

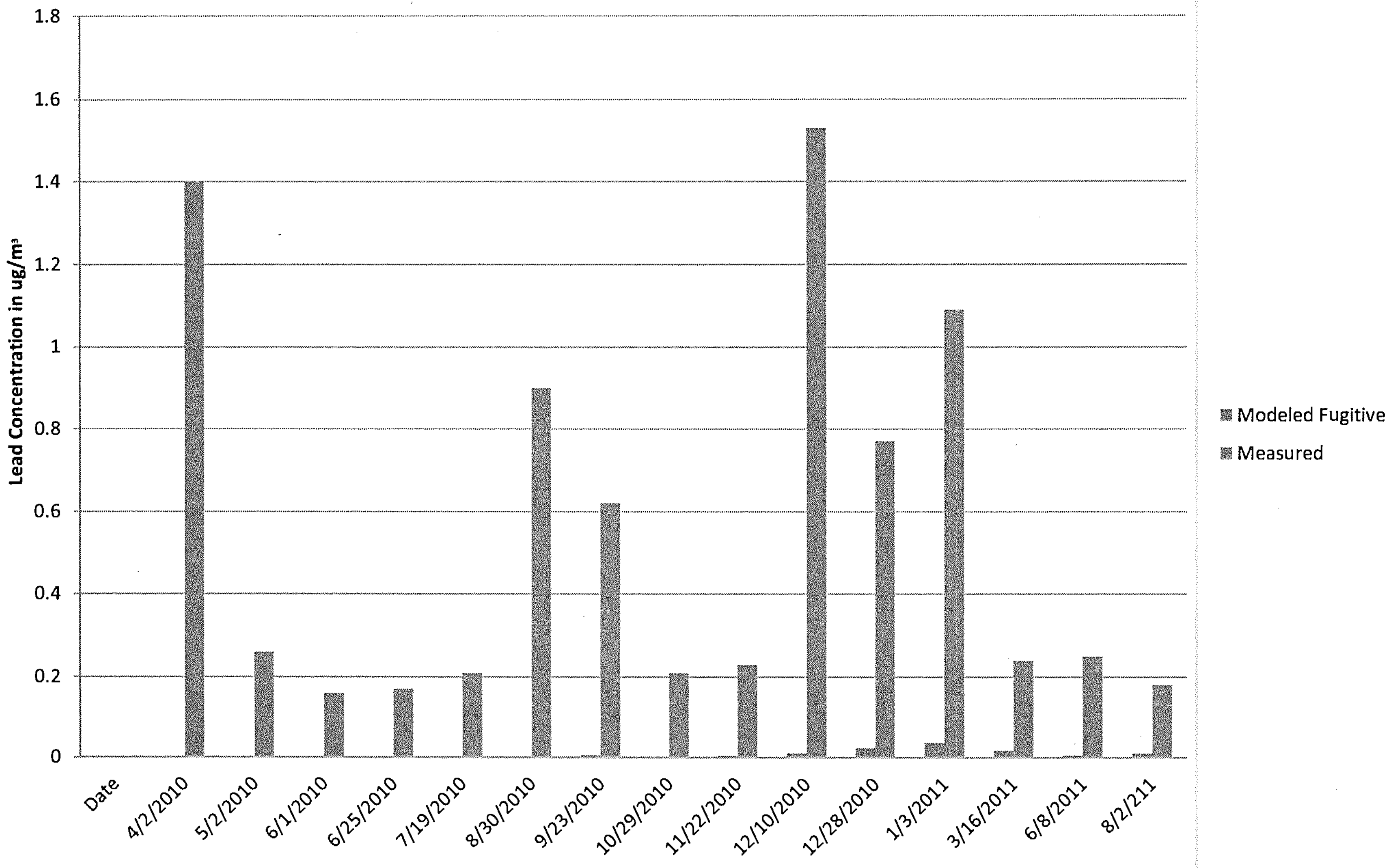
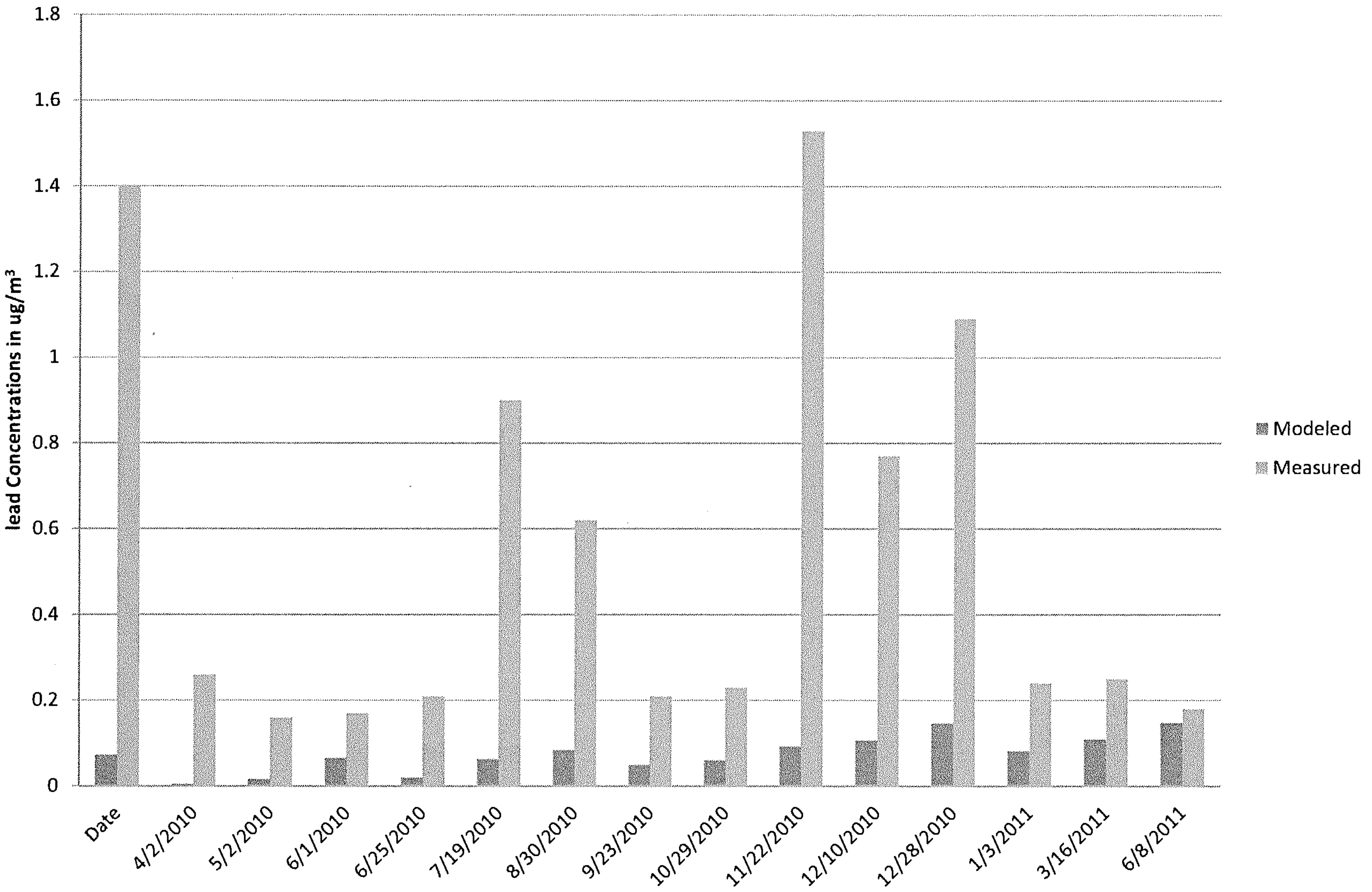


FIGURE 11

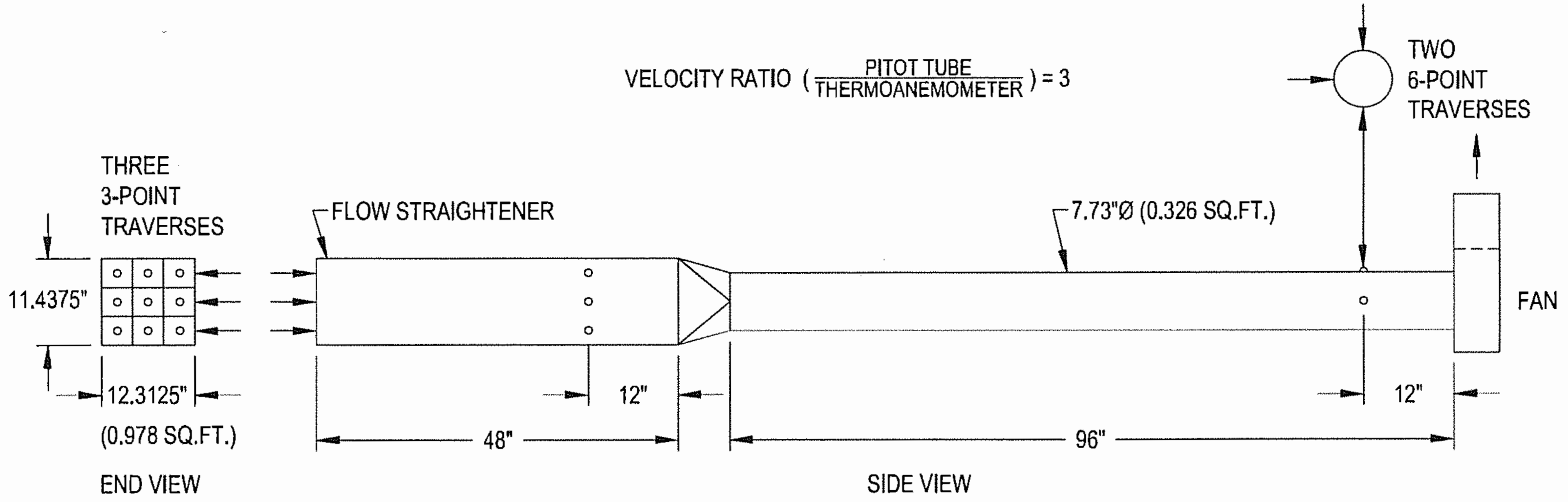
Modeling of Stacks and Fugitives for 15 Days with Measured Concentrations at Perez above 0.15 ug/m^3



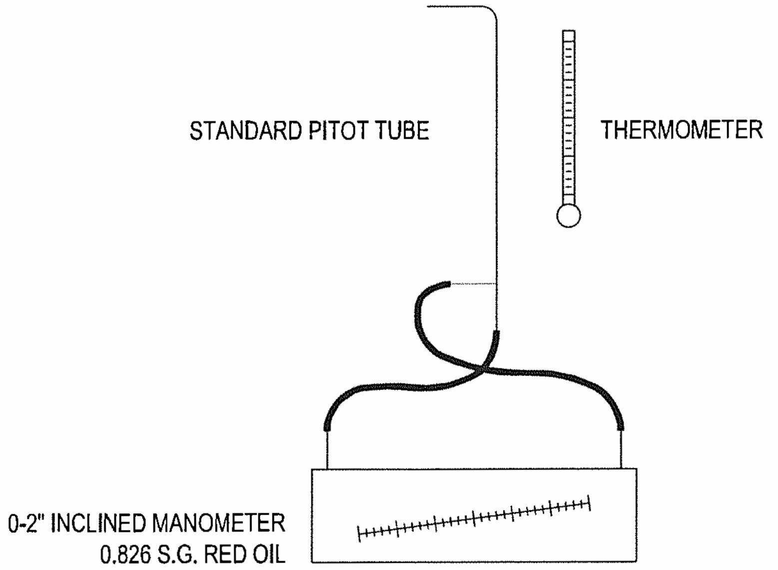
Appendix A

PLOT DATA

Drawing Name: J:\H Kramer\185796\185796.0000-00.dwg
Operator Name: KONIAR, JOHN
Drawing Plot Scale: 0.386863
Dwg Size: 0.49 Mb
Plot Date: June 1, 2012
Plot Time: 9:58 AM
Attached Xref's:
Attached Images:
Layout: FIGURE A-1



NOTE:
ALL TRAVERSE POINTS AT
CENTROIDS OF EQUAL AREAS.



FAN SPECIFICATION:
NEW YORK BLOWER JUNIOR
FAN- 411 CFM@0.5 SP AND 70°F.
SHOP No. B12087-100.

TRC

150 North Patrick Blvd.
Suite 180
Brookfield, WI 53045
Phone: 262.879.1212

PROJECT:

THERMOANEMOMETER CALIBRATION CHECKING METHOD

SHEET TITLE:

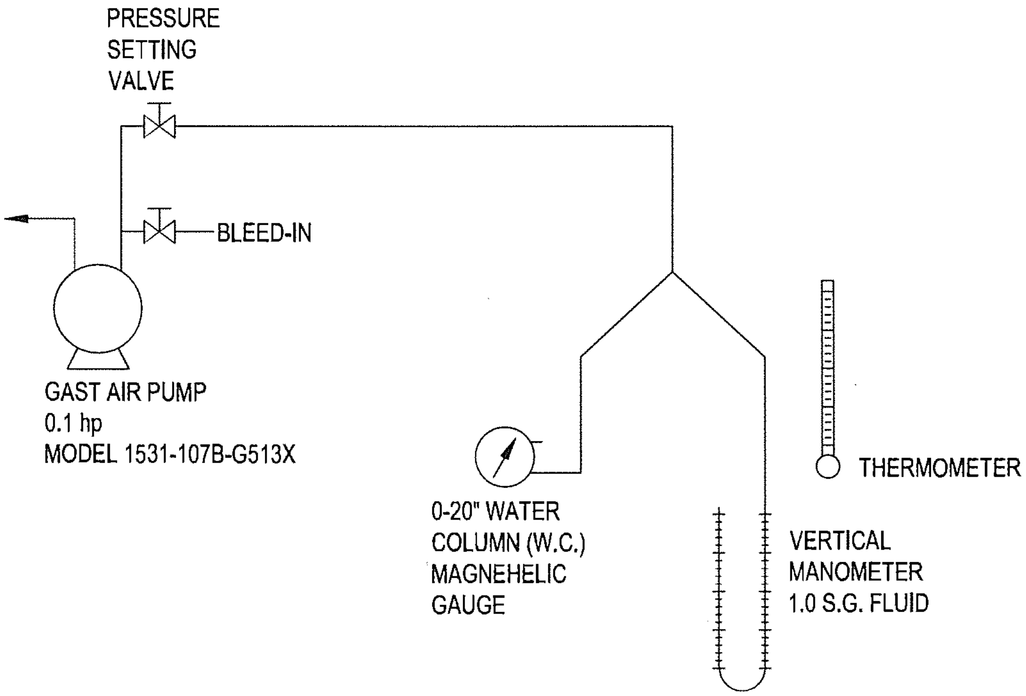
WIND TUNNEL CALIBRATION SETUP A

DRAWN BY:	J KONIAR
APPROVED BY:	B SCHOLZ
PROJ. NO.	185796.0000.0000
FILE NO.	185796.0000-00.dwg
DATE:	MAY 2012

FIGURE #A-1

PLOT DATA

Drawing Name:	J:\H Kramer\185796\185796.0000-00.dwg	Dwg Size:	0.49 Mb	Attached Xref's:	
Operator Name:	KONIAR, JOHN	Plot Date:	June 1, 2012	Attached Images:	
Drawing Plot Scale:	0.386863	Plot Time:	9:57 AM	Layout:	FIGURE A-2



TRC
150 North Patrick Blvd.
Suite 180
Brookfield, WI 53045
Phone: 262.879.1212

PROJECT:

DIFFERENTIAL PRESSURE GAUGE CALIBRATION CHECKING METHOD

SHEET TITLE:

PRESSURE PUMP CALIBRATION SETUP B

DRAWN BY:	J KONIAR
APPROVED BY:	B SCHOLZ
PROJ. NO.	185796.0000.0000
FILE NO.	185796.0000-00.dwg
DATE:	MAY 2012

FIGURE #A-2

Figure A - 3
Thermoanemometer Calibration Check by TRC
TSI Model 8360 VelociCalc
H. Kramer Project
April, 2012

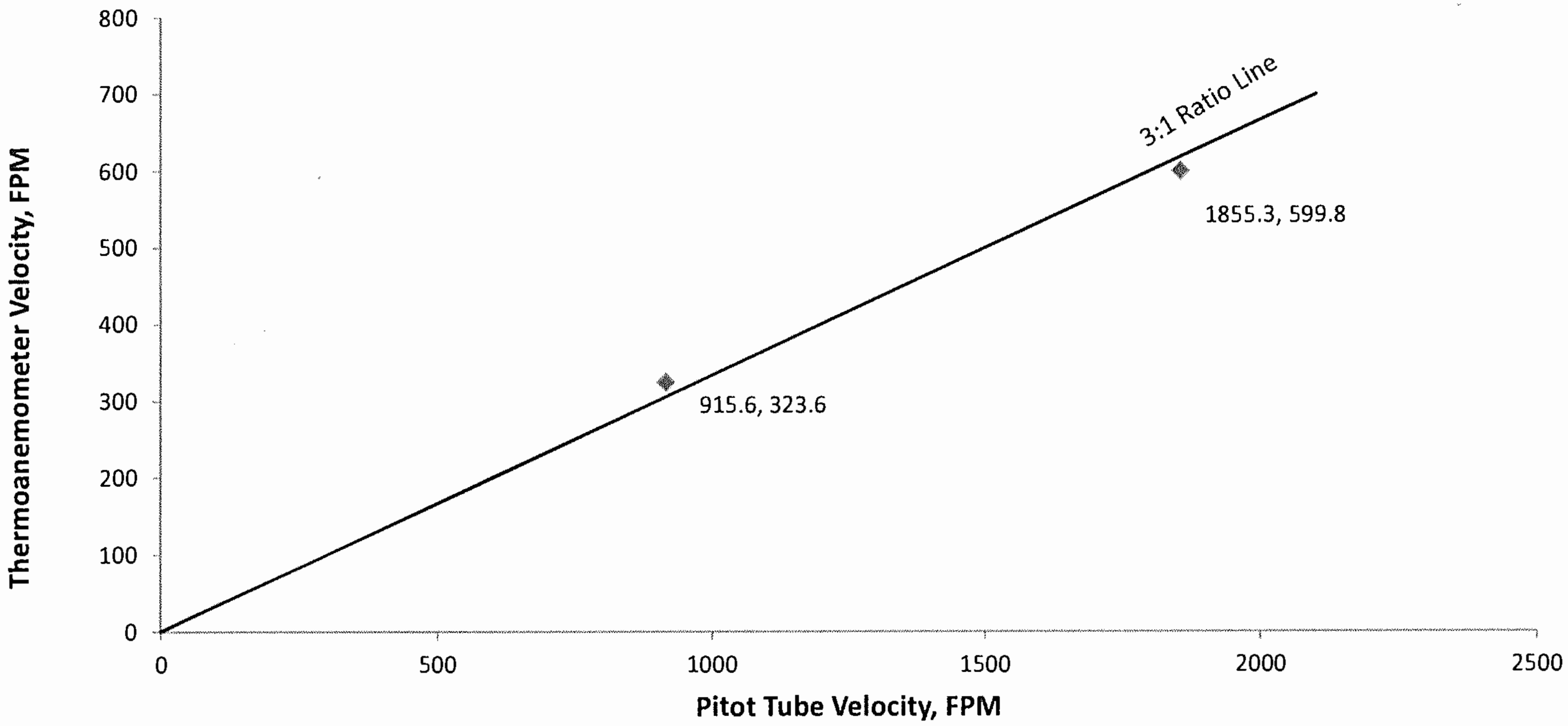
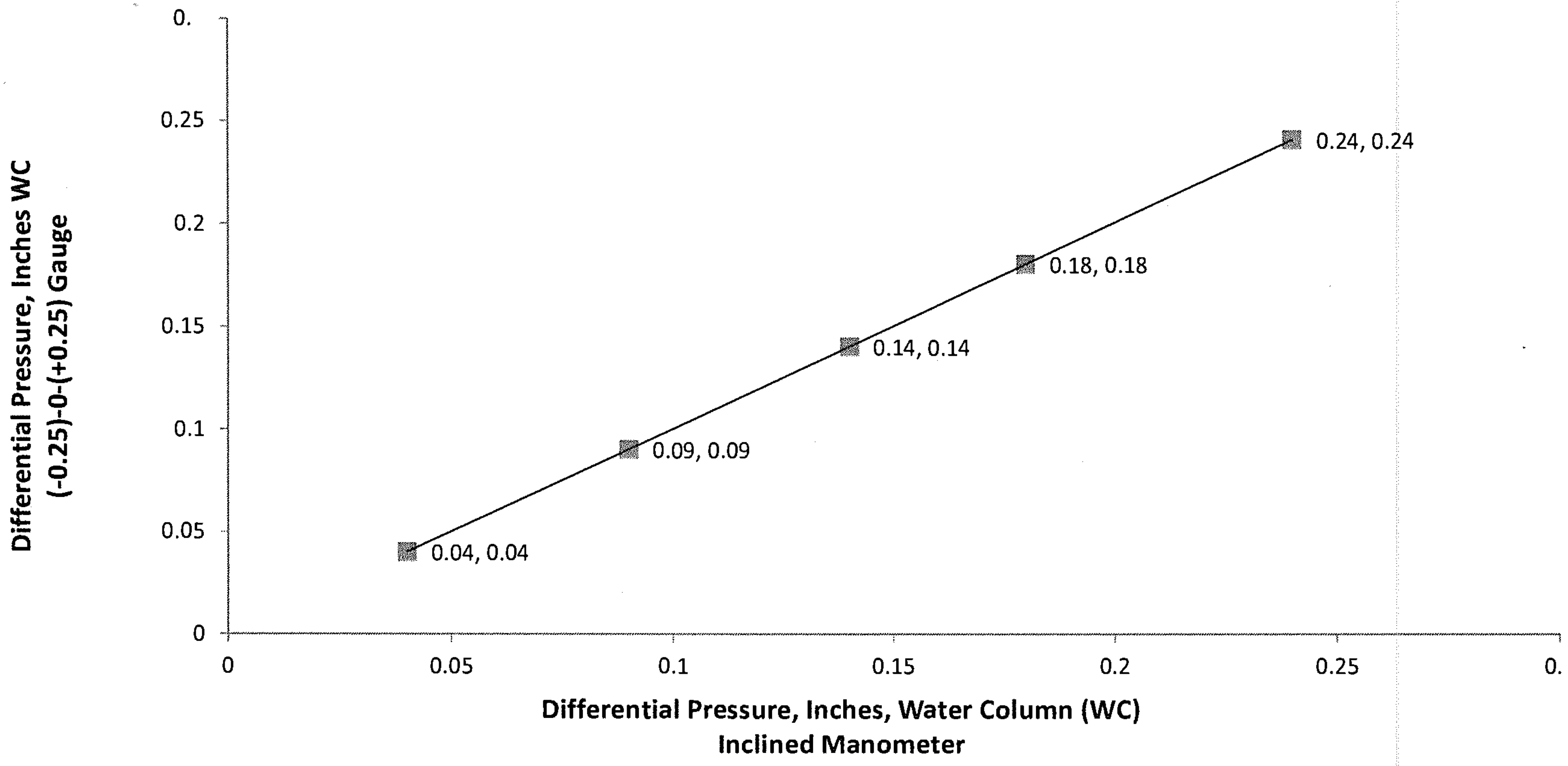
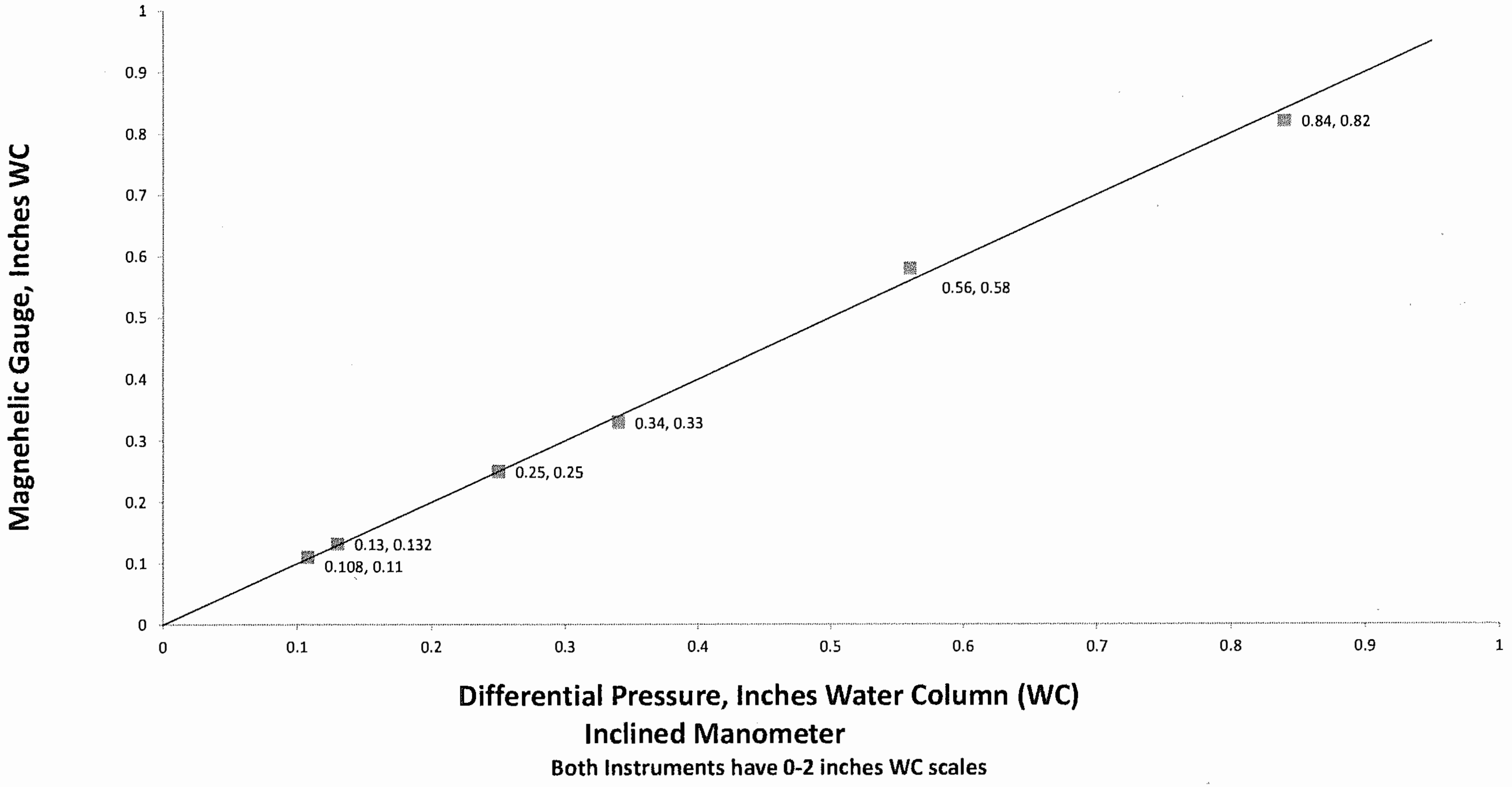


Figure A - 4
Building Differential Pressure Gauge Calibration Check by TRC for H. Kramer Project
April, 2012



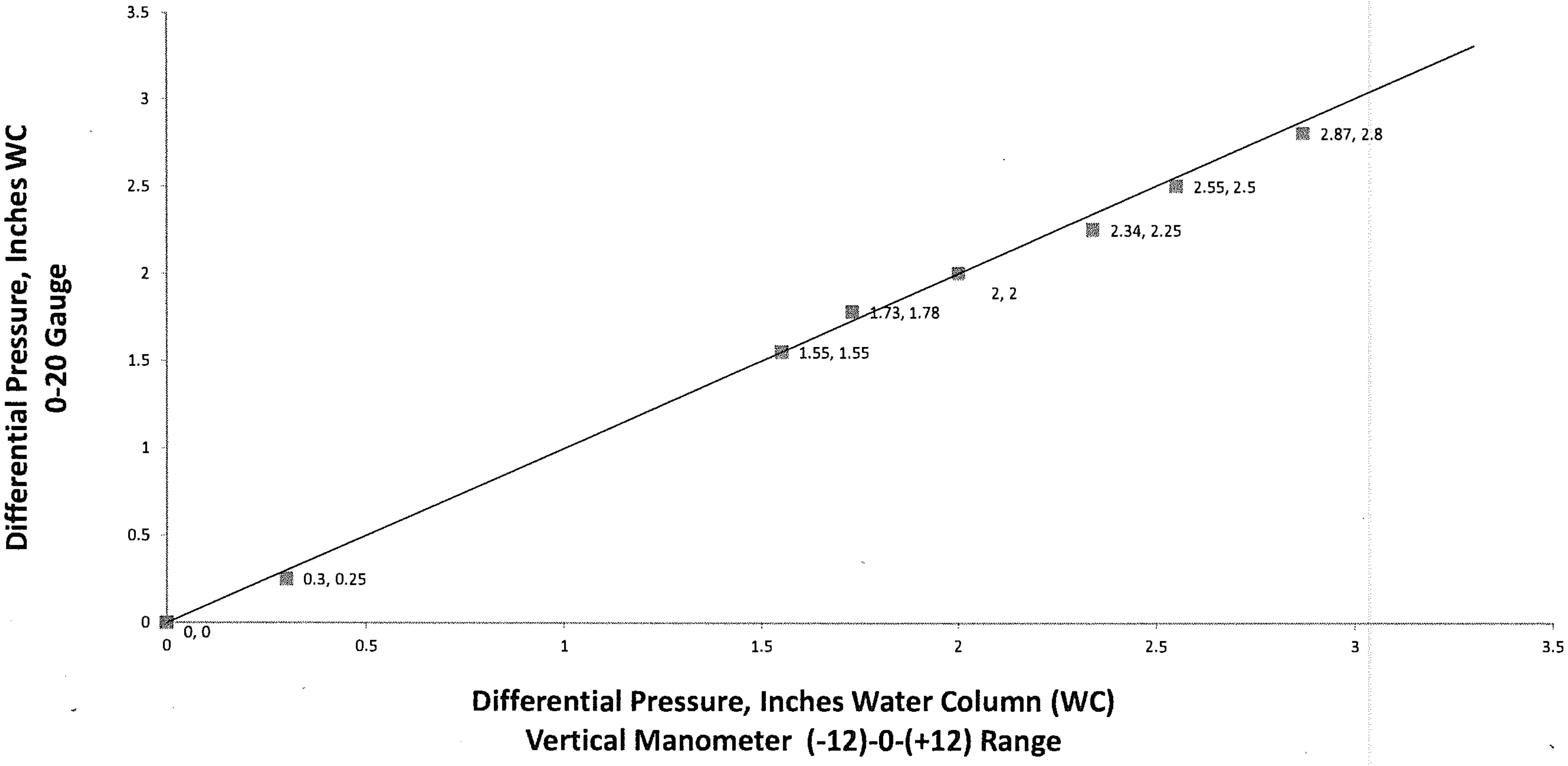
\\ntapabrookfield\MLW-VOL1\-\WPMLW\PJT2\185796\0000\Figure A-4

Figure A - 5
Pitot Tube Differential Pressure Gauge Calibration Check by TRC
for H. Kramer Project
April, 2012



\\ntapabrookfield\MLW-VOL1\-\WPMLW\PJT2\185796\0000\Figure A-5

Figure A - 6
Differential Pressure Gauge Calibration Check by TRC
for H. Kramer Project
April, 2012



Certificate of Calibration

A.P. BUCK, INC. mini-BUCK CALIBRATOR™

Serial No: 030356 **Date Calibrated :** 7-13-11 **Next Calibration due date :** 7-13-12

Model No : ☐ M-1 ☐ M-5 ☑ M-30 ☐ M-30B

Applicable Measurement Standards

Description	MFR.	Model	Serial #	N. I. S. T.
☐ 100ml Burette	Kimble	17027F-100	1220	SPECIAL17027F
☐ 1000ml Burette	Kimble	17081	0002	ASTM E542
☐ 1000ml Burette	Kimble	17081	0003	ASTM E542
☑ 1000ml Burette	Kimble	17081	1003	ASTM E542
☐ 1000ml Burette	Kimble	17081	1004	ASTM E542
☐ 1000ml Burette	Kimble	17081	2087	ASTM E542
☐ Stopwatch	Fisher	14-649-5	72495994	EL015
☑ Stopwatch	Fisher	14-649-5	230268455	EL015

AMBIENT CONDITIONS: Temperature 74±3° F Relative Humidity 50±10%

This instrument as received on 7-11-11 at A.P. Buck Inc.'s facility was found to be:

☑ Unable to calibrate as received due to condition of unit .
☐ Within specification of ± 0.5% of the display reading .
☐ Not in specification by ____ . _____ % High.____ . _____ % Low of the display

The instrument listed above has been adjusted to nominal, utilizing a 1,000ml burette, and an electronic digital stop watch, which are traceable to the National Institute of Standards & Technology (NIST). The accuracy of the instruments used to perform calibration is greater than 4 to 1. The A.P. Buck, Inc. Calibration system is in compliance with ANSI Z540-1 and IEC guide 25.

☑ Unit within specifications after calibration.

Calibration was conducted with A.P. Buck, Inc. Calibration Procedure APB-1 Rev. 6.2 with a constant flow pump using the Bubble-meter method. A.P. Buck, Inc. guarantees the accuracy and repeatability of ± 0.5% for any display reading as described under the instruction manual "Principles of Operation". Responsibilities shall in no event, nor for any cause whatsoever, exceed the price charged for the calibration represented by this certification.

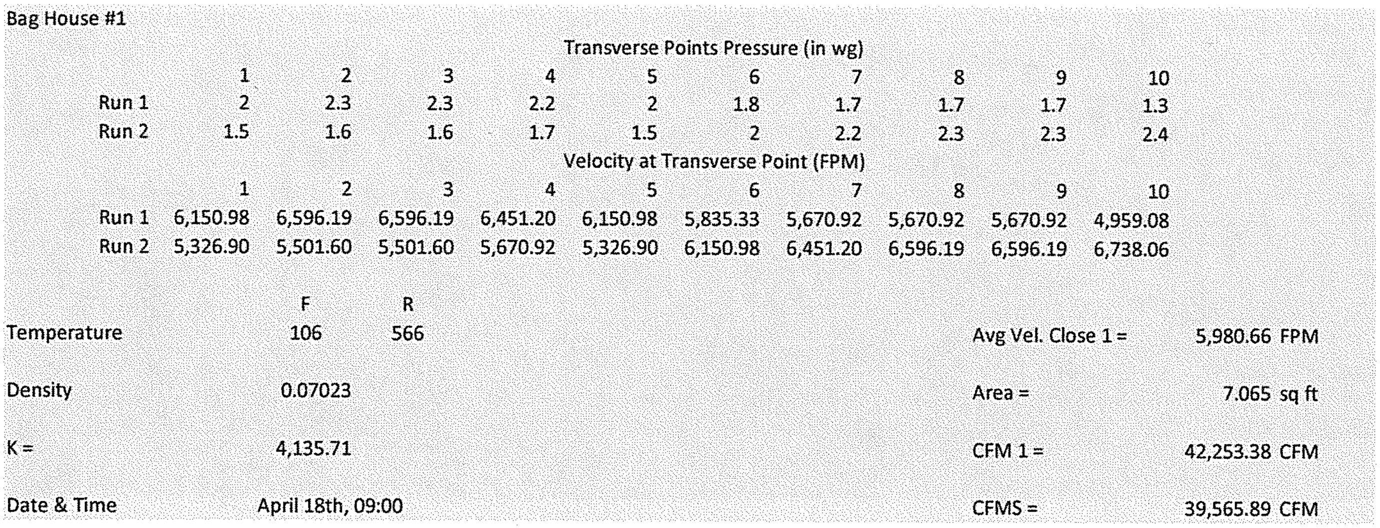
QA APPROVAL BY: Pedro A Vargas

Information contained in this document should not be reproduced in any form without the written consent of A.P. Buck Inc. It is for reference only and cannot be used as a form of endorsement by any private or governmental regulatory body.

A.P. BUCK, INC.
7101 Presidents Drive, Suite 110
Orlando, FL 32809
Phone: 407-851-8602 · Fax: 407-851-8910

BUCK
A P BUCK INC

Appendix B



Bag House #1

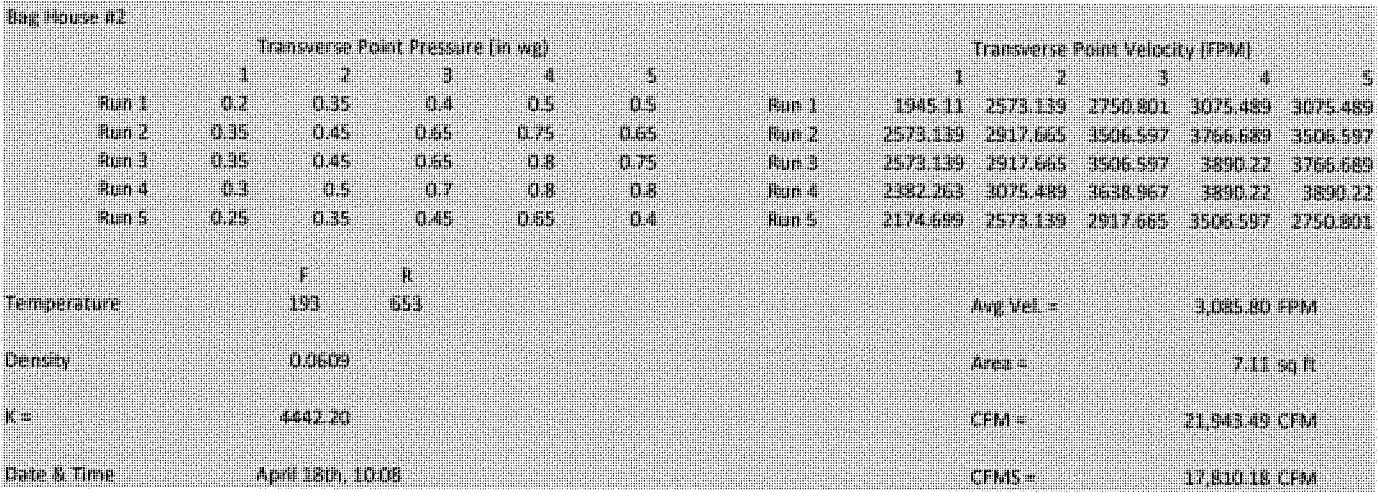
Transverse Points Pressure (in wg)

	1	2	3	4	5	6	7	8	9	10
Run 1	2	2.3	2.3	2.2	2	1.8	1.7	1.7	1.7	1.3
Run 2	1.5	1.6	1.6	1.7	1.5	2	2.2	2.3	2.3	2.4

Velocity at Transverse Point (FPM)

	1	2	3	4	5	6	7	8	9	10
Run 1	6,150.98	6,596.19	6,596.19	6,451.20	6,150.98	5,835.33	5,670.92	5,670.92	5,670.92	4,959.08
Run 2	5,326.90	5,501.60	5,501.60	5,670.92	5,326.90	6,150.98	6,451.20	6,596.19	6,596.19	6,738.06

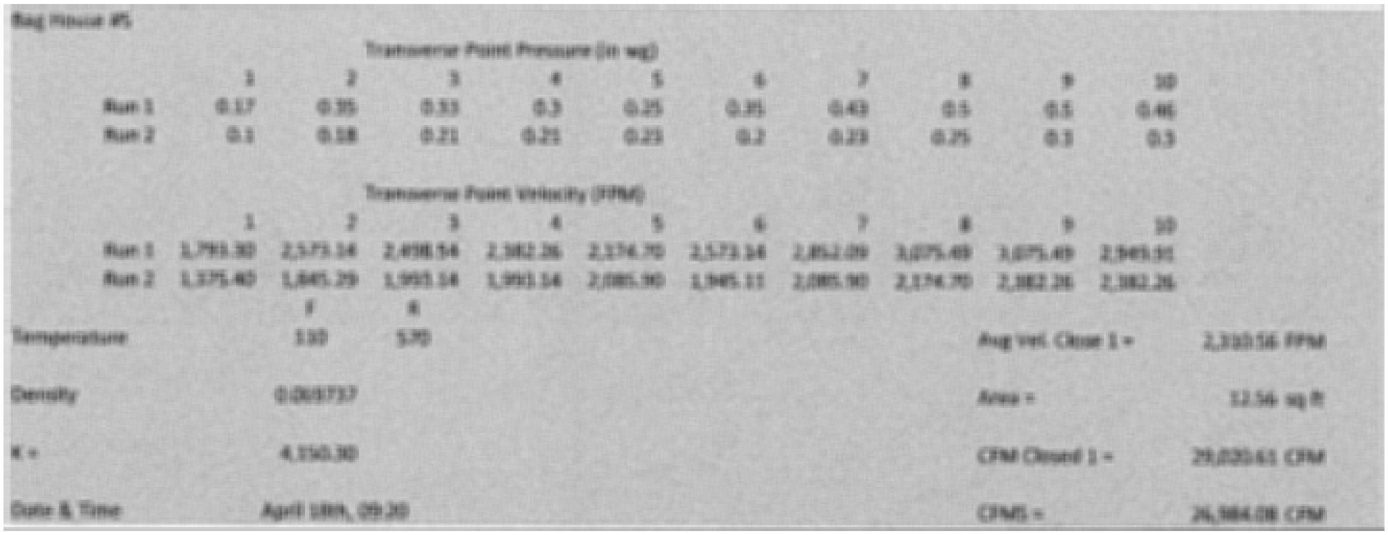
	F	R			
Temperature	106	566	Avg Vel. Close 1 =	5,980.66	FPM
Density	0.07023		Area =	7.065	sq ft
K =	4,135.71		CFM 1 =	42,253.38	CFM
Date & Time	April 18th, 09:00		CFMS =	39,565.89	CFM



Bag House #2

	Transverse Point Pressure (in wg)						Transverse Point Velocity (FPM)				
	1	2	3	4	5		1	2	3	4	5
Run 1	0.2	0.35	0.4	0.5	0.5	Run 1	1945.11	2573.139	2750.801	3075.489	3075.489
Run 2	0.35	0.45	0.65	0.75	0.65	Run 2	2573.139	2917.665	3506.597	3766.689	3506.597
Run 3	0.35	0.45	0.65	0.8	0.75	Run 3	2573.139	2917.665	3506.597	3890.22	3766.689
Run 4	0.3	0.5	0.7	0.8	0.8	Run 4	2382.263	3075.489	3638.967	3890.22	3890.22
Run 5	0.25	0.35	0.45	0.65	0.4	Run 5	2174.699	2573.139	2917.665	3506.597	2750.801

	F	R			
Temperature	193	653	Avg Vel. =	3,085.80	FPM
Density	0.0609		Area =	7.11	sq ft
K =	4442.20		CFM =	21,943.49	CFM
Date & Time	April 18th, 10:08		CFMS =	17,810.18	CFM



Bag House #5

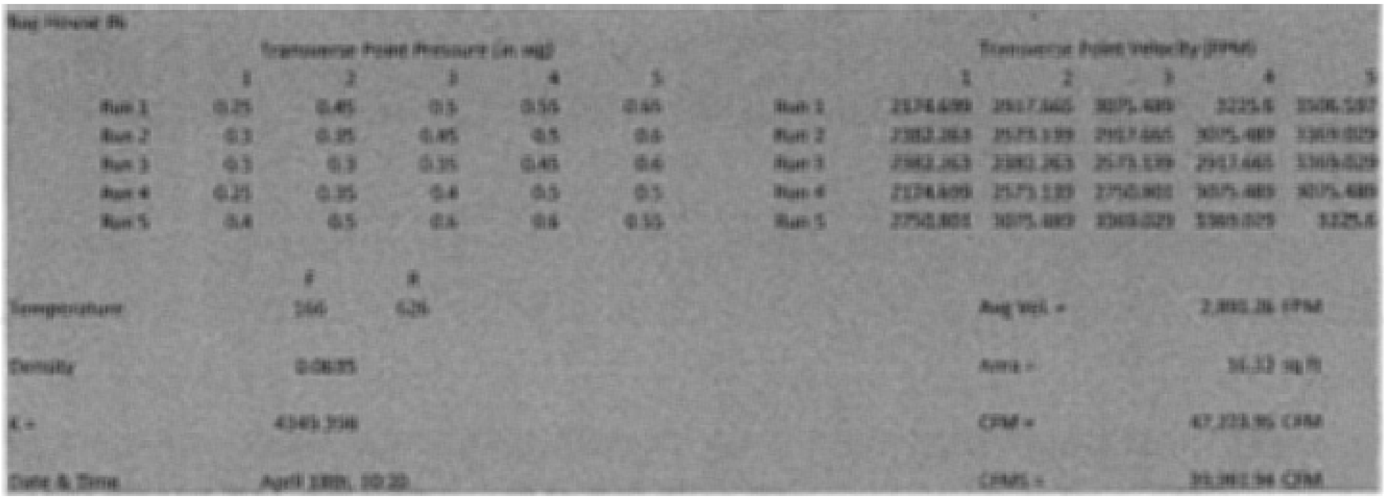
Transverse Point Pressure (in wg)

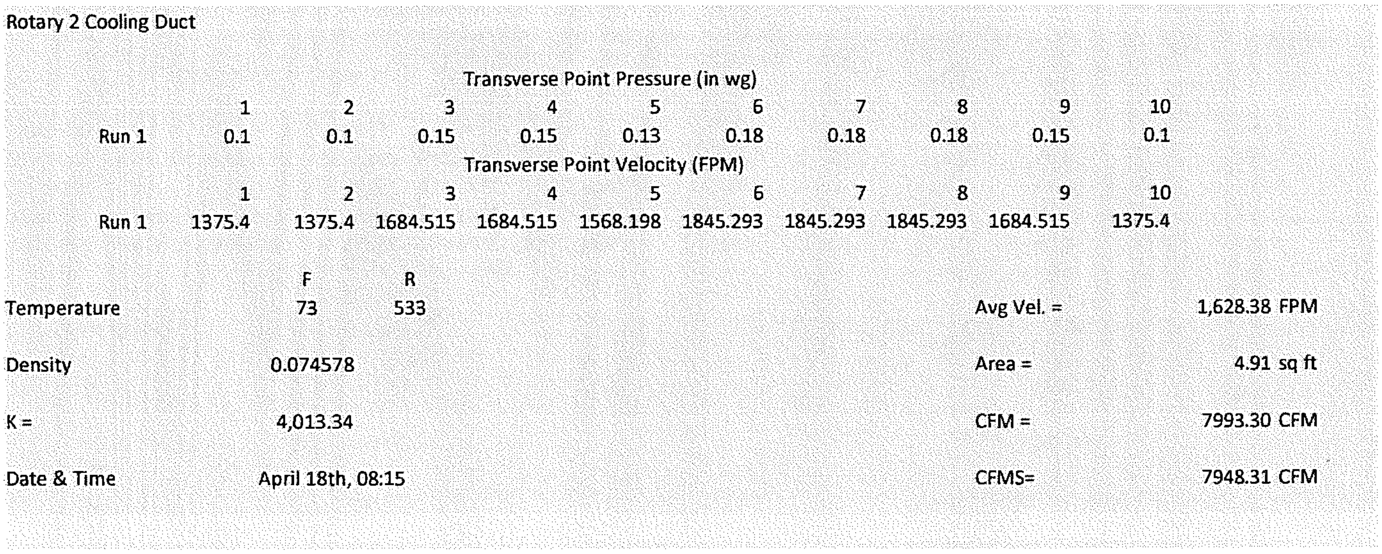
	1	2	3	4	5	6	7	8	9	10
Run 1	0.17	0.35	0.33	0.3	0.25	0.35	0.43	0.5	0.5	0.46
Run 2	0.1	0.18	0.21	0.21	0.23	0.2	0.23	0.25	0.3	0.3

Transverse Point Velocity (FPM)

	1	2	3	4	5	6	7	8	9	10
Run 1	1,793.30	2,573.14	2,498.54	2,382.26	2,174.70	2,573.14	2,852.09	3,075.49	3,075.49	2,949.91
Run 2	1,375.40	1,845.29	1,993.14	1,993.14	2,085.90	1,945.11	2,085.90	2,174.70	2,382.26	2,382.26

	F	R			
Temperature	110	570	Avg Vel. Close 1 =	2,310.56	FPM
Density	0.069737		Area =	12.56	sq ft
K =	4,150.30		CFM Closed 1 =	29,020.61	CFM
Date & Time	April 18th, 09:20		CFMS =	26,984.08	CFM





Rotary 2 Cooling Duct

Transverse Point Pressure (in wg)

	1	2	3	4	5	6	7	8	9	10
Run 1	0.1	0.1	0.15	0.15	0.13	0.18	0.18	0.18	0.15	0.1

Transverse Point Velocity (FPM)

	1	2	3	4	5	6	7	8	9	10
Run 1	1375.4	1375.4	1684.515	1684.515	1568.198	1845.293	1845.293	1845.293	1684.515	1375.4

	F	R		
Temperature	73	533	Avg Vel. =	1,628.38 FPM
Density	0.074578		Area =	4.91 sq ft
K =	4,013.34		CFM =	7993.30 CFM
Date & Time	April 18th, 08:15		CFMS=	7948.31 CFM

Rotary 1 Cooling Duct

Transverse Point Pressure (in wg)

	1	2	3	4	5	6	7	8	9	10
Door Closed 1	0.55	0.55	0.55	0.55	0.55	0.47	0.45	0.45	0.47	0.42
Door Open	0.48	0.48	0.5	0.5	0.46	0.45	0.41	0.4	0.4	0.35
Door Closed 2	0.43	0.45	0.5	0.5	0.47	0.45	0.45	0.5	0.5	0.42

Transverse Point Velocity (FPM)

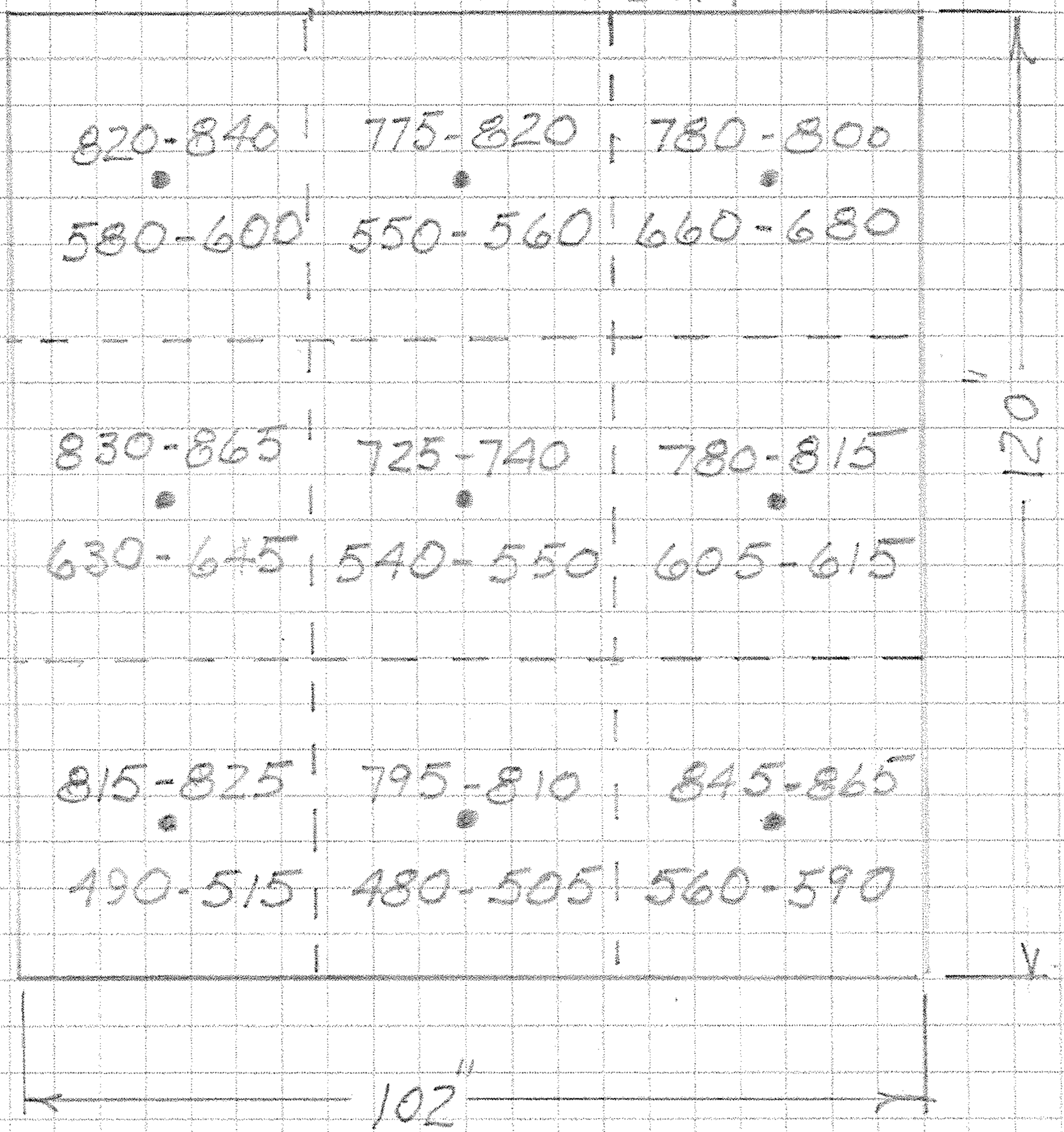
	1	2	3	4	5	6	7	8	9	10
Door Closed	3225.6	3225.6	3225.6	3225.6	3225.6	2981.797	2917.665	2917.665	2981.797	2818.732
Door Open	3013.35	3013.35	3075.49	3075.49	2949.91	2917.66	2784.97	2750.80	2750.80	2573.14
Door Closed	2852.09	2917.66	3075.49	3075.49	2981.80	2917.66	2917.66	3075.49	3075.49	2818.73

	F	R			
Temperature	77	537	Avg Vel. Close 1 =	3,074.57	FPM
Density	0.074022		Area =	4.91	sq ft
K =	4,028.37		CFM Closed 1 =	15,092.24	CFM
Date & Time	April 18th, 09:40		CFMS Closed 1 =	14,895.51	CFM
			Avg Vel. Open =	2,890.50	FPM
			Area =	4.91	sq ft
			CFM Open =	14,188.69	CFM
			CFMS Open =	14,003.74	CFM
			Avg Vel. Close 2 =	2,970.76	FPM
			Area =	4.91	sq ft
			CFM Closed 2 =	14582.67	CFM
			CFMS Closed 2 =	14,392.58	CFM

Appendix C

SHEET NO. 1 OF 2
PROJECT NO. H. KRAMER
DATE APRIL 18, 2012
BY R. SCHOLZ
SUBJECT DOOR INFILTRATION
CHK'D

VELOCITIES,
INTERIOR DOOR,
SOUTH FOUNDRY



TOP LINE: THIS DOOR OPEN ONLY	820-840	775-820	780-800
	580-600	550-560	660-680
SECOND LINE: BOTH DOORS OPEN	830-865	725-740	780-815
	630-645	540-550	605-615
	815-825	795-810	845-865
	490-515	480-505	560-590

ELEVATION VIEW:
INSIDE FOUNDRY, LOOKING OUT

VELOCITY READINGS IN FT./MIN.

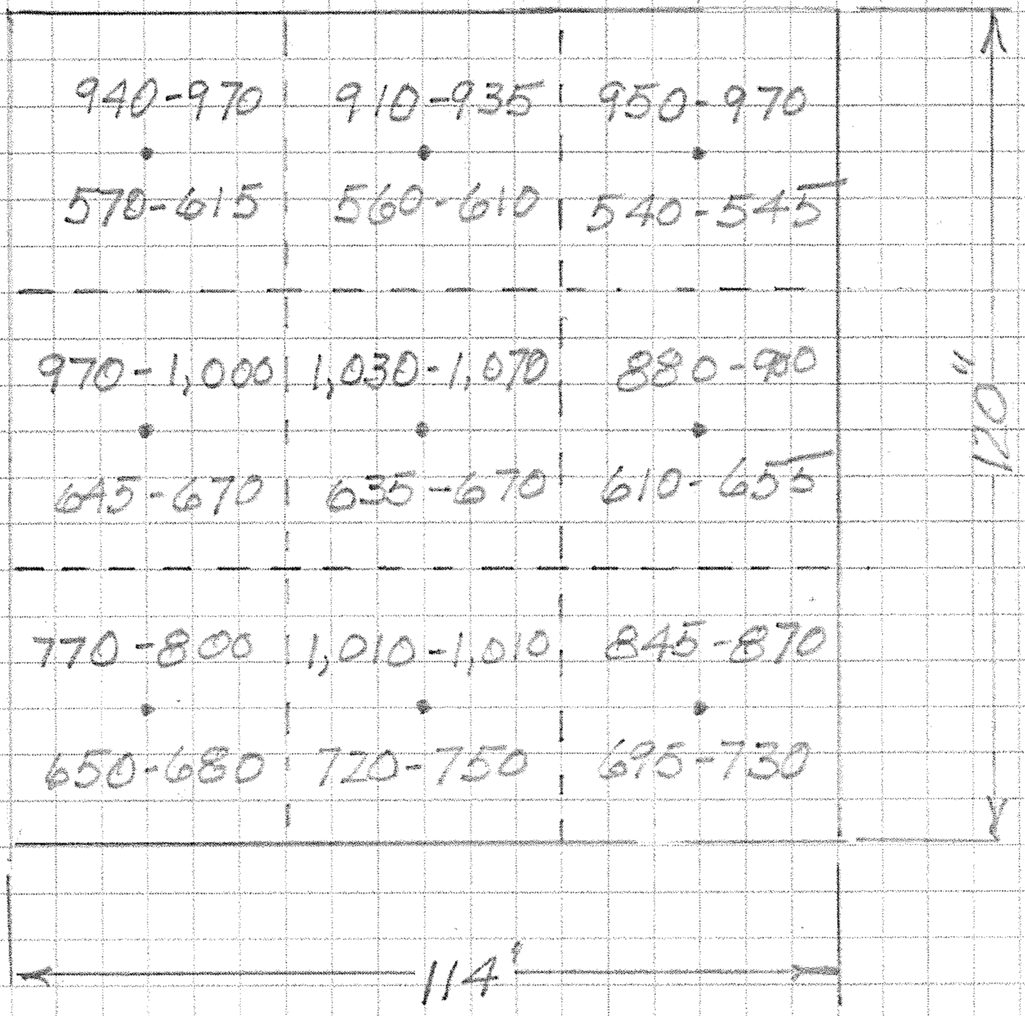
A

SHEET NO. 2 OF 2
PROJECT NO. H. KRAMER
DATE APRIL 18, 2012
BY R. SCHOLZ
CHK'D

SUBJECT DOOR INFILTRATION VELOCITIES, EXTERIOR DOOR, SOUTH FOUNDRY

TOP LINE: THIS DOOR OPEN ONLY

SECOND LINE: BOTH DOORS OPEN



940-970	910-935	950-970
570-615	560-610	540-545
970-1,000	1,030-1,070	880-900
645-670	635-670	610-655
770-800	1,010-1,010	845-870
650-680	720-750	695-730

ELEVATION VIEW:
INSIDE BUILDING, LOOKING OUT

VELOCITY READINGS IN FT./MIN.

A

AP-42
FIFTH EDITION
JANUARY 1995

COMPILATION OF AIR POLLUTANT EMISSION FACTORS

VOLUME I: STATIONARY POINT AND AREA SOURCES

Office Of Air Quality Planning And Standards
Office Of Air And Radiation
U. S. Environmental Protection Agency
Research Triangle Park, NC 27711

January 1995

AP-42
Fifth Edition
Volume I

NOTICE

The Emission Factor And Inventory Group (EFIG) has been working for several months on this Fifth Edition of AP-42. It is the result of a major technical undertaking by EFIG's AP-42 Team and the several contractors who assisted. This document represents a substantial step toward complying with Section 130 of the *Clean Air Act Amendments Of 1990*, which direct the U. S. Environmental Protection Agency to review and revise its air pollutant emission factors every three years. Although such updating is required only for ozone-related pollutants (total organic compounds, oxides of nitrogen, and carbon monoxide), the AP-42 Team has also addressed the other criteria pollutants, hazardous pollutants, global warming gases and speciation information, where data are available. Sections of AP-42 are continuously being developed, reviewed and/or updated.

Even though there are significant additions and improvements in this book, many data gaps and uncertainties still exist. All readers and users of AP-42 are asked to provide comments, test data, and any other information for our evaluation and possible use to improve future updates.

Users familiar with this document may notice changes in factor quality ratings, specifically that some factors, although unchanged or supported by even newer and more extensive data, are rated lower in quality than previously in the AP-42 series. This is attributable to the adoption of more consistent and stringently applied rating criteria. There are some factors in this edition with lower ratings than previously, but they are believed to represent appropriate estimates. AP-42 emission factors are truly for estimation purposes and are no substitute for exact measurements taken at a source.

Users should especially note this edition's expanded "Introduction", for its information on pollutant definition, factor limitations, the factor rating system, and cautionary notes on the use of factors for anything other than emission estimation and inventory and approximation purposes.

In addition to print, the AP-42 series is available in several other media. The *Air CHIEF* compact disc (CD-ROM), with AP-42 and other hazardous air pollutant emission estimation reports and data bases, can be purchased from the Government Printing Office. Also, *The CHIEF* electronic bulletin board (by modem, 919-541-5742) posts the latest AP-42 and other reports and tools before they are available on paper. Final sections of AP-42 can be obtained quickly from our automatic *Fax CHIEF* service (919-541-5626 or -0548). These last two media operate 24 hours per day, 7 days per week. If you have questions or need further information on these tools or other aspects of emission estimation, call our help line, *Info CHIEF*, at 919-541-5285, during regular office hours, eastern time.

If you have factor needs, new data, questions, or suggestions, please send them to the address below. You may also ask for a free subscription to *The CHIEF*, our quarterly newsletter (also on the electronic bulletin board and *Fax CHIEF*). Our abilities to respond to individual questions often get impinged by time and resource constraints and the sheer volume of requests, so please use the above capabilities and tools whenever possible. Though we are a client-oriented organization, we have neither staff nor structure to provide engineering support.

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12.17 Miscellaneous Lead Products

12.17.1 General[1]

In 1989 the following categories (in decreasing order of lead usage) were significant in the miscellaneous lead products group: ammunition, cable covering, solder, and type metal. However, in 1992, U. S. can manufacturers no longer use lead solder. Therefore, solder will not be included as a miscellaneous lead product in this section. Lead used in ammunition (bullets and shot) and for shot used at nuclear facilities in 1989 was 62,940 megagrams (Mg) (69,470 tons). The use of lead sheet in construction and lead cable sheathing in communications also increased to a combined total of 43,592 Mg (48,115 tons).

12.17.2 Process Description

12.17.2.1 Ammunition And Metallic Lead Products[8] -

Lead is consumed in the manufacture of ammunition, bearing metals, and other lead products, with subsequent lead emissions. Lead used in the manufacture of ammunition is melted and alloyed before it is cast, sheared, extruded, swaged, or mechanically worked. Some lead is also reacted to form lead azide, a detonating agent. Lead is used in bearing manufacture by alloying it with copper, bronze, antimony, and tin, although lead usage in this category is relatively small.

Other lead products include terne metal (a plating alloy), weights and ballasts, caulking lead, plumbing supplies, roofing materials, casting metal foil, collapsible metal tubes, and sheet lead. Lead is also used for galvanizing, annealing, and plating. In all of these cases lead is usually melted and cast prior to mechanical forming operations.

12.17.2.2 Cable Covering[8,11] -

About 90 percent of the lead cable covering produced in the United States is lead-cured jacketed cables, the remaining 10 percent being lead sheathed cables. The manufacture of cured jacketed cables involves a stripping/remelt operation as an unalloyed lead cover that is applied in the vulcanizing treatment during the manufacture of rubber-insulated cable must be stripped from the cable and remelted.

Lead coverings are applied to insulated cable by hydraulic extrusion of solid lead around the cable. Extrusion rates of typical presses average 1360 to 6800 Mg/hr (3,000 to 15,000 lb/hr). The molten lead is continuously fed into the extruder or screw press, where it solidifies as it progresses. A melting kettle supplies lead to the press.

12.17.2.3 Type Metal Production[8] -

Lead type, used primarily in the letterpress segment of the printing industry, is cast from a molten lead alloy and remelted after use. Linotype and monotype processes produce a mold, while the stereotype process produces a plate for printing. All type is an alloy consisting of 60 to 85 percent recovered lead, with antimony, tin, and a small amount of virgin metal.

12.17.3 Emissions And Controls

Tables 12.17-1 and 12.17-2 present emission factors for miscellaneous lead products.

Table 12.17-1 (Metric Units). EMISSION FACTORS FOR MISCELLANEOUS SOURCES[a]

Process	Particulate	EMISSION FACTOR RATING	Lead	EMISSION FACTOR RATING	Reference
Type Metal Production (SCC 3-60-001-01)	0.4[b]	C	0.13	C	2,7
Cable Covering (SCC 3-04-040-01)	0.3[c]	C	0.25	C	3,5,7
Metallic Lead Products:					
Ammunition (SCC 3-04-051-01)	ND	NA	≤ 0.5	C	3,7
Bearing Metals (SCC 3-04-051-02)	ND	NA	Negligible	NA	3,7
Other Sources of Lead (SCC 3-04-051-03)	ND	NA	0.8	C	3,7

[a] Factors are expressed as kg/Mg lead (Pb) processed. ND = no data. NA = not applicable.
[b] Calculated on the basis of 35% of the total (Reference 2). SCC = Source Classification Code.
[c] Reference 8, p. 4-301.

Table 12.17-2 (English Units). EMISSION FACTORS FOR MISCELLANEOUS SOURCES[a]

Process	Particulate	EMISSION FACTOR RATING	Lead	EMISSION FACTOR RATING	Reference
Type Metal Production	0.7 [b]	C	0.25	C	2,7
Cable Covering (SCC 3-04-040-01)	0.6 [c]	C	0.5	C	3,5,7
Metallic Lead Products:					
Ammunition (SCC 3-04-051-01)	ND	NA	1.0	C	3,7
Bearing Metals (SCC 3-04-051-02)	ND	NA	Negligible	NA	3,7
Other Sources of Lead (SCC 3-04-051-03)	ND	NA	1.5	C	3,7

[a] Factors are expressed as lb/ton lead (Pb) processed. ND = no data. NA = not applicable.
[b] Calculated on the basis of 35% of the total (Reference 2). SCC = Source Classification Code.
[c] Reference 8, p. 4-301.

12.17.3.1 Ammunition And Metallic Lead Products[8] -

Little or no air pollution control equipment is currently used by manufacturers of metallic lead products. Emissions from bearing manufacture are negligible, even without controls.

12.17.3.2 Cable Covering[8,11] -

The melting kettle is the only source of atmospheric lead emissions and is generally uncontrolled. Average particle size is approximately 5 micrometers, with a lead content of about 70 to 80 percent.

Cable covering processes do not usually include particulate collection devices. However, fabric filters, rotoclone wet collectors, and dry cyclone collectors can reduce lead emissions at control efficiencies of 99.9 percent, 75 to 85 percent, and greater than 45 percent, respectively. Lowering and controlling the melt temperature, enclosing the melting unit and using fluxes to provide a cover on the melt can also minimize emissions.

12.17.3.3 Type Metal Production[2,3] -

The melting pot is again the major source of emissions, containing hydrocarbons as well as lead particulates. Pouring the molten metal into the molds involves surface oxidation of the metal, possibly producing oxidized fumes, while the trimming and finishing operations emit lead particles. It is estimated that 35 percent of the total emitted particulate is lead.

Approximately half of the current lead type operations control lead emissions, by approximately 80 percent. The other operations are uncontrolled. The most frequently controlled sources are the main melting pots and drossing areas. Linotype equipment does not require controls when operated properly. Devices in current use on monotype and stereotype lines include rotoclones, wet scrubbers, fabric filters, and electrostatic precipitators, all of which can be used in various combinations.

Additionally, the VOC/PM Speciation Data Base has identified phosphorus, chlorine, chromium, manganese, cobalt, nickel, arsenic, selenium, cadmium, antimony, mercury, and lead as occurring in emissions from type metal production and lead cable coating operations. All of these metals/chemicals are listed in CAA Title III as being hazardous air pollutants (HAPs) and should be the subject of air emissions testing by industry sources.

References For Section 12.17

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EPA United States
Environmental Protection
Agency

Implementation of the 2008 Lead National Ambient Air Quality Standards

Guide to Developing Reasonably Available Control Measures (RACM) for Controlling Lead Emissions

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Implementation of the 2008 Lead National Ambient Air Quality Standards Guide to Developing Reasonably Available Control Measures (RACM) for Controlling Lead Emissions

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List of Acronyms

BDT	Best Demonstrated Technology
BOPF	Basic Oxygen Process Furnace
BOPH	Basic Oxygen Process Heater
CAA	Clean Air Act
CFR	Code of Federal Regulations
EAF	Electric Arc Furnace
EIF	Electric Induction Furnace
EPA	Environmental Protection Agency
FR	Federal Register
GACT	Generally Available Control Technology
HAP	Hazardous Air Pollutant
HEPA	High Efficiency Particulate Air
MACT	Maximum Available Control Technology
NAAQS	National Ambient Air Quality Standard
NAICS	North American Industry Classification System
NEI	National Emissions Inventory
NESHAP	National Emission Standards for Hazardous Air Pollutants
NSPS	New Source Performance Standard
PM	Particulate Matter
RACM	Reasonably Available Control Measure
RACT	Reasonably Available Control Technology
SCAQMD	South Coast Air Quality Management District
SIP	State Implementation Plan
TPY	Tons Per Year
WESPs	Wet Electrostatic Precipitators

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1.0. INTRODUCTION.

1.1. Purpose – Supporting the Implementation of the 2008 Lead NAAQS by Analyzing Relevant Control Measures for RACM Development.

In order to support the implementation of the 2008 Lead National Ambient Air Quality Standards (NAAQS), this document contains an analysis of air control measures for the purpose of determining what controls may constitute reasonably available control measures (RACM), including reasonably available control technologies (RACT), for controlling lead emissions pursuant to Section 172(c)(1) of the Clean Air Act (CAA). This document was prepared pursuant to EPA Contract EP-D-07-001, Work Assignment # 4-10, by EC/R Incorporated.

This document identifies control measures used to control lead emissions from sources in the Secondary Lead Smelting, Lead Acid Battery Manufacturing, Iron and Steel Mills, and Iron and Steel Foundries source categories. For each identified control measure, this document contains a RACM criteria assessment to determine how likely each control measure is to constitute RACM. In addition, for the Primary Lead Smelting, Secondary Aluminum Production, Secondary Copper Smelting, Mining, and Petroleum Refineries source categories, data relevant to a RACM determination was collected from EPA's CoST database and is presented here for a RACM criteria assessment.

A prior EPA document identifies potential RACM for controlling lead emissions.[1] This document, "Implementation of the 2008 Lead National Ambient Air Quality Standards (NAAQS): Guide to Developing Reasonably Available Control Measures (RACM) for Controlling Lead Emissions," is intended to replace such prior document, and any other EPA-issued document, with respect to identifying RACM for controlling lead emissions.

1.2. The 2008 Lead NAAQS and RACM Requirements.

On November 12, 2008, EPA published the final rule on the Lead NAAQS. Based on its review, EPA made revisions to the primary and secondary Lead NAAQS to provide requisite protection of the public health and welfare. EPA revised the primary standard to provide increased protection for children and other at-risk populations against an array of adverse health effects. Such health effects most notably include neurological effects in children, including neurocognitive and neurobehavioral effects. EPA revised the level from 1.5 to 0.15 micrograms per cubic meter ($\mu g/m^3$). EPA revised the secondary standard to be identical in all respects to the revised primary standard.[2]

The CAA requires that states submit for each nonattainment area a state implementation plan (SIP) that contains RACM, including RACT. Specifically, section 172(c)(1) of the CAA requires that nonattainment SIPs "provide for the implementation of all *reasonably available control measures* as expeditiously as practicable (including such reductions in emissions from existing sources in the area as may be obtained through the adoption, at a minimum, of *reasonably available control technology*) and shall provide for the attainment of the NAAQS [emphasis added]."[3]

The first step in addressing RACM for the 2008 Lead NAAQS is to identify potential measures for controlling lead emissions from lead sources in nonattainment areas. In addition, if states are aware of

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[1] "Lead Guideline Document." EPA-452/R-93-009. April 1993.

[2] National Ambient Air Quality Standards for Lead; Final Rule, 73 FR 66964, 67036 (Published November 12, 2008).

[3] Id. at 67036.

information or receive substantive public comments that demonstrate through appropriate documentation that additional control measures may be reasonably available in a specific area, the measures should be added to the list of available measures for consideration in that particular area.[4]

While EPA does not presume that control measures are reasonably available in all areas, a reasoned justification for rejection of any available control measure should be prepared. If it can be shown that such control measures, if applied to individual sources or to a source category, are unreasonable because emissions from the affected sources are insignificant (i.e., would not have any effect on attainment), then the control measures may be excluded from further consideration as they would not be representative of RACM for the affected area. The resulting control measures should then be evaluated for reasonableness, considering their technological feasibility and the cost of control in the area for which the SIP applies.[5]

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[4] Id.

[5] Id.

2.0. EPA CRITERIA AND PROCEDURES FOR RACM DEVELOPMENT.

This section provides EPA criteria and procedures for the development of RACM, which will be used in subsequent sections to assess how likely each control measure is a RACM.

2.1. EPA Criteria for Determining whether a Control Measure is a RACM.

EPA provides that in determining whether a control measure is a RACM, the following factors should be considered:

1. The economic feasibility of the control measure,
2. The capital costs, annualized cost, and cost effectiveness of the control measure; and
3. The extent of adoption of the control measure by state regulations.[6]

2.1.1. The Economic Feasibility of the Control Measure.

The economic feasibility of a control measure refers to the cost of reducing emissions and the difference between the cost of the control measure at the particular source in question and the costs of control measures that have been implemented at similar sources. Economic feasibility is largely determined by evidence that other sources in a particular source category have applied the control measure in question, although EPA does encourage the development of innovative measures not previously employed that may be technically and economically feasible. Absent other indications, EPA, as a general matter, expects that it is reasonable for similar sources to bear the costs for similar control measures.[7]

2.1.2. The Capital Costs, Annualized Costs, and Cost Effectiveness of the Control Measure.

Substantial weight should be given to cost effectiveness in evaluating whether a control measure is a RACM. The cost effectiveness of a technology is its annualized cost (e.g, $/year) divided by the emissions reduced (e.g., tons/year) which yields a cost per amount of emission reduction (e.g., $/ton).[8]

In considering what level of control is reasonable, EPA has not adopted a specific dollar per ton cost threshold. However, a control measure is likely to be a RACM if it has a cost per ton similar to other measures previously employed for that pollutant, or similar to that of other measures needed to achieve expeditious attainment in the area within the CAA's timeframes. A higher cost per ton value may be reasonable in areas with more serious air quality problems than in areas with less serious problems because it is expected that the residents in the areas with more serious air quality problems could realize greater public health benefits from attaining the standard as expeditiously as practicable. A higher cost per ton value also may be reasonable in areas where essential reductions are difficult to achieve (e.g., because many sources are already controlled).[9]

In addition, EPA believes that in determining appropriate emission control levels, the state should consider the collective public health benefits that can be realized in the area due to projected

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[6] Id. at 67035-67037.
[7] Id. at 67036.
[8] Id.
[9] Id.

improvements in air quality.[10] One such collective public health benefit might be improved air quality in areas with large demographic populations that are the subject of environmental justice concerns, as more expensive control measures might be more reasonable for sources in a nonattainment area with large demographic populations that are the subject of environmental justice concerns. Considering environmental justice concerns in this way is consistent with EPA Plan EJ 2014, which represents a strategy aimed at protecting health in communities that are over-burdened by pollution.[11]

2.1.3. The Adoption of Control Measures by States.

The fact that a control measure has been adopted or is in the process of being adopted by states is an indicator that the measure may be a RACM.[12] This document will specifically focus on the state regulations and permit requirements that pertain to source categories with corresponding sources in such states.

Similarly, the fact that EPA has identified a control measure as a generally available control technology (GACT), best demonstrated technology (BDT), or a maximum available control technology (MACT) might also suggest that the control measure is reasonably available. EPA identifies control measures as GACT when promulgating National Emission Standards for Hazardous Air Pollutants (NESHAP) for area sources in a source category. In determining what constitutes GACT for a particular area source category, EPA evaluates the control technologies and management practices that are generally available for the area sources in a source category that reduce hazardous air pollutants (HAP). EPA may consider costs in determining what constitutes GACT for the area source category.[13] The fact that EPA has considered a control measure GACT after considering costs would generally suggest that such a control measure is likely a RACM.

EPA identifies control measures as BDT when promulgating New Source Performance Standards (NSPS). BDT refers to the best system of continuous emissions reduction that has been demonstrated to work in a given industry, considering economic costs and other factors, such as energy use.[14] The fact that EPA has considered a control measure BDT after considering costs would generally suggest that such a control measure is a RACM.

EPA identifies control measures as MACT when promulgating NESHAP standards for major sources in a source category. For major sources, MACT standards must reflect the maximum degree of emissions reductions of HAP achievable after considering cost, energy requirements, and non-air quality health and environmental impacts. The MACT ''floor'' is the minimum control level allowed for MACT standards promulgated under CAA section 112(d)(3) and may not be based on cost considerations. For new sources, the MACT floor cannot be less stringent than the emissions control that is achieved in practice by the best controlled similar source. The MACT floors for existing sources can be less stringent than floors for new sources, but they cannot be less stringent than the average emissions limitation achieved by the best performing 12 percent of existing sources in the category or subcategory (or the best performing five sources for categories or subcategories with fewer than 30 sources).[15] In

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[10] Id.

[11] EPA Plan EJ 2014. EPA Office of Environmental Justice (Published September 2011).

[12] National Ambient Air Quality Standards for Lead; Final Rule, 73 FR 66964, 67036 (Published November 12, 2008).

[13] See, for example, NESHAP for Area Source: Acrylic and Modacrylic Fibers Production, Carbon Black Production, Chemical Manufacturing, Flexible Polyurethane Foam Production and Fabrication, Lead Acid battery Manufacturing, and Wood Preserving; Final Rule, 72 FR 38864, 38880 (Published July 16, 2007).

[14] NSPS for Portland Cement Manufacturing, 75 CFR 54970, 54974-54975 (Published September 9, 2010).

[15] See, for example, Proposed NESHAP for Iron and Steel Foundries, 67 CFR 78274, 78276 (Published December 23, 2002).

some circumstances, such as when a large amount of time has passed since a control measure was identified as MACT, the fact that a control technology was identified as MACT might suggest that such a control measure is a RACM.

2.2. Using Particulate Matter Cost-Effectiveness Information as a Surrogate for Lead Cost-Effectiveness Information.

As indicated in Section 2.1, cost-effectiveness information is an important factor to consider when determining whether a control measure is a RACM. However, cost-effectiveness information for controlling lead is often limited. Consequently, EPA often uses the cost-effectiveness information for controlling particulate matter (PM) for a control measure as a surrogate for the cost-effectiveness of controlling lead for the measure. That is, EPA will use evidence that suggests that a control measure is cost effective for controlling PM emissions to support the contention that the control measure is also cost effective for controlling lead emissions.

For example, for the development of RACM/RACT for the 2008 Lead NAAQS, EPA guidance indicates that states should rely on the RACM guidance issued for PM. Regulations and guidance that address the implementation of pre-existing NAAQS for lead are mainly provided in the following documents: (1) ''state Implementation Plans; General Preamble for the Implementation of Title I of the Clean Air Act Amendments of 1990,''57 FR 13549, April 16, 1992, (2) ''state Implementation Plans for Lead Nonattainment Areas; Addendum to the General Preamble for the Implementation of Title I of the Clean Air Act Amendments of 1990,''58 FR 67748, December 22, 1993, and (3) regulations listed at 40 CFR 51.117.[16]

In accordance with such EPA guidance, when lead cost-effectiveness information is limited for a control measure, this document contains cost-effectiveness data for controlling PM for control measures to glean whether the control measure might also be cost effective for controlling lead. However, it is important to note that the cost-effectiveness for a control measure at a specific facility depends on many factors such as the type, size and amount of emissions; the layout of the facility; control technology specifications and several other factors. Consequently, it will not always be the case that a control measure that is cost effective to control PM at one facility will be cost effective to control lead at the same facility, at another facility within the same source category, or at another facility from a different source category.

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[16] National Ambient Air Quality Standards for Lead; Final Rule, 73 FR 66964, 67030 (Published November 12, 2008).

3.0. OVERVIEW OF RACM DEVELOPMENT FOR THE IMPLEMENTATION OF THE 2008 LEAD NAAQS.

This section provides an overview of RACM development for the 2008 Lead NAAQS. Section 3.1 explains why this document assesses control measures for RACM development within the context of source categories. Section 3.2 explains why this document focuses on certain source categories - Secondary Lead Smelting, Lead Acid Battery Manufacturing, Iron and Steel Foundries, and Iron and Steel Mills – for RACM development. Section 3.3 provides a strategy for RACM development for sources in source categories not focused on in this document.

3.1. Overview of RACM Development.

This document presents control measures within specific source categories because applying the RACM criteria discussed in Section 2.1[17] is most conveniently analyzed and clearly presented within the context of source categories. For example, economic feasibility of a control measure is largely determined by the extent of adoption by sources is the same source category. Moreover, the cost-effectiveness of a control measure is often more similar (although variable) across a certain source category. In addition, state and federal regulations are generally written for specific source categories and, therefore, the extent to which a control measure is adopted by state/federal regulations is most easily analyzed within the context of source categories.

3.2. Selecting the Source Categories for which RACM Development is Focused on in this Document.

This document focuses on four source categories for which RACM development for the 2008 Lead NAAQS is likely to be most relevant. Some source categories do not emit lead in great enough quantities to cause lead NAAQS exceedances. Other source categories do not have corresponding sources in nonattainment areas with respect to lead and, therefore, no sources will be subject to the RACM requirement. Section 3.2.1 identifies sources categories with corresponding sources in nonattainment areas with respect to lead, and for such source categories, Section 3.2.2 provides an assessment of how relevant RACM development would likely be for each source category. Sections 4 through 7 present control measures relevant to each of the four selected source categories and assess he likelihood that each such control measure would constitute a RACM.

3.2.1. Identification of Lead-Emitting Sources in Nonattainment Areas with respect to the 2008 Lead NAAQS.

The task of identifying the lead-emitting sources in nonattainment areas with respect to the 2008 Lead NAAQS is a two-step process. First, the nonattainment areas with respect to the 2008 Lead NAAQS must be identified. Then, the lead-emitting sources within such nonattainment areas can be identified.

In order to identify the areas of nonattainment with respect to the 2008 Lead NAAQS, EPA's Area Designations for 2008 Lead Standards Website was reviewed.[18] Specifically, the counties and specific

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[17] (1) The economic feasibility of the control measure, as indicated by extent of adoption; (2) the capital costs, annualized cost, and the cost effectiveness of the control measure; and (3) the extent of adoption of the control measure by state regulations.

[18] EPA's Area Designations for 2008 Lead Standards Website (Accessed December, 2011).

cities/townships that were in nonattainment were identified in the designation support documents for each specific state as of December 1, 2011.[19] Table 3-1 provides a summary of the nonattainment areas with respect to the 2008 Lead NAAQS. Overall, there were 21 nonattainment areas within 22 counties.

Once the nonattainment areas were identified, the corresponding designation support documents were reviewed and the lead-emitting sources (emitting ≥ 0.10 TPY of lead) in each nonattainment area were identified. In order to determine the corresponding source category for each source, the corresponding North American Industry Classification System (NAICS) code and NAICS description for each source were identified using EPA's National Emission Inventory Database.[20] Table 3-2 provides a summary of the most significant lead-emitting sources in areas of nonattainment with the 2008 Lead NAAQS, with corresponding NAICS codes and descriptions. Table 3-2 also provides the values for emitted TPY of lead for each facility as provided by each state in its respective designation support document, except when indicated otherwise.

EPA's purpose in identifying the lead-emitting sources in nonattainment areas in Table 3-2 is to help determine the source categories for which information related to RACM development will be most useful and relevant. In preparing this draft document, EPA assumed that the source categories with the most and largest lead-emitting sources in nonattainment areas would be the source categories for which information on RACM development would be most useful and relevant. Therefore, this draft document was prepared to provide more in-depth RACM development information in Sections 4 through 8 for such source categories. However, EPA emphasizes that the list of sources identified in Table 3-2 is not an exhaustive list of all the lead-emitting sources in nonattainment areas. In addition, even though EPA focused its search on sources emitting more than 0.10 TPY of lead, EPA recognizes that sources emitting less than 0.10 TPY are might be required to install RACM pursuant to CAA §172(c)(1) and might be significant contributors to NAAQS exceedances.

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[19] Puerto Rico Support Document, Pennsylvania Support Document I, Pennsylvania Support Document II, Pennsylvania Support Document III, Alabama Support Document , Tennessee Support Document , Florida Support Document , Illinois Support Document I, Illinois Support Document II, Indiana Support Document , Michigan Support Document , Minnesota Support Document , Ohio Support Document I, Ohio Support Document II, Ohio Support Document III , Texas Support Document , Iowa Support Document , Kansas Support Document , Missouri Support Document I , Missouri Support Document II , California Support Document l. (All documents represent the most recent state designation documents for the 2008 Lead NAAQS as of December, 2011).

[20] EPA's National Emission Inventory Database (Accessed December, 2011).

Table 3-1. Nonattainment Areas with respect to the 2008 Lead NAAQS.

State	Area Name	County Name
Alabama	Troy	Pike (partial)
California	Los Angeles County within the South Coast Air Basin, excluding San Clemente and Santa Catalina Islands (Southern Los Angeles County)	Los Angeles (partial)
Florida	Tampa	Hillsborough (partial)
Illinois	Granite City	Madison (partial)
	Chicago	Cook (partial)
Indiana	Muncie	Delaware (partial)
Iowa	Pottawattamie County	Pottawattamie (partial)
Kansas	Saline County	Saline (partial)
Michigan	Belding	Ionia (partial)
Minnesota	Eagan	Dakota (partial)
Missouri	Iron County	Iron (partial), Dent (partial), Reynolds (partial)
	Jefferson County	Jefferson (partial)
Ohio	Bellefontaine	Logan (partial)
	Cleveland	Cuyahoga (partial)
	Delta	Fulton (partial)
Pennsylvania	Lower Beaver Valley	Beaver (partial)
	Lyons	Berks (partial)
	North Reading	Berks (partial)
Puerto Rico	Arecibo	Arecibo (partial)
Tennessee	Bristol	Sullivan (partial)
Texas	Frisco	Collin (partial)
Total	21 Nonattainment Areas	22 partial counties (parts of Berks County, PA in 2 areas)

Table 3-2. Lead-emitting Sources (≥ 0.10 TPY) in Nonattainment Areas with the 2008 Lead NAAQS

Region	State	County	Source Name	Emissions (TPY)	NAICS Code and Description	
Secondary Lead Smelting						
2	PR	Arecibo	The Battery Recycling Company	1.22	331492	Secondary Smelting, and Alloying of Nonferrous Metal
3	PA	Berks	East Penn Manfg. Co.	0.20	331492	…
3	PA	Berks	Exide Technologies	1.44[21]	331492	…
4	AL	Pike	Sanders Lead Comp.	4.44	331492	…
4	FL	Hills-borough	EnviroFocus Technologies	1.30	331492	…
5	IN	Delaware	Exide Technologies	0.81	331492	…
5	MN	Dakota	Gopher Resource Corp.	0.36[22]	331314	…
6	TX	Collin	Exide Corp.	2.0	331492	…
7	MO	Iron, Dent, Reynolds	Buick Resources Recycling	12.1	331492	…
9	CA	LA	Exide Technologies	2.00	335911	…
9	CA	LA	Quemetco Inc.	0.32	331492	…
Lead Acid Battery Manufacturing						
3	PA	Berks	East Penn Manf.	2.49	335911	Storage Battery Manf.
3	PA	Berks	Yuasa Battery Inc.	0.18[23]	335911	…
4	TN	Sullivan	Exide Technologies	0.78	335912	Primary Battery Manf.
7	KS	Salina	Exide Technologies	2.17	335912	…
Iron and Steel Foundries						
5	IL	Madison	ASF-Keystone, Inc. (Amsted Rail)	0.19[24]	331513	Steel Foundries
5	OH	Fulton	Northstar Bluescope Steel, LLC	.30	331515	Iron Foundries
7	IA	Potta-wattamie	Griffin Pipe Facility	1.20	331515	…
7	KS	Saline	Metlcast Products	0.14	331515	…
Iron and Steel Mills						
5	IL	Madison	US Steel Corp.	1.33[25]	33111	Iron and Steel Mills
Other Source Categories[26]						
7	MO	Jefferson	Doe Run	59.00[27, 28]	331419	Primary Smelting and

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[21] PA state 2008 inventory (As of December 2011).

[22] 2008 NEI v1.5 (As of December, 2011).

[23] Id.

[24] 2008 NEI v1.5 (As of December 2011).

[25] Id.

[26] These are source categories with at least one corresponding source in a nonattainment area, which are not focused on in this document. This document focuses on developing RACM for the following source categories: Secondary Lead Smelting, Lead Acid Battery Manufacturing, Iron and Steel Foundries, Iron and Steel Mills

Region	State	County	Source Name	Emissions (TPY)	NAICS Code and Description	
			Herculaneum			Refining of Nonferrous Metal (except Copper and Aluminum)
5	IL	Cook	H. Kramer & Company	0.12[29]	331423	Secondary Smelting, Refining, and Alloying of Copper
5	MI	Ionia	Mueller Industries	0.80[30]	331421	Copper Rolling, Drawing, and Extruding
2	PR	Arecibo	PREPA Cambalache Combustion Turbine Plant	0.17	221112	Fossil Fuel Electric Power Generation
7	MO	Iron, Dent, Reynolds	Doe Run Company-Buick Mill	0.10	212231	Lead Ore and Zinc Ore Mining
5	IL	Cook	Fisk Electric Generating Station	0.07[31]	221112	Fossil Fuel Electric Power Generation
9	CA	Los Angeles	BP West Coast Products LLC	0.79	324110	Petroleum Refineries
9	CA	Los Angeles	Tesoro LA Refinery	0.15	324110	Petroleum Refineries

3.2.2. Source Categories with Corresponding Sources in Nonattainment Areas for which RACM Development is Likely to be Most Relevant.

RACM development is only relevant for a source category if corresponding sources from the source category are located in nonattainment areas. For such source categories with a least one corresponding source in a nonattainment area, we used four factors to determine which of these source categories to include in this document for further assessment.

The first factor is the number of sources a corresponding source category has in nonattainment areas. The more sources a corresponding source category has in nonattainment areas, the more likely that the source category would be included in this document.

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[27] The Regulatory Impact Analysis of the Proposed Revisions to the National Ambient Air Quality Standards for Lead (Published October 2008). Page 7.

[28] EPA's purpose in identifying the lead-emitting sources in nonattainment areas in Table 3-2 is to help determine the source categories for which information related to RACM development will be most useful and relevant. In preparing this draft document, EPA assumed that the source categories with the most and largest lead-emitting sources in nonattainment areas would be the source categories for which information on RACM development would be most useful and relevant. Therefore, this draft document was prepared to provide more in-depth RACM development information in Sections 4 through 8 for such source categories. However, EPA emphasizes that the list of sources identified in Table 3-2 is not an exhaustive list of all the lead-emitting sources in nonattainment areas. In addition, even though EPA focused its search on sources emitting more than 0.10 TPY of lead, EPA recognizes that sources emitting less than 0.10 TPY might be required to install RACM pursuant to CAA §172(c)(1) and might be significant contributors to NAAQS exceedances.

[29] Id.

[30] Id.

[31] Id.

The second factor is the total annual emissions emitted from all the sources within a source category. Specifically, higher emissions are likely to make control measures more cost effective and, therefore, more appropriate to include in this document.
The third factor is the overall number of sources in a corresponding source category. The more sources in a source category, the more likely that a source will be identified as being in an area classified as nonattainment in the future and, therefore, more appropriate to include in this document.

The fourth factor is other reasons cited in designation support documents, such as if modeling indicates that certain sources within a source category are significantly contributing to nonattainment with the NAAQS. Specifically, control measures are more likely to be necessary for a source if emission reductions are needed to attain the NAAQS.

Table 3.3 contains some of the information we used to decide which source categories to cover in this document, including the overall lead emissions from each source category in TPY and the number of sources in each source category.[32]

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[32] The Regulatory Impact Analysis of the Proposed Revisions to the National Ambient Air Quality Standards for Lead (Published October 2008). Page 7. (Unless indicated otherwise). Note that in the referenced RIA, the table lists many more source categories and accounts for all lead emissions from stationary sources except for 7.08 % of the total national annual lead emitted. The table was revised in this document to only list the source categories with corresponding lead-emitting sources in nonattainment areas. In the referenced RIA, the smallest lead-emitting source category listed emitted 5 TPY of lead. In the referenced RIA, the source categories of Petroleum Refineries and Fossil Fuel Electric Power Generation were not listed, and therefore, the lead emissions are assumed to be less than 5 TPY.

Table 3-3. Nationwide Lead Emissions from Stationary Source Categories with Corresponding Sources in Current Nonattainment Areas.

Source Category	Annual Emission (Tons Lead/Year)	Number of Sources in Source Category	Relative % of Total Emissions from Stationary Source Categories
Iron and Steel Foundries	83	600+ [33]	6.05
Primary Lead Smelting	59	1 [34]	4.30
Secondary Lead Smelting	44	15 [35]	3.21
Iron & Steel Mills	17	18 [36]	1.24
Lead Acid Battery Manufacturing	17	60 [37]	1.24
Mining	15	Undetermined	1.09
Secondary Aluminum Production	9	Undetermined	0.66
Secondary Copper Smelting	6	Undetermined	0.44
Petroleum Refineries	< 5	Undetermined	< 0.40
Fossil Fuel Electric Power Generation	< 5	Undetermined	< 0.40
Remainder of Lead Emissions from Sources in Other Source Categories			**88%**[38]

Application of the four factors suggests that the following source categories are the most relevant for including in this document: Secondary Lead Smelting, Lead Acid Battery Manufacturing, Iron and Steel Mills, and Iron and Steel Foundries. The source category of Secondary Lead Smelting has the highest number of corresponding sources in nonattainment areas, as shown in Table 3-2. Moreover, such sources have some of the highest annual emissions of lead, with three sources each emitting four tons of lead per year, also shown in Table 3-2. Overall, there are 15 secondary lead smelting sources in the United States.[39] However, this small number of facilities is responsible for the emission of 44 tons of lead per year, which represents 3.21% of all lead emitted, as shown in Table 3-3. Consequently, control measures for this source category are reviewed in this document.

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[33] NESHAP for Iron and Steel Foundries - Background Information for Proposed Standards. Document # EPA-HQ-OAR-2006-0359-0002 (Published December, 2002). Page 2-1 .

[34] Memorandum – Summary of Information Collection Request. Received from Source- Doe Run Resources Corporation. From V. Hanzel. RTI International. To Docket. November 19. 2010.

[35] Memorandum –Draft Development of the RTR Emissions Dataset for the Secondary Lead Source Category. From Mike Burr. ERG. To Chuck French of EPA/OAQPS. April 2011. Page 1.

[36] NESHAP for Iron and Steel Foundries - Background Information for Proposed Standards. Document # EPA-HQ-OAR-2006-0359-0002 (Published December. 2002). Page 2-1.

[37] Memorandum – Lead Acid Battery Manufacturing Area Source Category Additional Information to Support Proposed Rule. From Nancy Jones. EC/R. To U.S. EPA Docket Number EPA-HQ-OAR-2006-0897. February 28. 2007. Page 3.

[38] The largest-emitting source categories that make up this 88% are mobile sources (45.44%), Industrial/Commercial/Institutional Boilers & Process Heaters (3.87%), and Hazardous Waste Incinerators (3.43%). All other source categories have relative % of total lead emissions of less than 2%. Generally, many of the source categories that make up this 88% were not focused on by this document because the emissions per source were too low to likely cause significant contributions to NAAQS exceedances.

[39] Memorandum – Draft Development of the RTR Emissions Dataset for the Secondary Lead Smelting Source Category. From Mike Burr. ERG. To Chuck French of EPA/OAQPS. April 2011. Page 1.

The source category of Lead Acid Battery Manufacturing has the second highest number of corresponding sources in nonattainment areas, as shown in Table 3-2. Moreover, such sources have relatively high levels of annual lead emissions, with two sources each emitting over two tons of lead per year, as shown in Table 3-2. Overall, there are roughly 60 lead acid battery manufacturing sources in the United States.[40] This high number of facilities is responsible for 17 tons of lead per year, which represents 1.24% of all lead emitted, as shown in Table 3-3. Consequently, control measures for this source category are reviewed in this document.

The source category of Iron and Steel Foundries has the third highest number of corresponding sources in nonattainment areas, as shown in Table 3-2. Such sources have relatively moderate levels of annual emissions of lead - only emitting less than two tons of lead per year. However, overall there are over 600 iron and steel foundries sources in the United States.[41] This large number of facilities is responsible for the emission of 83 tons of lead per year, which represents 6.05% of all lead emitted, as shown in Table 3-3. The percent of lead emissions emitted from the sources within the Iron and Steel Foundries source category is higher than the lead emissions emitted from sources within any other one source category with at least one corresponding source in a nonattainment area. Consequently, control measures for this source category are reviewed in this document.

The source category of Iron and Steel Mills only has two sources in nonattainment areas, which have relatively small annual lead emissions, as shown in Table 3-3. However, there are 18 iron and steel mill sources in the United States.[42] This number of facilities is responsible for 17 tons of lead per year, which represents 1.24% of all lead emitted, as shown in Table 3-3. Consequently, control measures for this source category are reviewed in this document.

Other source categories with at least some corresponding sources in nonattainment areas are not included in this document for several reasons, including: (1) lack of a large number of corresponding sources in nonattainment areas, or (2) a small likelihood that a source category's corresponding sources in nonattainment areas will contribute significantly to NAAQS exceedances due to low emissions or otherwise. Such source categories include the following: Primary Lead Smelting, Secondary Aluminum Production, Secondary Copper Smelting, Mining, and Petroleum Refineries.

The source category of Primary Lead Smelting has only one corresponding source in a nonattainment area, as shown in Table 3-2. Such a source currently has a very large level of annual emissions of lead, with the one source emitting over 60 tons of lead per year, as shown in Table 3-2. However, there are no other primary lead smelters currently operating in the United States, even though the emissions from this one source account for 4.3% of the total lead annual emissions.[43] More importantly, this one source is being rebuilt from the ground up with state-of-the art control technology. Consequently, control measures for this source are not reviewed in this document.

The source category of Secondary Aluminum Production has only two corresponding sources in nonattainment areas, as shown in Table 3-2. Moreover, while one source is a fairly large emitter,

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[40] Memorandum – Lead Acid Battery Manufacturing Area Source Category Additional Information to Support Proposed Rule. From Nancy Jones. EC/R. To U.S. EPA Docket Number EPA-HQ-OAR-2006-0897. February 28. 2007. Page 3.

[41] NESHAP for Iron and Steel Foundries - Background Information for Proposed Standards. Document # EPA-HQ-OAR-2006-0359-0002 (Published December 2002). Page 2-1.

[42] NESHAP for Integrated Iron and Steel Plants - Background Information for Proposed Standards. Document # EPA-453/R-01-005. (Published January 2001). Page 2-1.

[43] Memorandum – Summary of Information Collection Request. Received from Source- Doe Run Resources Corporation; From V. Hanzel. RTI International. To Docket. November 19. 2010.

emitting over three tons of lead per year, the other source emits less than one ton of lead per year, as shown in Table 3-2. Moreover, while there are a very large number (> 100) of secondary aluminum production facilities,[44] the overall annual emissions of lead from such facilities is very small - only 9 tons of lead per year. This is less than one percent of the total annual lead emitted from all source categories, as shown in Table 3-3. Consequently, control measures for this source category are not reviewed in this document.

The source category related to Secondary Copper Production has only two corresponding sources in nonattainment areas, as shown in Table 3-2. Both facilities emit under one ton of lead per year each, as shown in Table 3-2.[45] Moreover, such facilities account for a less than one percent of the overall annual lead emissions (6 tons, or less than 0.6%). Consequently, control measures for this source category are not reviewed in this document.

The source category of Petroleum Refineries has only two corresponding sources in nonattainment areas, as shown in Table 3-2. Moreover, both facilities emit well under one ton of lead per year each, as shown in Table 3-2. While the total number of facilities in the source category was not determined, the annual emissions from all facilities in the source category are very small, not even registering in Table 3-3. Furthermore, the designation support document for the corresponding nonattainment county indicates that a secondary lead smelter in the county is responsible for the elevated lead concentrations, and not the petroleum refineries listed.[46] Consequently, control measures for this source category are not reviewed in this document.

The source category of Fossil Fuel Electric Power Generation has only one corresponding source in a nonattainment area, as shown in Table 3-2. Moreover, the emissions from this source are less than 0.5 TPY, as shown in Table 3-2. While the number of facilities in the source category was not determined, the annual emissions from all facilities in the source category are very small, not even registering in Table 3-3. Consequently, control measures for this source category are not reviewed in this document.

The source category of Mining has only one corresponding source in a nonattainment area, as shown in Table 3-2. Moreover, the emissions from this source are less than 0.5 TPY. While the number of mining facilities was not determined, the annual emissions from all mining facilities are only about 1 percent, as shown in Table 3-3. Consequently, control measures for this source are not reviewed in this document.

3.3. Strategy for Developing RACM for Source Categories not Focused on in this Document.

Most sources that will be required to implement RACM will be in the source categories focused on by this document – Secondary Lead Smelting, Lead Acid Battery Manufacturing, Iron and Steel Foundries, and Iron and Steel Mills. However, there might be some sources in other source categories that will be required to implement RACM for controlling lead emissions.

For source categories not focused on by this document states can begin to determine what constitutes RACM accordingly. First, states can begin developing RACM by using EPA's CoST database. A review of all stationary source categories was conducted to determine the control measures typically used to

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[44] List of Sources Subject to the Secondary Aluminum Production MACT Standard. EPA.

[45] Current Status of Secondary Copper Production Facilities in the United States, Document # EPA-HQ-OAR-2006-0510-0008 (Published March 31, 2006).

[46] California Designation Support Document I. (Most recent state designation document for 2008 Lead NAAQS as of December, 2011).

control lead emissions. Specifically, EPA's CoST database contains the most cost effective control technologies typically used to control PM process emissions and, therefore, likely lead process emissions, including fabric filters (e.g., reverse air, mechanical shaker, pulse jet), scrubbers (e.g., impingement and Venturi) and electrostatic precipitators (e.g., wet and dry). The database contains the most cost effective control technologies typically used to control PM fugitive dust emissions, including paving unpaved roads, chemically stabilizing unpaved roads, and vacuum sweeping paved roads.[47]

In addition, states can glean information from the control measure information for the source categories focused on in this document. States might analyze the three RACM factors for its corresponding source category to see how they compare to the control measures for source categories focused on in this document. As an example, suppose a state is determining how likely a particular control measure is RACM for a hypothetical source category. Suppose that the extent of adoption of the control measure in the hypothetical source category is as widespread as the extent of the adoption of the control measure in the Secondary Lead Smelting source category. Further, suppose that the cost effectiveness of the control measure for sources in the hypothetical source category is similar to the cost effectiveness of the control measure for sources in the Secondary Lead Smelting source category. Also suppose that the control measure has been adopted by state regulations pertaining to the hypothetical source category to a similar extent that the control measure has been adopted by state regulations pertaining to the Secondary Lead Smelting source category. In this situation, the control measure is as likely to be a RACM for the hypothetical source category as it is likely to be RACM for the Secondary Lead Smelting source category.

States can also search other sources of information on how the RACM criteria apply to various possible control measures for controlling lead emissions. With respect to the first two RACM factors – the economic feasibility of the control measures (as indicated by extent of adoption by other sources in source category) and the cost effectiveness of the control measures – information related to such factors can be found in support documents located in the dockets of related MACT standard development. Information related to the third RACM factor - extent of adoption by state regulations-can be obtained through state environmental agencies.

In addition, it is important to note that, while not all sources will be covered by the four source categories focused on by this document, many of the sources in source categories not focused on in this document may have implemented corresponding RACM in order to comply with other federal or state regulations. For instance, the controls required by MACT standards for sources in the Fossil Fuel Electric Power Generation and Petroleum Refinery source categories may be RACM.

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[47] EPA CoST database.

4.0. RACM DEVELOPMENT FOR THE SECONDARY LEAD SMELTING SOURCE CATEGORY.

This section presents control measures to consider for RACM development for the Secondary Lead Smelting source category. Section 4.1 provides an overview of the Secondary Lead Smelting source category. Section 4.2 provides a summary of the operations and lead emission points with respect to secondary lead smelting facilities. Section 4.3 provides a summary of the control measures utilized at secondary lead smelting facilities, and Section 4.4 provides a more detailed application of the RACM criteria to each identified control measure.

4.1. Overview of Source Category.

The Secondary Lead Smelting source category includes any facility at which lead-bearing scrap material, primarily, but not limited to, lead acid batteries, is recycled into elemental lead or lead alloys by smelting.[48] The corresponding NAICS Code for the Secondary Lead Smelting source category is 331492. The NAICS description for facilities with such NAICS code is "establishments primarily engaged in alloying purchased nonferrous metals and/or recovering nonferrous metals from scrap." The NAICS description specifically includes establishments engaged in "lead recovering from scrap and/or alloying purchased metals."[49]

As of March, 2012, there are 15 secondary lead smelting facilities in the United States. No new secondary lead smelters have been built in the last 20 years. However, one facility is currently in the process of expanding its operations.[50] Another facility is currently under construction in South Carolina.[51]

4.2. Facility Operations and Lead Emission Points.

The secondary lead smelting process consists of pre-processing lead-bearing materials, melting lead metal and reducing lead compounds of lead metal in the smelting furnace, and refining and alloying lead to customer specifications. There are three types of emissions from secondary lead smelting facilities: process emissions, process fugitive emissions, and fugitive dust emissions. Each type of emissions has its own corresponding control measures.[52]

Process emissions include exhaust gases from feed dryers and from blast, reverberatory, rotary, and electric-melting furnaces. While such emissions include some organic compounds, process emissions are mostly metal, primarily lead compounds. Such emissions are released from a stack directly into the atmosphere. The control measures used to control such process emissions are fabric filters, wet electrostatic precipitators (WESPs), and cartridge controls.[53]

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[48] Memorandum – Draft Summary of the Technology Review for the Secondary Lead Smelting Source Category. From Mike Burr, ERG, to Chuck French, EPA/OAQPS. April 2011. Page 2.

[49] North American Industry Classification System Website (Accessed December, 2011).

[50] Memorandum – Draft Summary of the Technology Review for the Secondary Lead Smelting Source Category. From Mike Burr, ERG, to Chuck French, EPA/OAQPS. April 2011. Page 2.

[51] Correspondence with Nathan Topham of EPA/RTP (December, 2011).

[52] Id at 2.

[53] Id.

Process fugitive emissions are released from various sources throughout the smelting process, including smelting furnace charging and tapping points, refining kettles, agglomerating furnace product taps, and kiln transition equipment. Process fugitive emissions are comprised primarily of metal emissions, such as lead.[54] The control measures used to control such emissions include partial and total enclosures, which may or may not be maintained under negative pressure.

Fugitive dust emissions are another type of emissions from secondary lead smelting facilities. Such emissions are not associated with a specific process or process fugitive vent or stack. Fugitive dust emissions are comprised of metal emissions, such as lead, and result from the entrainment of emissions in ambient air due to material handling activities, vehicle traffic, wind, and other activities.[55] The control measures used to control such emissions include paving unpaved roads, vacuuming paved roads, and chemical stabilization of paved roads.

4.3. Identification and Summary of Possible RACM Candidates.

Table 4-2 provides a summary of control measures for which the RACM criteria are applied and the relative likelihood that each control measure is a RACM. Specifically, each control measure is assigned a rating of 1 through 3; where the higher the number, the more likely that the control measure is a RACM. Table 4-1 provides an explanation of these assigned values.

Table 4-1. General Meanings of Assigned RACM Ratings.

RACM Rating	General Meaning of RACM Rating
1	There is limited support for identifying the control measure as a RACM.
2	There is some support for identifying the control measure as a RACM; more than for a control measure with a RACM Rating of "1."
3	There is substantial support for identifying the control measure as a RACM.
U (+ or -)	A "U" indicates that the likelihood that the control measure constitutes a RACM is undetermined due to incomplete information. A corresponding "+" indicates that despite incomplete information, an application of RACM criteria would likely suggest that the control measure is a RACM, while a "-" indicates that despite incomplete information, an application of the RACM criteria would likely suggest that the control measure is not a RACM.

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[54] Id.

[55] Id.

Table 4-2. Secondary Lead Smelting Source Category - Summary of Known Control Measures and Relative Likelihood that each Control Measure is a RACM.

RACM Rating	Control Measure	Brief Reasoning for RACM Rating
3	Fabric filters controlling uncontrolled lead process emissions from stacks.	1. Adoption by almost all sources. 2. Cost data suggest cost effective. 3. Identified as MACT for almost 14 years. 4. California's South Coast Air Quality Management District (SCAQMD) adopted a rule practically requiring such a control measure; it requires that filter media other than filter bags are to be rated by the manufacturer of achieving 99.97% capture efficiency for 0.3 micron particles.
1.5	Fabric filters with downstream add-on control devices controlling uncontrolled lead process emissions from stacks.	1. Adoption by 1 of 14 sources and plans to adopt by two other sources. 2. Cost data suggest not cost effective. 3. Not required by any known federal regulation.
1	Replacing old fabric filters controlling uncontrolled lead process emissions from stacks with new fabric filters.	1. No known adoption. 2. Cost data suggest not cost effective. 3. Not required by any known federal regulation. 4. California's SCAQMD adopted a rule that might practically require such a control measure; it requires that filter media other than filter bags are to be rated by the manufacturer of achieving 99.97% capture efficiency for 0.3 micron particles.
U+	Other control measures for process emissions from fabric filters: (1) switching bag types, (2) properly installing bags, (3) sealing ducts and dust conveyance devices, (4) replacing and not repairing torn bags.	1. Not enough information to apply RACM criteria. 2. California's SCAQMD adopted a rule that might practically require such a control measure; it requires that filter media other than filter bags are to be rated by the manufacturer of achieving 99.97% capture efficiency for 0.3 micron particles.
3	Enclosure hoods and partial enclosures with wet suppression for process units and storage areas to capture process fugitive emissions.	1. Adoption by all sources, and exceeded by a supermajority of sources. 2. No known cost data. 3. Identified as MACT for almost 14 years. 4. California's SCAQMD adopted a rule that requires total enclosures for many areas and operations.
3	In addition to enclosure hoods, a combination of negative pressure total enclosures and partial enclosures with wet suppressions for process units and storage areas to capture fugitive emissions.	1. Adoption by 11 of 14 sources. 2. No known cost data. 3. Required by 2012 NESHAP for secondary lead smelters. 4. California's SCAQMD adopted a rule that requires total enclosures under negative pressure for many areas/operations.

RACM Rating	Control Measure	Brief Reasoning for RACM Rating
3	In addition to enclosure hoods, negative pressure total enclosures for all process units and storage areas to capture process fugitive emissions.	1. Adoption by 7 of 14 sources. 2. No known cost data. 3. Not required by any known federal regulations. 4. California's SCAQMD adopted a rule that requires total enclosures under negative pressure for many areas/operations, and the 2012 NESHAP for secondary lead smelting requires such controls.
3	Paving unpaved roads and cleaning paved roads for controlling fugitive dust sources.	1. Adoption by all sources. 2. Cost data suggest cost effective. 3. Identified as MACT for almost 14 years. 4. Required by California's SCAQMD rule as this rule requires cleaning surfaces subject to vehicular traffic and paving facility ground subject to traffic.
3	Partial enclosure, wet suppression, and pavement cleaning of operating areas and storage piles; totally enclosing operating areas and storage piles; and vehicle washing at each facility exit to control fugitive dust lead emissions.	1. Adoption by all sources. 2. No known cost data available. 3. Identified as MACT for almost 14 years. 4. Required by rule adopted by California's SCAQMD. Rule requires several such measures including requiring dust-forming material to be stored in enclosure, washing/vacuuming surfaces accumulating lead-containing dust, etc.
U+	Other control measures for controlling fugitive dust emissions: more complete vehicle washing inside buildings, improved roadway cleaning techniques, pavement of entire facility, cleaning of building and roofs, etc.	1. Seven of 14 facilities adopted a combination of such control measures, and, generally, emissions from such facilities were lower. 2. California's SCAQMD rule requires several such control measures. 3. The 2012 NESHAP for secondary lead smelting requires many such control measures.

4.4. Application of RACM Criteria to Possible RACM Candidates.

4.4.1. <u>Fabric Filters (or other Primary Controls) Controlling Uncontrolled Lead Emissions from Stacks.</u>

The common use of fabric filters by secondary lead smelters suggests that fabric filters are the most economically feasible control technologies for regulating process lead emissions from stacks. A 2011 review of information collection request responses from secondary lead smelters revealed that almost all (if not all) secondary lead smelters use fabric filters to control uncontrolled PM (including lead) emissions from stacks. Several types of fabric filters are used by the industry, including shaker, pulse jet, and reverse pulse jet fabric filters.[56]

In addition, the available data suggest that fabric filters are cost effective for regulating process lead emissions. Specifically, cost-effectiveness information for PM was available for selected control technologies in the source category of Lead Processing, as shown in Table 4-3, where cost-effectiveness

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[56] Id at 4.

values for fabric filters are on average roughly $400/ton.[57] This information suggests that fabric filters are cost effective for regulating lead as well.

Table 4-3. Cost-Effectiveness Information for Selected Control Technologies for Controlling Particulate Matter for the Lead Processing Source Category.

Control Technology	Cost Effectiveness* ($/ton PM)	Low/High Control Efficiency
Dry Electrostatic Precipitator – Wire Plate Type	400	95/98
Fabric Filter – Reverse-Air Cleaned Type	500	99/99.5
Fabric Filter (Mech. Shaker Type)	450	99/99.5
WESP – Wire Plate Type	800	99/99.5
* Rounded to the nearest $50 and escalated from 1999 to 2011 U.S. dollars.[58]		

The 1997 NESHAP for Secondary Lead Smelting suggests that such fabric filters are reasonably available. Specifically, the 1997 NESHAP applies to process emissions from the following furnace configurations: collated blast and reverberatory furnace; blast furnace; and reverberatory, rotary and electric furnaces. The 1997 NESHAP provides an emissions limit for lead compounds of 2.0 milligrams per dry standard cubic meter (mg/dscm) from each such furnace configuration. Such a standard does not explicitly require a control, such as a fabric filter, but such a control is practically required in order to comply with the emission limit. The fact that such controls were MACT 14 years ago, and have been required by all currently operating sources for at least 11 years, suggests that such controls may be RACM today.[59]

A review of state rules from California and Missouri further suggests that such control measures are reasonably available. These states were chosen for review because they both have secondary lead sources (2 in each state) within their states. Missouri incorporates the federal 1997 NESHAP into state law.[60] California's SCAQMD adopted a rule practically requiring such a control measure adopted a rule that might practically require such a control measure; it requires that filter media other than filter bags are to be rated by the manufacturer of achieving 99.97% capture efficiency for 0.3 micron particles.[61]

4.4.2. Fabric Filters (or other Primary Controls) Controlling Uncontrolled Lead Emissions with Add-on Downstream Control Technologies.

The current use of add-on control technologies, such as WESP and high efficiency particulate air (HEPA) filters, downstream of fabric filters (or other primary controls) to further reduce lead emissions from stacks suggests that such add-on control technologies are less economically feasible but are becoming more economically feasible. Specifically, while only one secondary lead smelting facility uses a WESP as an add-on control to a fabric filter, two other facilities currently have plans to install WESP

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[57] EPA CoST database.

[58] In order to escalate from 1999 dollars to 2011 dollars, used the formula and approach presented in EPA's Control Strategy Tool (CoST) Control Measures Database (CMDB) Documentation, Page 9.

[59] NESHAP for Secondary Lead Smelting, 40 CFR 63, Subpart X (Published June 13, 1997).

[60] 10 CSR 10-6.075 Maximum Achievable Control Technology Regulations: Air Quality Standards, Definitions, Sampling, and Reference Methods and Air Pollution Control Regulations for the Entire State of Missouri. (Published August 16, 1977). Page 91.

[61] California (South Coast Air Quality Management District), Rule 1420.1 - Emission Standards for Lead from Large Lead Acid Battery Recycling Facilities (Adopted November 5, 2010).

units to be used as add-on controls to fabric filters. Several facilities also reported using HEPA filters as add-on controls downstream of their fabric filters.[62]

However, the available data suggest that using add-on control technologies downstream of fabric filters is much less cost effective for controlling lead than the cost effectiveness of the primary control. Specifically, installing an add-on control technology, such as a WESP, downstream of the primary control would double the control technology costs. Moreover, because fabric filters can achieve efficiencies of greater than 99%, the amount of further lead emissions captured is relatively low compared to the amount captured with a fabric filter controlling uncontrolled emissions. In fact, one recent estimate of the cost effectiveness of an add-on WESP at a secondary lead smelting facility in Quemetco, California, revealed that the cost effectiveness of the add-on WESP would be $295,900/ton PM (and $2,279,500/ton of lead)[63]. Thus using a WESP as an add-on control can be over 250 times less cost effective than using a WESP as a primary control. There is no known federal standard currently requiring such a control measure.

There is no known federal standard currently requiring such a control measure. However, California's SCAQMD, which has two sources, adopted a rule that practically requires such a control measure by requiring 99.97% capture efficiency for 0.3 micron particles.[64]

4.4.3. Replacing Old Fabric Filters Controlling Uncontrolled Lead Emissions from Stacks with New Fabric Filters.

A recent comparison of fabric filter outlet lead emissions revealed that the controlling factor determining the effectiveness of the fabric filter was the age of the fabric filter. Generally, older fabric filters have higher outlet lead emissions, while newer fabric filters have lower outlet emissions. The average outlet lead concentration for lead emissions for fabric filters installed in the 1960s is roughly 0.40 mg/dscm, in the 1970s roughly 0.30 mg/dscm, in the 1980s roughly 0.20 mg/dscm, and in the 2000s less than 0.10 mg/dscm. Consequently, one possible control measure would be to replace old fabric filters with new fabric filters, as on average, this could reduce lead emissions by a factor of four or more.[65]

Similarly, a recent comparison of fabric filter outlet lead emissions also revealed that another factor that determines the effectiveness of the fabric filter is the type of fabric filter (e.g., shaker, pulse jet, reverse bag pulse jet). Specifically, shaker fabric filters appear to have higher outlet lead concentrations than those of the pulse jet or reverse bag pulse jet type. However, this finding may be misleading because the majority of the older units appear to be shaker types.[66]

There is no known federal standard currently requiring old fabric filters to be replaced by higher efficiency types. A review of state rules from California and Missouri weakly suggests that such control measures might be within economic reach. Such states were chosen for review because they both have secondary lead sources (2 in each state) within their states. Missouri incorporates the federal 1997 NESHAP into state law, which does not require such a measure.[67] However, California's SCAQMD,

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[62] Memorandum – Draft Summary of the Technology Review for the Secondary Lead Smelting Source Category. From Mike Burr, ERG, to Chuck French, EPA/OAQPS. April 2011. Page 4.

[63] Cost estimate provided by Nathan Topham/EPA/OAQPS/SPPD/MIG.

[64] California (South Coast Air Quality Management District), Rule 1420.1 - Emission Standards for Lead from Large Lead Acid Battery Recycling Facilities (Adopted November 5, 2010).

[65] Id at 7.

[66] Id.

[67] Air10 CSR 10-6.075 Maximum Achievable Control Technology Regulations: Air Quality Standards, Definitions.

which has two sources, adopted a rule that might practically require such a control measure; it requires that filter media other than filter bags are to be rated by the manufacturer of achieving 99.97% capture efficiency for 0.3 micron particles.[68]

4.4.4. Other Control Measures for Controlling Process Lead Emissions.

One company in the industry has suggested that Teflon (polytetrafluoroethylene) bags specifically supplied by Gore-Tex© performed better than other bag types, such as polyester. The company also suggested that the most critical factors influencing fabric filter performance are proper installation and maintenance practices. The company mentioned specific practices such as ensuring proper installation of the bags and properly sealing all ducts and dust conveyance devices help increase control efficiency. Additionally, the company claimed that replacing torn bags, rather than repairing them, can significantly improve fabric filter performance. However, while such control measures might be utilized, information is not available for a RACM criteria analysis.[69]

4.4.5. Partial and Total Enclosures to Control Fugitive Process Lead Emissions.

The complete adoption of partial and total enclosures by secondary lead smelters to control fugitive process emissions suggests that partial and total enclosures are economically feasible control measures. Specifically, all secondary lead smelting facilities currently use partial and total enclosures to control process fugitive emissions from the following emission sources: smelting furnace and dryer charging hoppers, chutes, and skip hoists; smelting furnace lead taps, and molds during tapping; smelting furnace slag taps, and molds during tapping; refining kettles; dryer transition pieces; and agglomerating furnace product taps. All secondary lead smelters equip such fugitive emission sources with an enclosure hood or locate such sources in a total enclosure subject to general ventilation that maintains the building at a lower than ambient pressure to ensure in-draft through any doorway opening accordingly. All process fugitive hoods (except for refining kettles and dryer transition pieces) are ventilated to ensure a face velocity of at least 90 meters per minute at all hood openings. Process fugitive hoods for refining kettles are ventilated to maintain a face velocity of at least 75 meters per minute. Process fugitive hoods for dryer transition pieces are ventilated to maintain a face velocity of at least 110 meters per minute. Such ventilation air is conveyed to a controlled device.[70] No cost-effectiveness information was available for such control measures.

The 1997 NESHAP for Secondary Lead Smelting requires such partial and total enclosure control measures for fugitive process lead emissions. The fact that such controls were MACT 14 years ago, and have been required by all currently operating sources for 11 years, suggests such controls are RACM today.[71]

A review of state rules from California and Missouri further suggests that such control measures are reasonable. Such states were chosen for review because they both have secondary lead sources (2 in

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Sampling, and Reference Methods and Air Pollution Control Regulations for the Entire State of Missouri (Published August 16, 1977). Page 91.

[68] California (South Coast Air Quality Management District), Rule 1420.1 - Emission Standards for Lead from Large Lead Acid Battery Recycling Facilities (Adopted November 5, 2010).

[69] Memorandum – Draft Summary of the Technology Review for the Secondary Lead Smelting Source Category, From Mike Burr, ERG, to Chuck French, EPA/OAQPS, April 2011, Page 7.

[70] Id at 11.

[71] NESHAP for Secondary Lead Smelting, 40 CFR 63, Subpart X (Published June 13, 1997).

each state) located within the state. Missouri incorporates the federal 1997 NESHAP into state law.[72] California's SCAQMD adopted a rule that requires total enclosure of several areas (e.g., battery breaking areas; materials storage and handling areas; dryer and dryer areas; smelting furnaces; agglomerating furnaces; and refining and casting areas).

4.4.6. In Addition to Enclosure Hoods, a Combination of Negative Pressure Total Enclosures and Partial Enclosures with Wet Suppression for Process Units and Storage Areas.

The common use of, in addition to enclosure hoods, a combination of negative pressure total enclosures and partial enclosures with wet suppression for process units and storage areas, suggests these additional control measures are economically feasible. Specifically, 12 of the 14 secondary lead smelting facilities use a combination of negative pressure total enclosures and partial enclosures with wet suppression for process units and storage areas in addition to enclosures hoods. Additionally, half of the secondary lead smelting facilities, in addition to enclosure hoods for process fugitive sources, use negative pressure total enclosures for all process units and storage areas.[73] No cost-effectiveness information was available for such control measures.[74]

There is no identified federal standard currently requiring such a control measure. However, California requires negative pressure total enclosures for several areas (e.g., battery breaking areas; materials storage and handling areas; dryer and dryer areas; smelting furnaces; agglomerating furnaces; and refining and casting areas).[75] Also, the 2012 NESHAP for Secondary Lead Smelting requires facilities to locate and control sources of fugitive lead emissions within total enclosures that are maintained under negative pressure and vented to a control device.[76] These emissions sources include the smelting furnaces; smelting furnace charging areas; lead taps; slag taps; molds during tapping; battery breakers, refining kettles; casting areas; dryerts; material handling areas; and areas where dust from fabric filters, sweepings, or used fabric filters are processed.

4.4.7. Paving Unpaved Roads and Cleaning Paved Roads for Controlling Fugitive Dust Lead Emissions.

The common practice of paving plant roadways, including all areas subject to vehicle traffic – and cleaning such pavement twice per day, except when natural precipitation makes cleaning unnecessary or when sand or similar material has been spread on plant roadways to provide traction on ice and snow, suggest that such practice is economically feasible. Specifically, all secondary smelting facilities have adopted such practices.[77]

In addition, available data suggest that such control measures are cost effective for controlling lead emissions. Specifically, cost-effectiveness information was available for the control measures in the source category of Lead Processing for PM in 2010 dollars, as shown in Table 4-3, where cost-

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[72] Air10 CSR 10-6.075 Maximum Achievable Control Technology Regulations: Air Quality Standards, Definitions, Sampling, and Reference Methods and Air Pollution Control Regulations for the Entire State of Missouri (Published August 16, 1977). Page 91.

[73] Memorandum – Draft Summary of the Technology Review for the Secondary Lead Smelting Source Category, From Mike Burr, ERG, to Chuck French, EPA/OAQPS, April 2011, Page 11.

[74] Id. at 11.

[75] California (South Coast Air Quality Management District), Rule 1420.1 - Emission Standards for Lead from Large Lead Acid Battery Recycling Facilities (Adopted November 5, 2010).

[76] NESHAP for Secondary Lead Smelting (Published January, 2012).

[77] Memorandum – Draft Summary of the Technology Review for the Secondary Lead Smelting Source Category, From Mike Burr, ERG, to Chuck French, EPA/OAQPS, April 2011, Page 11.

effectiveness values for such measures were on average roughly $500/ton.[78] Since lead is commonly associated with PM, this information suggests that such control measures are cost effective for controlling lead as well.

Table 4-4. Cost-Effectiveness Information for Selected Control Measures for Controlling Particulate Matter with respect to All Source Categories.

Control Measure	Cost Effectiveness* ($/ton PM)	Control Efficiency (%)
Vacuum Sweeping Paved Roads	500	50.0
Hot Asphalt Paving of Unpaved Roads	800	66.6
* Rounded to the nearest $100 and escalated from 1999 to 2011 U.S. dollars.[79]		

A review of state rules from California and Missouri suggests such control measures reasonable. Such states were chosen for review because they both have secondary lead sources (2 in each state) within the state. Missouri incorporates the federal 2007 NESHAP into state law, which only requires such control measures for major sources.[80] A California's SCAQMD rule requires paving facility grounds and daily cleaning/sweeping of such paved surfaces.[81]

4.4.8. Partially Enclosing , Wet Suppressing, and Pavement Cleaning of Operating Areas and Storage Piles; Totally Enclosing of Operating Areas and Storage Piles; and Vehicle Washing at each Facility Exit to Control Fugitive Dust Lead Emissions.

The common practices of (1) partially enclosing, wet suppressing, and pavement cleaning of operating areas and storage piles, (2) totally enclosing operating areas and storage piles, and (3) vehicle washing at each facility exit to control fugitive dust lead emissions suggests that such practices are economically feasible. All secondary lead smelting facilities have adopted such practices. Specifically, for battery breaking areas, all secondary lead smelting facilities partially enclose storage piles, wet suppress storage piles with sufficient frequency and quantity to prevent the formation of dust, and clean the pavement of such areas twice per day; or alternatively, totally enclose the battery breaking area. For furnace areas, all secondary lead smelting facilities partially enclose such areas and clean the pavement of such areas twice per day, or alternatively, totally enclose and ventilate the enclosed areas to a control device. For refining and casting areas, all secondary lead smelting facilities partially enclose and clean the pavement of such areas twice per day; or alternatively, totally enclose and ventilate such areas to a control device. For material and storage handling areas, all secondary lead smelting facilities partially enclose such areas, wet suppress the storage piles with sufficient frequency and quantity to prevent the formation of dust, wash vehicles at each exit from the such areas, and pave such areas; or alternatively, totally enclose such areas and ventilate to a control device. Moreover all facilities wash vehicles at the exits of facility property.[82]

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[78] EPA CoST database.

[79] In order to escalate from 1999 dollars to 2011 dollars, used the formula and approach presented in EPA's Control Strategy Tool (CoST) Control Measures Database (CMDB) Documentation. Page 9.

[80] Air10 CSR 10-6.075 Maximum Achievable Control Technology Regulations: Air Quality Standards, Definitions, Sampling, and Reference Methods and Air Pollution Control Regulations for the Entire State of Missouri (Published August 16, 1977). Page 91.

[81] California (South Coast Air Quality Management District), Rule 1420.1 - Emission Standards for Lead from Large Lead Acid Battery Recycling Facilities (Adopted November 5, 2010).

[82] Memorandum – Draft Summary of the Technology Review for the Secondary Lead Smelting Source Category, From Mike Burr, ERG, to Chuck French, EPA/OAQPS, April 2011, Page 11.

No cost-effectiveness information is available for such practices. The 1997 NESHAP for Secondary Lead Smelting requires such control measures for controlling fugitive dust process lead emissions. The old NESHAP was published June 1997. The fact that such controls were MACT 14 years ago, and have been required by all currently operating sources for 15 years, suggests such controls are RACM today.[83] The 2012 NESHAP requires the total enclosure under negative pressure with ventilation to a control device of process areas that are sources of fugitive lead emissions. The 2012 NESHAP also requires facilities to adopt a list of specified work practice standards to minimize fugitive emissions, including wet suppression, pavement cleaning, and vehicle washing at facility exits.[84]

A review of state rules from California and Missouri suggests such control measures are reasonable. Such states were chosen for review because they both have secondary lead sources (2 in each state) within the state. Missouri incorporates the federal 1997 NESHAP into state law, which only requires such a control measure for major sources.[85] California's SCAQMD rule requires such control measures and is even more stringent.[86]

4.4.9. Other Control Measures for Controlling Fugitive Dust Emissions.

A recent review revealed that, generally, facilities that adopted the following additional fugitive dust emissions controls had lower fugitive dust emissions:

1. More complete vehicle washing inside buildings.
2. Improved roadway cleaning techniques and frequency.
3. Pavement of entire facility grounds.
4. Cleaning of building roofs and exteriors.
5. Use of daily ambient monitoring to diagnose plant activities that lead to exceedances of the NAAQS for lead.
6. Timely cleaning of accidental releases.
7. Inspection of outside battery storage areas for broken batteries.[87]

Moreover, California's SCAQMD adopted a rule that requires several such control measures for controlling fugitive dust emissions, which include the following:

1. Clean roof top structures and other areas where lead-containing waste generated from housekeeping activities are stored, disposed of, recovered, or recycled by wet wash or vacuum equipped with a filter rated by the manufacturer to achieve 99.97% capture efficiency for 0.3 micron particles in a manner that does not generate fugitive lead dust (monthly or quarterly, depending on the height of the roof).
2. Monthly inspection of total enclosures and facility structures that contain fugitive dust emissions for gaps, breaks, separations, leak points, etc.
3. Pave, concrete, asphalt or encapsulate certain facility grounds.

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[83] NESHAP for Secondary Lead Smelting, 40 CFR 63, Subpart X (Published June, 1997).

[84] NESHAP for Secondary Lead Smelting (Published January, 2012).

[85] Air10 CSR 10-6.075 Maximum Achievable Control Technology Regulations: Air Quality Standards, Definitions, Sampling, and Reference Methods and Air Pollution Control Regulations for the Entire State of Missouri (Published August 16, 1977). Page 91.

[86] California (South Coast Air Quality Management District), Rule 1420.1 - Emission Standards for Lead from Large Lead Acid Battery Recycling Facilities (Adopted November 5, 2010).

[87] Memorandum – Draft Summary of the Technology Review for the Secondary Lead Smelting Source Category, From Mike Burr, ERG, to Chuck French, EPA/OAQPS, April 2011, Page 11.

4. Storing all materials capable of generating any amount of fugitive lead-dust in a sealed, leak-proof container.[88]

In addition, the 2012 NESHAP for Secondary Lead Smelting requires many such control measures for controlling fugitive emissions to be installed by January 2014. Sources that will be subject to the NESHAP must prepare an operating procedures manual that describes in detail the work practice standards that will be put in place and implemented to control fugitive dust emissions from plant roadways, plant buildings, plant building exteriors, accidental releases, battery storage areas, equipment maintenance areas, material storage areas and material handling areas. Specifically, the proposed NESHAP would require the following fugitive dust control measures to be included in the operating procedures manual:

1. Cleaning certain areas by wet wash or a vacuum equipped with a filter rated by the manufacturer to achieve 99.97 percent capture efficiency for 0.3 micron particles.
2. Paving all areas subject to vehicle traffic and cleaning such pavement twice per day.
3. Monthly or quarterly cleaning of building roofs and exteriors, depending on the height of such roofs and exteriors.
4. Initiating cleaning of affected areas within one hour after any accidental release of lead dust.
5. Inspection of unenclosed battery storage areas twice each day.
6. Washing of vehicles at each exit of the material storage and handling areas.
7. Paving grounds on the facility sufficient to prevent wind-blown dust.[89]

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[88] California (South Coast Air Quality Management District). Rule 1420.1 - Emission Standards for Lead from Large Lead Acid Battery Recycling Facilities (Adopted November 5, 2010).

[89] NESHAP for Secondary Lead Smelting (Published January, 2012).

5.0. RACM DEVELOPMENT FOR THE LEAD ACID BATTERY MANUFACTURING SOURCE CATEGORY.

This section presents control measures to consider for RACM development for the Lead Acid Battery Manufacturing source category. Section 5.1 provides an overview of the Lead Acid Battery source category. Section 5.2 provides a summary of operations and lead emission points for lead acid battery facilities. Section 5.3 provides a summary of the control measures utilized at lead acid battery manufacturing facilities, and Section 5.4 provides a more detailed application of the RACM criteria to each identified control measure.

5.1. Overview of Source Category.

The Lead Acid Battery Manufacturing source category includes any facility that manufactures either starting lighting/ignition batteries that are primarily used in automobiles or industrial/traction batteries that are used for uninterruptible power supply or to power electric vehicles such as forklifts.[90] The corresponding NAICS code for the Lead Acid Battery Manufacturing source category is 335911. The NAICS Description for facilities with such NAICS Code is "establishments primarily engaged in manufacturing primary batteries." The NAICS description specifically includes "lead acid storage batteries manufacturing."[91]

Today, there are approximately 60 lead acid battery manufacturing facilities in the United States, all of which are area sources. Such facilities are located throughout 23 states and Puerto Rico.[92]

5.2. Facility Operations and Lead Emission Points.

Lead acid batteries are produced from lead alloy ingots, sheet lead, and lead oxide. Lead acid battery manufacturing consists of several processes, including the following: (1) grid casting, (2) grid stamping, lead paste mixing, (3) the three-process operation of plate stacking, plate burning and plate assembly, (4) charge formation, and (5) lead reclamation.[93]

Specifically, the manufacturing process includes preparing battery grids through stamping or casting lead. Lead oxide paste is added to the grids in the grid pasting operation creating plates that are cured and assembled into a battery. Batteries are then charged using sulfuric acid in the forming operations. Lead oxide may be prepared by the battery manufacturer, as is the case for many larger battery manufacturing facilities, or may be purchased from a supplier. The control measures that are used to control such process emissions are fabric filters for the paste mixing, three-process plate operation, lead oxide manufacturing, and other lead emitting processes; and impingement scrubbers for the grid casting and lead reclamation operations.[94]

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[90] Memorandum – Lead Acid Battery Manufacturing Area Source Category Additional Information to Support Proposed Rule. From Nancy Jones, EC/R, To U.S. EPA Docket Number EPA-HQ-OAR-2006-0897. February 28, 2007. Page 1.

[91] North American Industry Classification System Website (Accessed December, 2011).

[92] Memorandum – Lead Acid Battery Manufacturing Area Source Category Additional Information to Support Proposed Rule. From Nancy Jones, EC/R, To U.S. EPA Docket Number EPA-HQ-OAR-2006-0897. February 28, 2007. Page 1.

[93] Id at 1.

[94] Id at 2.

5.3. Identification and Summary of Possible RACM Candidates.

Table 5-2 provides a summary of control measures used in the Lead Acid Battery source category for which the RACM criteria are applied in section 5.4 and the relative likelihood that each control measure is a RACM. Specifically, each control measure is assigned a rating of 1 through 3; where the higher the number, the more likely that the control measure is a RACM. Such assigned values are explained in Table 5-1.

Table 5-1. General Meanings of Assigned RACM Ratings.

RACM Rating	General Meaning of RACM Rating
1	There is limited support for identifying the control measure as a RACM.
2	There is some support for identifying the control measure as a RACM; more than for a control measure with a RACM Rating of "1."
3	There is substantial support for identifying the control measure as a RACM.
U **(+ or -)**	A "U" indicates that the likelihood that the control measure constitutes a RACM is undetermined due to incomplete information. A corresponding "+" indicates that despite incomplete information, an application of RACM criteria would likely suggest that the control measure is a RACM, while a "-" indicates that despite incomplete information, an application of the RACM criteria would likely suggest that the control measure is not a RACM.

Table 5-2. Lead Acid Battery Source Category - Summary of Known Control Measures and Relative Likelihood that each Control Measure is a RACM.

RACM Rating	Control Measure	Brief Reasoning for RACM Rating
3	Fabric Filters to Control Process Lead Emissions from Paste Mixing, Three-Process Plate Operation, Lead Oxide Manufacturing, and Other Lead Emitting Processes.	1. Adoption by almost all (or all) sources. 2. Cost data suggest cost effective. 3. EPA determined such control measures constitute BDT over thirty years ago and as GACT four years ago. 4. California's SCAQMD adopted a rule practically requiring such a control measure, as it requires 98% efficiency for lead for facilities exceeding specific process and emission thresholds (i.e., processing more than 2 tons of lead per year with daily emissions of lead greater than or equal to 0.5lbs/day).
3	Impingement Scrubbers to Control Process Lead Emissions from Lead Reclamation and Grid Casting Operations.	1. Adoption by almost all (or all) sources. 2. Cost data suggest cost effective. 3. EPA determined such control measures constitute BDT over thirty years ago and as GACT four years ago. 4. California's SCAQMD adopted a rule practically requiring such a control measure, as it requires 98% efficiency for lead for facilities exceeding specific process and emission thresholds (i.e., processing more than 2 tons of lead per year with daily emissions of lead greater than or equal to 0.5lbs/day).
1	Other control measures to control process lead emissions from stacks.	1. Only limited adoption by facilities revealed through a review of publicly available information

RACM Rating	Control Measure	Brief Reasoning for RACM Rating
		and correspondence with EPA employees. 2. EPA determined that cost data suggested such additional control measures not cost effective. 3. EPA refused to develop any such controls as GACT technology as recent as four years ago. 4. California's SCAQMD adopted a rule practically requiring such control measures as it requires 98% efficiency for lead for facilities exceeding specific process and emission thresholds (i.e., processing more than 2 tons of lead per year with daily emissions of lead greater than or equal to 0.5lbs/day)..
1.5	Paving unpaved roads and cleaning unpaved roads for controlling fugitive dust sources.	1. Only limited adoption by facilities revealed through a review of public available information and correspondence with EPA employees. 2. Cost data suggest cost effective. 3. Not required by any known federal regulation. 4. Required in part by California's SCAQMD. The SCAQMD rule requires cleaning surfaces subject to vehicular traffic weekly.
U -	Other Control measures to control fugitive emissions.	1. Lack of known adoption by any facilities for controlling lead emissions. 2. No known cost data. However, lead acid battery facilities are all area sources, which results in fugitive dust control measures being less likely to be cost effective. 3. Not required by any known federal regulation. 4. California's SCAQMD requires several such measures, such as requiring dust-forming material to be stored in enclosures, washing/vacuuming surfaces accumulating lead-containing dust, etc.

5.4. Application of RACM Criteria to Possible RACM Candidates.

5.4.1. Fabric Filters to Control Process Lead Emissions from Paste Mixing, the Three-Process Plate Operation, Lead Oxide Manufacturing, and Other Lead Emitting Processes; and Impingement Scrubbers to Control Process Lead Emissions from Lead Reclamation and Grid Casting Operations.

The almost complete adoption of fabric filters by lead acid battery manufacturing facilities in the United States to control process lead emissions from paste mixing, the three-process plate operation, lead oxide manufacturing, and other lead-emitting processes; and almost complete adoption of impingement scrubbers to control process emissions from lead reclamation and grid casting operations, suggests that such control measures are the most economically feasible control technologies for regulating lead emissions from such operations in the Lead Acid Battery source category. Specifically, almost all (53/58) of the lead acid battery manufacturing facilities comply with the current NSPS and NESHAP standards for the Lead Acid Battery source category, which are identical standards. The NSPS and

NESHAP emission limitations, control efficiencies, and control bases for relevant operations are listed in Table 5-3.[95]

Table 5-3. NSPS and NESHAP for Lead Acid Battery Manufacturing (40 CFR 60, Subpart KK; 40 CFR 63, Subpart PPPPPP).

Operation	Emission Limitation	Control Efficiency	Control Basis
Paste mixing	1 mg/dscm (0.00044 gr/dscf)	99%	Fabric filter (6:1 air to cloth ratio)
Three-process operation	1 mg/dscm (0.00044 gr/dscf)	99%	Fabric filter (6:1 air to cloth ratio)
Lead oxide manufacturing	5 mg/kg of lead processed	> 99%	Fabric Filter (2:1 air to cloth ratio)
Other lead emitting processes	1 mg/dscm (0.00044 gr/dscf)	90%	Fabric filter (6:1 air to cloth ratio)
Grid casting	0.4 mg/dscm (0.00024 gr/dscf)	90%	Impingement scrubber
Lead Reclamation	4.5 mg/dscm (0.0022 gr/dscf)	90%	Impingement scrubber

The available cost information might further suggest that such control measures are cost effective. For example, a recent cost analysis was conducted to determine the cost effectiveness of fabric filters for the paste mixing, three plate process, and other lead process operations for a typical lead acid battery manufacturing plant. Such cost analysis assumed the characteristics for the fabric filters and plants listed in Table 5-4. Such cost analysis revealed that the cost effectiveness of the fabric filters ranged from roughly $381,000 to $4.3 million per ton of lead.[96]

Table 5-4. Cost Effectiveness of Fabric Filters Controlling Previously Uncontrolled Lead Emissions for Paste Mixing, Three Plate Process, and Other Lead Processes in a Typical Lead Acid Battery Manufacturing Plant.

Operation	Capital Costs Low/High ($)	Annual Costs Low/High ($)	Equipment Life (Years)	Annual Emissions (Tons Lead per year)	Cost Effectiveness, Low/High ($/Ton Lead)
Paste Mixing	70,000/ 70,000	224,000 / 224,000	20	0.052	4,375,000 / 4,375,000
Three Plate Process	130,000/ 520,000	253,000 / 321,000	20	0.420	617,857 / 826,190
Other Lead Processes	234,000/ 773,000	290,000 / 385,000	20	0.790	381,898 / 536,265

Current and past federal regulations suggest that such control measures are reasonably available. Specifically, the NSPS for Lead Acid Battery Manufacturing Plants (40 CFR 60, Subpart KK),

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[95] Id. at Attachment 2.

[96] Memorandum – Lead Acid Battery Manufacturing Area Source Category Costing Information in Response to Comments on Proposed Rule. From Nancy Jones, EC/R. To Sharon Nizich, EPA/OAQPS/SPPD/MICG. June 12, 2007. Page 4.

published in 1982, imposes the control technologies with corresponding emissions limitations and control efficiencies shown in Table 5-3.[97] Such standards require control technologies that are BDT. The fact that such control measures were BDT almost thirty years ago suggests that each such control measure constitutes a RACM.

Moreover, the current NESHAP for the Lead Acid Battery Manufacturing Area Sources (40 CFR 63, Subpart PPPPPP), published in 2007, incorporates the exact same control measures and corresponding emission limits and control efficiencies as the older NSPS.[98] The current NESHAP requires control technologies that are generally available control technologies (GACT). The fact that EPA determined that such control measures were GACT technologies in the source category four years ago further suggests that such control measures are RACM.

A review of rules from California and Missouri further suggests that such control measures are reasonable. Such states were chosen for review because they both have lead acid battery manufacturing sources within the state. Missouri incorporates the federal NESHAP into state law.[99] California's SCAQMD adopted a rule practically requiring such a control measure, as it requires 98% efficiency for lead for facilities exceeding specific process and emission thresholds (i.e., processing more than 2 tons of lead per year with daily emissions of lead greater than or equal to 0.5lbs/day).[100]

5.4.2. Other Control Measures to Control Process Lead Emissions from Stacks.

A review of publicly available literature and correspondence with several EPA employees revealed limited adoption of other control measures to control process lead emissions from the stacks from lead acid battery facilities. Specifically, one lead acid battery manufacturing facility has fabric filter baghouses with HEPA filter add-ons to control process lead emissions from two of its mills.[101] Such limited known adoption suggests that other control measures to control lead process emissions from stacks in lead acid battery manufacturing plants are not reasonably economically feasible.

The available cost data further suggest that other control measures to control process emissions from stacks is not cost effective. For example, a recent analysis was performed to determine the cost for a typical battery manufacturing plant to upgrade from the current 90/99.0 percent controls (i.e., controls required by current NESHAP and NSPS) to 99.9 percent controls. Such estimate revealed that the total capital investment to upgrade to 99.9 percent controls could range from more than $600,000 to almost $1.7 million, depending on the technologies selected. Moreover, the annual costs of such additional control for a typical plant would be around $1.2 million per year due to increased operator labor costs, maintenance labor/material costs, electricity/other utility costs, taxes, insurance and capital recovery costs. Such cost represents about 5 percent of the total shipments for an average lead acid battery establishment. EPA has indicated that it does not believe that such costs are appropriate for the area sources in the category. Such costs incurred per ton of lead emissions reduced would be around

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[97] NSPS for Lead acid Battery Manufacturing Plants, 40 CFR 60, Subpart KK (Published April 16, 1982).

[98] NESHAP for Lead Acid Battery Manufacturing Plants, 40 CFR 63 Subpart PPPPPP (Published July 16, 2007).

[99] Air10 CSR 10-6.075 Maximum Achievable Control Technology Regulations: Air Quality Standards, Definitions, Sampling, and Reference Methods and Air Pollution Control Regulations for the Entire State of Missouri (Published August 16, 1977). Page 91.

[100] California (South Coast Air Quality Management District), Rule 1420 - Emission Standards for Lead (Published September, 1992).

[101] Correspondence with Stephanie Doolan /EPA Region 7 in December, 2011 revealed that the Exide Facility in Salina, Kansas has adopted such additional control measures that control process lead emissions from stacks.

$450,000 to $500,000 based on replacing existing control devices or installing additional devices to increase control efficiency up to 99.9 percent.[102]

In addition, the EPA decision to not incorporate other control measures to control process emissions from stacks in recent standard development further suggests that there are no other control measures that are economically feasible. Specifically, citing the excessive costs, EPA decided that other control measures to control process emissions from stacks did not constitute GACT in the recent NESHAP for the Lead Acid Battery Manufacturing Source Category.[103]

A review of state rules from California and Missouri suggests that such control measures might be within economic reach. Such states were chosen for review because they both have lead acid battery manufacturing sources within the state. Missouri only incorporates the federal NESHAP into state law.[104] However, California's SCAQMD adopted a rule that might practically require such a control measure as it requires 98% efficiency for lead for facilities exceeding specific process and emission thresholds (i.e., processing more than 2 tons of lead per year with daily emissions of lead greater than or equal to 0.5lbs/day).[105]

5.4.3. Hot Asphalt Paving of Unpaved Roads, Chemical Stabilization of Unpaved Roads, and Vacuum Cleaning of Paved Roads to Control Fugitive Dust Lead Emissions.

A review of publicly available literature and correspondence with several EPA employees revealed limited adoption of control measures, like paving unpaved roads, chemically stabilizing unpaved roads, and vacuum cleaning of paved roads, to control fugitive dust emissions from lead acid battery facilities. Specifically, one lead acid battery manufacturing facility is paved on two sides, needs repair on one side, and the state in which the facility is located wants the facility to pave the unpaved side and repair the other side to control emissions.[106] Such limited adoption of such control measures suggests that such control measures do not constitute RACM.

Cost-effectiveness data for PM suggest that such control measures might be cost effective for controlling lead emissions as well. Specifically, such control measures have been shown to be cost effective, on average, for all facilities in all source categories for controlling PM, as shown in Table 5.5.[107] However, all of the facilities in the Lead Acid Battery Manufacturing source category are area sources, which suggests that the amount of emissions are much smaller than on average for all facilities.[108] Consequently, with lower emissions, the cost effectiveness for such control measures would decrease.

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[102] Memorandum – Lead Acid Battery Manufacturing Area Source Category Costing Information in Response to Comments on Proposed Rule, From Nancy Jones, EC/R, To Sharon Nizich, EPA/OAQPS/SPPD/MICG, June 12, 2007, Page 4.

[103] Introductory text to Lead Acid Battery Manufacturing Area Source NESHAP, 40 CFR 63, Subpart PPPPPP (Published July 16, 2007).

[104] Air10 CSR 10-6.075 Maximum Achievable Control Technology Regulations; Air Quality Standards, Definitions, Sampling, and Reference Methods and Air Pollution Control Regulations for the Entire State of Missouri (Published August 16, 1977). Page 91.

[105] California (South Coast Air Quality Management District), Rule 1420 - Emission Standards for Lead (Published September, 1992).

[106] Correspondence with Stephanie Doolan /EPA Region 7 in December, 2011, regarding the Exide Facility in Salina, Kansas.

[107] EPA CoST database.

[108] Memorandum – Lead Acid Battery Manufacturing Area Source Category Additional Information to Support Proposed Rule, From Nancy Jones, EC/R, To U.S. EPA Docket Number EPA-HQ-OAR-2006-0897, February 28, 2007.

Table 5-5. Cost-Effectiveness Information for Selected Control Measures for Controlling Particulate Matter with respect to the All Source Categories.

Control Measure	**Cost Effectiveness* ($/Ton of PM)**	**Control Efficiency (%)**
Vacuum Sweeping Paved Roads	400	50.0
Hot Asphalt Paving of Unpaved Roads	700	66.6
Chemical Stabilization of Unpaved Road	2600	37.5
* Rounded to the nearest $100 and escalated from 1999 to 2011 U.S. dollars.[109]		

No federal standards adopt such control measures. A review of state rules from California and Missouri suggests such control measures are reasonable. Such states were chosen for review because they both have secondary lead sources within the state. Missouri incorporates the federal NESHAP into state law, which does not require such control measures.[110] A California SCAQMD rule partially provides for such control measures by requiring sources to clean surfaces weekly that are subject to vehicular traffic.[111]

5.4.4. Other Control Measures for Controlling Fugitive Lead Emissions.

A review of state rules from California and Missouri suggests such control measures might be within economic reach, but there is a lack of support that such control measures are reasonably available. Such states were chosen for review because they both have secondary lead sources within the state (2 in each state). Missouri only incorporates the federal NESHAP into state law, which does not require such control measures.[112] However, a California SCAQMD rule requires several such control measures including requiring dust-forming material to be stored in an enclosure, washing/vacuuming surfaces accumulating lead-containing dust, etc.[113]

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[109] In order to escalate from 1999 dollars to 2011 dollars, used the formula and approach presented in EPA's Control Strategy Tool (CoST) Control Measures Database (CMDB) Documentation, Page 9.

[110] Air10 CSR 10-6.075 Maximum Achievable Control Technology Regulations; Air Quality Standards, Definitions, Sampling, and Reference Methods and Air Pollution Control Regulations for the Entire State of Missouri (Published August 16, 1977). Page 91.

[111] California (South Coast Air Quality Management District), Rule 1420 - Emission Standards for Lead (Published September, 1992).

[112] Air10 CSR 10-6.075 Maximum Achievable Control Technology Regulations; Air Quality Standards, Definitions, Sampling, and Reference Methods and Air Pollution Control Regulations for the Entire State of Missouri (Published August 16, 1977). Page 91.

[113] California (South Coast Air Quality Management District), Rule 1420 - Emission Standards for Lead (Published September, 1992).

6.0. RACM DEVELOPMENT FOR THE IRON AND STEEL FOUNDRIES SOURCE CATEGORY.

This section presents control measures to consider for RACM development for the Iron and Steel Foundries source category. Section 6.1 provides an overview of the Iron and Steel Foundries source category. Section 6.2 provides a summary of operations and lead emission points for iron and steel foundry facilities. Section 6.3 provides a summary of the control measures utilized at iron and steel foundries facilities, and Section 6.4 provides a more detailed application of the RACM criteria to each identified control measure.

6.1. Overview of Source Category.

The Iron and Steel Foundries source category is actually two source categories that are normally considered collectively due to the similarity in processes, emissions and controls. The Iron Foundries source category consists of plants engaged in producing final shape castings from grades of iron. The production steps related to the source category include raw materials handling, metal melting, mold/core production, and casting/finishing.[114] The corresponding NAICS Code for the Iron Foundries source category is 331511. The NAICS Description for facilities with such NAICS Code is "establishments primarily engaged in manufacturing iron castings and further manufacturing them into finished products that are further classified based on the specific finished product."[115]

The Steel Foundries category includes any facility engaged in producing final shape steel castings by the melting, alloying, and molding of pig iron and steel scrap. This source category also includes raw materials handling, metal melting, mold/core production, and casting/finishing.[116] The corresponding NAICS codes for the Steel Foundries source category are 331512 and 331513. The NAICS Descriptions for facilities with NAICS Codes of 331512 and 331513 are "establishments primarily engaged in manufacturing steel casings (except steel investment castings) and manufacturing steel investment castings and further manufacturing them into finished products" and "establishments primarily engaged in manufacturing steel investment castings and manufacturing steel castings and further manufacturing them into finished products," respectively.[117]

A 1992 census revealed that there were roughly 2800 iron and steel foundries in the United States at that time. Exactly 595 iron and steel foundries returned survey data from an EPA Information Collection Request in 2002, and roughly 100 of such sources are major sources, while the remaining are area sources.[118]

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[114] National Emissions Standards for Hazardous Air Pollutants (NESHAP) for Iron and Steel Foundries - Background Information for Proposed Standards. Document # EPA-HQ-OAR-2006-0359-0056-0002-1 (Published December 2002). Page 1-2.

[115] North American Industry Classification System Website.

[116] National Emissions Standards for Hazardous Air Pollutants (NESHAP) for Iron and Steel Foundries - Background Information for Proposed Standards. Document # EPA-HQ-OAR-2006-0359-0056-0002-1 (Published December 2002). Page 1-2.

[117] North American Industry Classification System Website.

[118] National Emissions Standards for Hazardous Air Pollutants (NESHAP) for Iron and Steel Foundries - Background Information for Proposed Standards. Document # EPA-HQ-OAR-2006-0359-0056-0002-1 (Published December 2002). Page 5-12.

6.2. Facility Operations and Lead Emission Points.

The operations and processes for iron and steel foundries include the following: (1) pattern making, (2) mold/core making, (3) scrap preparation, (4), metal melting, (5) pouring, cooling, and shakeout, (6) sand handling, (7) mechanical finishing, and (8) cleaning and coating.[119]

The first step in production of castings is making a pattern, which is a metal, wood, or plaster replica of a finishing casting, which can be used to create molds into which molten metal is poured. The next step in production of castings is preparing and melting metal, where typically recycled scrap metals are used as the source of metal. Such scrap metals typically undergo some type of preparation prior to melting such as sizing, cleaning, and drying. Then such scrap is "charged" to a furnace for melting, and the molten metal is poured from the furnace (i.e., tapped) into either a holding furnace or a transfer ladle, and then the molten metal is transported to the pouring location. Upon reaching the pouring area, the molten metal is poured into a mold. After it has solidified and cooled, it is separated from the mold, and the casting is transferred to a finishing and cleaning area. Specific finishing and cleaning operations will vary depending on the type of mold used to produce the casting and casting specifications. Finishing typically involves mechanical operations such as abrasive cleaning, torch cutoff, air-carbon arc cleaning, chipping, core knockout, and grinding. Cleaning usually involves the use of organic solvents to remove rust, oil, grease, and dirt from the surface of the casting. The casting may also be given a coating.[120]

Emissions points for lead are associated with the following operations: (1) scrap preparation, (2) metal melting, and (3) pouring, cooling, and shakeout. With respect to scrap preparation, the primary lead emissions come from preheaters, which are used to preheat the scrap for melting in the furnace. The control devices used to control lead emissions from preheaters are generally fabric filters.[121]

With respect to the metal melting process, the predominant types of furnaces used to melt metal include cupolas, which are used only at iron foundries; electric arc furnaces (EAF), which are used mainly at steel foundries; and electric induction furnaces (EIF), which are commonly used at both iron and steel foundries. For lead emissions from cupolas, such emissions arise primarily from the melting operations. The control devices used to control lead emissions from cupolas are generally fabric filters and also wet scrubbers (usually Venturi scrubbers).[122]

For lead emissions from electric furnaces, such furnaces do not have well-defined stacks like cupolas. Consequently, control systems for these furnaces must include hoods or other types of capture mechanisms ducted to the control device. Moreover, the charging, melting, and tapping phases of the melting cycle occur in sequence, not simultaneously as with cupolas. Consequently, it is more likely that the charging and melting emissions may be captured by different systems because the furnace is different for the two operations. The two exhaust streams may be ducted to separate control devices or to the same device. Depending on the capture systems used, tapping emissions may also be captured, usually incidentally because these emissions are relatively insignificant and no system dedicated to these emissions is normally used. The control devices used to control lead emissions from electric furnaces include fabric filters and wet scrubbers. Similar control devices are used for EAFs. Capture systems

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[119] Id. at 3-3.
[120] Id.
[121] Id.
[122] Id.

used for EAFs and EIFs include side draft hoods, direct evacuation control system, fume rings, close-fitting hoods, canopy hoods, total furnace enclosures, and building and bay evacuation.[123]

With respect to the pouring, cooling, and shakeout operations, lead emissions are primarily a problem in the shakeout process. Such emissions are usually controlled by fabric filters and cartridge filters, but wet scrubbers and other devices are also used.[124]

6.3. Identification and Summary of Possible RACM Candidates.

Table 6-2 provides a summary of control measures used in the Iron and Steel Foundries source category for which the RACM criteria are applied in section 6.4 and the relative likelihood that each control measure is a RACM. Specifically, each control measure is assigned a rating of 1 through 3; where the higher the number, the more likely that the control measure is a RACM. Such assigned values are explained in Table 6-1.

Table 6-1. General Meanings of Assigned RACM Ratings.

RACM Rating	**General Meaning of RACM Rating**
1	There is limited support for identifying the control measure as a RACM.
2	There is some support for identifying the control measure as a RACM; more than for a control measure with a RACM Rating of "1."
3	There is substantial support for identifying the control measure as a RACM.
U **(+ or -)**	A "U" indicates that the likelihood that the control measure constitutes a RACM is undetermined due to incomplete information. A corresponding "+" indicates that despite incomplete information, an application of RACM criteria would likely suggest that the control measure is a RACM, while a "-" indicates that despite incomplete information, an application of the RACM criteria would likely suggest that the control measure is not a RACM.

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[123] Id.

[124] Id.

Table 6-2. Iron and Steel Foundries Source Category - Summary of Known Control Measures and Relative Likelihood that each Control Measure is a RACM.

RACM Rating	Control Measure	Brief Reasoning for RACM Rating
1	Control devices (e.g., filters, cyclones, scrubbers) to control process lead emissions from preheaters during scrap preparation operations (e.g., loading, heating, and discharging).	1. Minority, albeit significant, adoption by sources. 2. Cost data suggest not cost effective. 3. Not identified as GACT for recent NESHAP. 4. Lack of adoption of such controls by state regulations. 5. California's SCAQMD adopted a rule practically requiring such a control measure, as it requires 98% efficiency for lead for facilities exceeding specific process and emission thresholds (i.e., processing more than 2 tons of lead per year with daily emissions of lead greater than or equal to 0.5lbs/day).
3	Control devices (e.g., filters, wet scrubbers, electrostatic precipitators) to control process lead emissions from cupolas during the melting operations at iron foundries.	1. Almost complete adoption by sources. 2. Cost data suggest cost effective for large and medium sources, but less cost effective for small sources. 3. Identified as GACT for larger area sources and MACT for major sources. 4. Many state regulations practically require such controls for cupolas. 5. California's SCAQMD adopted a rule practically requiring such a control measure, as it requires 98% efficiency for lead for facilities exceeding specific process and emission thresholds (i.e., processing more than 2 tons of lead per year with daily emissions of lead greater than or equal to 0.5lbs/day).
3	Control devices (e.g., filters and wet scrubbers) to control process lead emissions from electric arc furnaces (EAFs) during the melting operations.	1. Almost complete adoption by sources. 2. Cost data suggest cost effective for large and medium sources, but less cost effective for small sources. 3. Identified as GACT for larger area sources and MACT for major sources. 4. Many state regulations practically require such controls for EAFs. 5. California's SCAQMD adopted a rule practically requiring such a control measure, as it requires 98% efficiency for lead for facilities exceeding specific process and emission thresholds (i.e., processing more than 2 tons of lead per year with daily emissions of lead greater than or equal to 0.5lbs/day).
2.5	Control devices (e.g., filters and wet scrubbers) to control process lead emissions from electric induction furnaces (EIFs).	1. Minority, and less widespread, adoption by sources. 2. Cost effective for large foundries, but less cost effective for medium and small foundries. 3. Identified as GACT for larger area sources and MACT for major sources. 4. Some state regulations might practically require such controls for EIFs. 5. California's SCAQMD adopted a rule practically requiring such a control measure, as it requires 98% efficiency for lead for facilities exceeding specific process and emission thresholds (i.e., processing more than 2 tons of lead per year with daily emissions of lead greater than or

RACM Rating	Control Measure	Brief Reasoning for RACM Rating
		equal to 0.5lbs/day).
1	Control devices (e.g., filters) to control process lead emissions from the shakeout process.	1. Minority, albeit significant, adoption by sources. 2. Cost data suggest not cost effective. 3. Not identified as GACT for recent NESHAP. 4. Lack of adoption of such controls by state regulations.
U +	Improving currently installed control devices (e.g., filters and wet scrubbers) to more efficiently control process lead emissions (e.g., decreasing air to cloth ratio, increasing pressure differential, using horizontally hanging bags instead of vertically hanging bags).	1. Evidence suggests that such measures are more efficient, but there are limited cost data available.
2	Capture systems (e.g., side draft hoods, direct evacuation control systems, fume rings, close-fitting hoods, canopy hoods, total furnace enclosures, and building and bay evacuation) to control process fugitive lead emissions from EAFs during melting operations.	1. Majority use for at least some operations. 2. No cost data identified. 3. Identified as GACT for large area source foundries, but not for small foundries. 4. Many state regulations practically require such controls.
2	Capture systems (e.g., side draft hoods, direct evacuation control systems, fume rings, close-fitting hoods, canopy hoods, total furnace enclosures, and building and bay evacuation) to control process fugitive lead emissions from EIFs during melting operations.	1. Less widespread use compared to EAFs. 2. No cost data identified. 3. Identified as GACT for large area source foundries, but not for small foundries. 4. Many state regulations practically require such controls.
2.5	Pollution prevention measure of using scrap management practices and materials specifications to reduce lead content of scrap.	1. Extent of use not identified. 2. Cost data suggest cost effective. 3. Identified as GACT for both large and small area source foundries.
U +	Fugitive dust control measures.	1. Extent of use not identified. 2. No cost data identified. 3. A GACT emission limit exists, which prohibits foundries from discharging certain levels of fugitive emissions.

6.4. Application of RACM Criteria to Possible RACM Candidates.

6.4.1. Control devices (e.g., filters, cyclones, and scrubbers) to control process lead emissions from preheaters during scrap preparation operations (i.e., loading, heating, and discharging).

The common, but less than majority, use of control devices (e.g., filters, cyclones and scrubbers) for controlling process lead emissions from preheaters during scrap preparation operations suggests that such controls are somewhat economically feasible for larger foundries but less economically feasible for smaller foundries. For example, a majority of the total number of preheaters at iron and steel foundries are uncontrolled. Specifically, about 61 % of the total number of preheaters at iron foundries (68 of the 113 preheaters) and about 48% of iron foundries (76 of 157 iron foundries) use no controls to control process emissions from preheaters during all scrap preparation operations (i.e., loading, heating and discharging); [125] and about 78% of the total number of preheaters at steel foundries (7 of the 9 preheaters) and 90 % of the steel foundries (18 of the 20 steel foundries) use no controls to control process emissions from preheaters during scrap preparation operations (i.e., loading, heating and discharging).[126]

However there is a significant, albeit minority, use of such controls to control process emissions from preheaters at iron and steel foundries. Specifically, about 15% of the total number of preheaters at iron foundries (17 of the 113 preheaters) and about 15% of iron foundries (24/157 iron foundries) use filters to control process emissions from preheaters during all scrap preparation operations (i.e., loading, heating and discharging).[127] About 25% of the total number of preheaters at iron foundries (28 of 113 preheaters) and about 44% of iron foundries (50 of 113 iron foundries) use a control device (i.e., filter, scrubber, cyclone) to control process emissions from preheaters during some scrap preparation operations (i.e., loading, heating, discharging), but not all scrap preparation operations.[128] No steel foundries use filters to control process emissions from preheaters during all scrap preparation operations (i.e., loading, heating, and discharging).[129] One steel foundry uses a filter on one preheater to control process emissions from preheaters during scrap preparation for heating and discharging operations, but not for loading. One steel foundry uses a scrubber on one preheater to control process emissions during scrap preparation during discharging operations, but not for heating or loading.[130]

Available cost-effectiveness data suggest that such controls to control lead process emissions from preheaters is not cost effective. Specifically, EPA determined from an assessment of the impacts of meeting different candidate control options using three different model plants (small model plant with capacity of 500 TPY, medium model plant with capacity of 5,000 TPY, and large model plant with capacity of 50,000 TPY) that such controls were not reasonably cost effective for reducing emissions of PM and HAP metal compounds from sources for scrap preparation options (e.g., preheaters).[131] This suggests that using such controls to control lead emissions from preheaters is also not cost effective.

The recent NESHAP for Iron and Steel Foundries Area Sources (40 CFR 63, Subpart ZZZZZ) provides support that controls to control the process lead emissions from preheaters at foundries are not reasonably available.[132] Specifically, such standard does not require controls on preheaters. EPA's recent refusal to identify such controls as GACT suggests that such controls may not be RACM.

The current NESHAP for Iron and Steel Foundries Majors Sources (40 CFR 63, Subpart EEEEE) provides some support that controls to control the process lead emissions from preheaters at foundries are reasonably available. Specifically, such NESHAP requires that each scrap preheater at a new iron and steel foundry must not discharge emissions through a conveyance to the atmosphere that exceed either the of following limits for PM and total metal HAP: (1) 0.001 gr/dscf of PM, or (2) 0.0008 gr/dscf of total metal HAP; and requires that an existing iron and steel foundry must not discharge emissions

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[125] Id. at 4-8.
[126] Id.
[127] Id.
[128] Id.
[129] Id.
[130] Id.
[131] Memorandum – Impact Estimates for Area Source Iron and Steel Foundries. From Conrad Chin, EPA/SPPD. To EPA Docket Number EPA-HQ-OAR-2006-0359-0005-1. September 4. 2007. Page 4.
[132] NESHAP for Iron and Steel Foundries Area Sources, 40 CFR 63, Subpart ZZZZZ (Published April 22, 2004).

through a conveyance to the atmosphere that exceed either of the following limits for PM and total metal HAP: (1) 0.005 gr/dscf of PM, or (2) 0.0004 gr/dscf of total metal HAP.[133]

The lack of adoption of such controls in state regulations suggests that such controls are not highly reasonable for preheaters. Specifically, Table 6-3 lists state regulations from the six states with the highest foundry metal melting rates.[134] While one has a PM emission limit that applies to all foundry operations that might practically require implementation of such control measures on preheaters, no other of such states have such PM limits.

California's SCAQMD Rule 1420 requires a control efficiency of 98% for all operations.[135] Consequently, this requirement would apply to control devices to control process lead emissions from preheaters during scrap preparation operations (i.e., loading, heating, and discharging). Notwithstanding, this requirement only applies to facilities processing more than 2 tons of lead per year with daily emissions of lead greater than or equal to 0.5lbs/day.

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[133] Id.

[134] National Emissions Standards for Hazardous Air Pollutants (NESHAP) for Iron and Steel Foundries - Background Information for Proposed Standards. Document # EPA-HQ-OAR-2006-0359-0056-0002-1 (Published December 2002). Page 4-49.

[135] California (South Coast Air Quality Management District). Rule 1420 - Emission Standards for Lead (Published September, 1992).

Table 6-3. State Regulations from the Six States with the Highest Foundry Metal Melting Rates that Practically Require Implementation of Lead Control Measures.

	Melting Furnace – Cupolas (gr PM/dscf)	Melting Furnace – EAFs (gr Lead/dscf)	Melting Furnace – EIFs (gr Lead/dscf)	All Foundry Operations (gr PM/dscf)	Opacity Limit for Buildings that House Process Equipment[136]
Michigan	Existing cupolas: 0.2 (where melting capacity <10 tons/hour) to 0.08 (where melting capacity > 20 tons/hour). New cupolas: emission factor limits.	0.05	None	None	Opacity emission limits were found for five states, which generally apply to general roof vents that may contain fugitive emissions from various sources throughout the foundry. Four of the five states (Alabama, Wisconsin, Michigan, and Ohio) have 20 % opacity limits, while one state (Indiana) has a 30% to 40% opacity limit, depending on the location of the source.
Wisconsin	0.24	0.05	0.05		
Indiana	0.15	None	None	Cannot discharge any gases > 0.07	
Ohio	Based on process rate capacity of a generic PM emission source – vary widely.	Based on process rate capacity of a generic PM emission source – vary widely.	Based on process rate capacity of a generic PM emission source – vary widely.	None	
Illinois	Based on process weight rates – vary widely.	Based on process weight rates – vary widely.	Based on process weight rates – vary widely.	None	
Alabama	Based on process weight rates – vary widely	Based on process weight rates – vary widely	Based on process weight rates – vary widely	None	

6.4.2. Control devices (e.g., filters, wet scrubbers, electrostatic precipitators) to control process lead emissions from cupolas during the melting operations at iron foundries.

The almost complete adoption of control devices (e.g., filters, scrubbers, and electrostatic precipitators) for controlling process lead emissions from cupola furnaces during melting operations (i.e., charging, melting, tapping) at iron foundries suggests that such controls are economically feasible. Specifically, about 44% of foundries (48/110) and about 43% (62/143) of the total number of cupolas at iron foundries use a filter to control process emissions from cupolas during melting operations (charging, melting, and tapping). About 48% of foundries (53/110) and 50% of cupolas (71/143) at such foundries

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[136] EPA examined such limits and determined that almost all States apply an opacity limit for buildings that house the process equipment. EPA determined that fugitive emissions from such equipment are effectively regulated by such opacity limits. NESHAP for Iron and Steel Foundries –Background Information for Promulgated Standards. EPA Document # EPA-HQ-OAR-2002-0034-0144 (Published August 2003). Page 109.

use wet scrubbers to control process emissions from cupolas during melting operations. Exactly 1/110 foundries and 1/143 cupolas at such foundries use electrostatic precipitator to control process emission from cupolas during melting (i.e., charging, melting, and tapping). Only about 7% (8/110) of foundries and about 6% (9/143) of the cupolas at such foundries did not use any control.[137]

Available cost-effectiveness data suggest that such controls to control lead process emissions from cupolas is generally cost effective. EPA determined from an assessment of the impacts of meeting different candidate control options using three different model plants (small model plant with capacity of 500 TPY, medium model plant with capacity of 5,000 TPY, and large model plant with capacity of 50,000 TPY) that add-on controls, such as filters (and cyclones or scrubbers) are reasonably cost effective for reducing emissions of PM and HAP metal compounds from medium and large sources for melting operations on furnaces, but less cost effective for smaller foundries.[138] Specifically, the model plant analysis also indicated that add-on controls for metal melting furnaces are much less cost effective for the small model plant than for the large model plant (costs exceeded $60,000/ton of PM removed for the 500 TPY model plant versus $3,000/ton of PM removed or less for the 50,000 TPY model plant). EPA further noted that the cost effectiveness for add-on controls for the medium model plants appeared to be reasonable for cupolas.[139] This suggests that using such controls to control lead from cupolas is cost effective, especially for medium and large plants.

The current NESHAP for Iron and Steel Foundries Area Sources (40 CFR 63, Subpart ZZZZZ) suggests that such controls are reasonably available. Specifically, such NESHAP requires that large foundries (existing source with annual metal melt production > 20,000 tons or new source with an annual metal melt capacity > 10,000 tons), but not small foundries (existing source with annual melt production of ≤ 20,000 tons or less or new source with an annual metal melt capacity of ≤ 10,000 tons or less) must not discharge to the atmosphere emissions from any metal melting furnace or group of all metal melting furnaces that exceed the applicable limits: (1) for an existing iron and steel foundry, 0.8 pounds of PM per ton of metal charged or 0.06 pounds of total metal HAP per ton of metal charged and (2) for a new iron and steel foundry, 0.1 pounds of PM per ton of metal charged or 0.008 pounds of total metal HAP per ton of metal charged.[140] The fact that EPA recently decided that such controls are GACT for some area sources suggests that such controls are RACM.

Moreover, such controls are required by the NESHAP for Iron and Steel Foundries Major Sources (40 CFR 63, Subpart EEEEE) for both new and existing sources. This provides support that such controls are RACM, since such controls represent MACT standards that are 7 years old.[141]

The fact that many state regulations practically require such controls for cupolas suggests that such controls are reasonable. Specifically, Table 6-3 lists state regulations from the six states with the highest foundry metal melting rates.[142] All states require PM emission limits that might practically require implementation of such control measures on cupolas.

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[137] National Emissions Standards for Hazardous Air Pollutants (NESHAP) for Iron and Steel Foundries - Background Information for Proposed Standards. Document # EPA-HQ-OAR-2006-0359-0056-0002-1 (Published December 2002). Page 4-11.

[138] Memorandum – Impact Estimates for Area Source Iron and Steel Foundries. From Conrad Chin, EPA/SPPD. To EPA Docket Number EPA-HQ-OAR-2006-0359-0005-1. September 4, 2007. Page 4.

[139] Id. at 4.

[140] NESHAP for Iron and Steel Foundries Area Sources. 40 CFR 63. Subpart ZZZZZ (Published April 22, 2004).

[141] Id.

[142] National Emissions Standards for Hazardous Air Pollutants (NESHAP) for Iron and Steel Foundries - Background Information for Proposed Standards. Document # EPA-HQ-OAR-2006-0359-0056-0002-1 (Published December 2002). Page

California's SCAQMD Rule 1420 requires a control efficiency of 98% for all operations.[143] Consequently, this requirement would apply to control devices to control process lead emissions from cupolas during the melting operations at iron foundries. Notwithstanding, this requirement only applies to facilities processing more than 2 tons of lead per year with daily emissions of lead greater than or equal to 0.5lbs/day.

6.4.3. Control devices to control process emissions from EAFs during the melting operations at iron and steel foundries.

The almost complete adoption of control devices (mostly filters) for controlling emissions from EAFs during melting operations (i.e., charging, melting, tapping) at iron and steel foundries suggests that such controls are economically feasible. Specifically, there were no uncontrolled EAFs at iron foundries. One hundred percent of the total number of EAFs at iron foundries (28 of the 28) and one hundred percent of iron foundries (11 of 11) use controls (mostly filters) to control process emissions from EAFs during at least some melting operations (i.e., charging, melting or tapping).[144]

Moreover, only about 2% (3/136) of the total number of EAFs at steel foundries and about 2% (3/71) of the total number of steel foundries are uncontrolled.[145] About 73% (99/135) of the total number of EAFs at steel foundries and about 70% (50/71) of steel foundries used filters to control emissions from EAFs during some melting operations (i.e., charging, melting, tapping) at steel foundries.[146] About 24% (33/135) of the total number of EAFs at steel foundries and about 30% (21/71) foundries used filters to control emissions from EAFs during the melting operations (i.e., charging, melting, and tapping) at steel foundries.[147]

Available cost-effectiveness data suggest that such controls to control EAFs are cost effective. EPA determined from an assessment of the impacts of meeting different candidate control options using three different model plants (small model plant with capacity of 500 TPY, medium model plant with capacity of 5,000 TPY, and large model plant with capacity of 50,000 TPY) that add-on controls, such as filters (and cyclones or scrubbers) are reasonably cost effective for reducing emissions of PM and HAP metal compounds from medium and large sources for melting operations on furnaces, but less cost effective for smaller foundries.[148] Specifically, the model plant analysis also indicated that add-on controls for metal melting furnaces are much less cost effective for the small model plant than for the large model plant (costs exceeded $60,000/ton of PM removed for the 500 TPY model plant versus $3,000/ton of PM removed or less for the 50,000 TPY model plant). EPA further noted that the cost effectiveness for add-on controls for the medium model plants appeared to be reasonable for EAFs.

The current NESHAP for Iron and Steel Foundries Area Sources (40 CFR 63, Subpart ZZZZZ) suggests that such controls are reasonably available. Specifically, such NESHAP requires that large foundries

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4-49.

[143] California (South Coast Air Quality Management District), Rule 1420 - Emission Standards for Lead (Published September, 1992).

[144] National Emissions Standards for Hazardous Air Pollutants (NESHAP) for Iron and Steel Foundries - Background Information for Proposed Standards. Document # EPA-HQ-OAR-2006-0359-0056-0002-1 (Published December 2002). Page 4-27.

[145] Id. at 4-27.

[146] Id.

[147] Id.

[148] Memorandum – Impact Estimates for Area Source Iron and Steel Foundries, From Conrad Chin, EPA/SPPD, To EPA Docket Number EPA-HQ-OAR-2006-0359-0005-1, September 4, 2007. Page 4.

(existing source with annual metal melt production > 20,000 tons or new source with an annual metal melt capacity > 10,000 tons), but not small foundries (existing source with annual melt production of ≤ 20,000 tons or less or new source with an annual metal melt capacity of ≤ 10,000 tons or less) must not discharge to the atmosphere emissions from any metal melting furnace or group of all metal melting furnaces that exceed the applicable limits: (1) for an existing iron and steel foundry, 0.8 pounds of PM per ton of metal charged or 0.06 pounds of total metal HAP per ton of metal charged and (2) for a new iron and steel foundry, 0.1 pounds of PM per ton of metal charged or 0.008 pounds of total metal HAP per ton of metal charged.[149] The fact that EPA recently decided that such controls are GACT for some area sources suggests that such controls are RACM.

Moreover, such controls are required by the NESHAP for Iron and Steel Foundries Major Sources (40 CFR 63, Subpart EEEEE) for both new and existing sources. This further provides support that such controls are RACM, since such controls represent MACT standards that are 7 years old.[150]

The fact that many state regulations practically require such controls for EAFs suggests that such controls are reasonable. Specifically, Table 6-3 lists state regulations from the six states with the highest foundry metal melting rates.[151] Five of the six states require PM emission limits that might practically require implementation of such control measures on EAFs.

California's SCAQMD Rule 1420 requires a control efficiency of 98% for all operations.[152] Consequently, this requirement would apply to control devices to control process emissions from EAFs during the melting operations at iron and steel foundries. Notwithstanding, this requirement only applies to facilities processing more than 2 tons of lead per year with daily emissions of lead greater than or equal to 0.5lbs/day.

6.4.4. Control devices (e.g., filters, wet scrubbers, and cyclones) used to control the process emissions from EIFs during the melting operations at iron and steel foundries.

The less widespread adoption of control devices used to control the process emissions from EIFs during the melting operations at iron and steel foundries suggests that such controls are less economically feasible for EIFs than for EAFs or cupolas. For example, most iron foundries do not control EIFs with a control device. Specifically, about 58% (438 of the 754) of the total number of EIFs at iron foundries and about 64% (181 of 286) of iron foundries (64%) use no controls to control process emissions from EIFs during melting (i.e., charging, melting, tapping). Only about 28% (210 of the 754) of the total number of EIFs at iron foundries and about 24% (69 of 286) of iron foundries use filters to control process emissions from EIF during melting (i.e., charging, melting, tapping). About 12 % (88 of the 754) of the total number of EIFs at iron foundries and about 10% (30 of 286) of iron foundries (10%) use filters to control process emissions from EIF during some melting operations (charging, melting, tapping) but not all.[153] About 2% (17 of 754) of the total number of EIFs at iron foundries and about 2% (6 of 286) of iron foundries use wet scrubbers to control process emissions from EIF during some melting (i.e., charging, melting, tapping) but not all. Less than 1% (2 of 754) of the total number of EIFs

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[149] NESHAP for Iron and Steel Foundries Area Sources, 40 CFR 63, Subpart ZZZZZ (Published April 22, 2004).

[150] NESHAP for Iron and Steel Foundries Major Sources, 40 CFR 63, Subpart EEEEE (Published April 22, 2004).

[151] National Emissions Standards for Hazardous Air Pollutants (NESHAP) for Iron and Steel Foundries - Background Information for Proposed Standards, Document # EPA-HQ-OAR-2006-0359-0056-0002-1 (Published December 2002), Page 4-49.

[152] California (South Coast Air Quality Management District), Rule 1420 - Emission Standards for Lead (Published September, 1992).

[153] Id. at 4-21 through 4-22.

at iron foundries and less than 1% (2 of 286) of the iron foundries use cyclones to control process emissions from EIFs during some melting operations (i.e., charging, melting, and tapping) but not all.[154]

Most steel foundries also do not control EIFs with a control device. Specifically, about 79% (509 of the 643) of the total number of EIFs at steel foundries and about 77% (144 of 186) of steel foundries use no controls to control process emissions from EIFs during melting (i.e., charging, melting, tapping).[155] About 13% (81 of the 643) of the total number of EIFs at steel foundries, and about 12% (23 of 186) of steel foundries use filters to control process emissions from EIFs during melting (i.e., charging, melting, tapping).[156] About 5% (34 of the 643) of the total number of EIFs at steel foundries, and about 7% of (13 of 186) steel foundries use filters to control process emissions from EIFs during some melting (i.e., charging, melting or tapping).[157] Less than 1% (6 of the 643) of the total number of EIFs at steel foundries, and about 1% (2 of 186) of steel foundries use wet scrubbers to control process emissions from EIFs during some melting (charging, melting or tapping).[158] Less than 1 % (6 of the 643) of the total number of EIFs at steel foundries, and about 1% (2 of 186) of steel foundries, use cyclones to control process emissions from EIFs during some melting (i.e., charging, melting or tapping).[159]

Available cost-effectiveness data suggest that such controls to control for lead process emissions from EIFs are less cost effective than for cupolas and EAFs. EPA determined from an assessment of the impacts of meeting different candidate control options using three different model plants (small model plant with capacity of 500 TPY, medium model plant with capacity of 5,000 TPY, and large model plant with capacity of 50,000 TPY) that add-on controls, such as filters (and cyclones or scrubbers) are reasonably cost effective for reducing emissions of PM and HAP metal compounds from sources for melting operations on furnace, but less cost effective for smaller foundries. Specifically, the model plant analysis also indicated that add-on controls for metal melting furnaces are much less cost effective for the small model plant than for the large model plant (costs exceeded $60,000/ton of PM removed for the 500 TPY model plant versus $3,000/ton of PM removed or less for the 50,000 TPY model plant). EPA further noted that the cost effectiveness for add-on controls for the medium model plants appeared to be reasonable for cupolas and EAFs, but were less reasonable for EIFs due to the lower emissions from uncontrolled EIFs as compared to cupolas and EAFs.[160]

The current NESHAP for Iron and Steel Foundries Area Sources (40 CFR 63, Subpart ZZZZZ) suggests that such controls are reasonably available. Specifically, such NESHAP requires that large foundries (existing source with annual metal melt production > 20,000 tons or new source with an annual metal melt capacity > 10,000 tons), but not small foundries (existing source with annual melt production of ≤ 20,000 tons or less or new source with an annual metal melt capacity of ≤ 10,000 tons or less) must not discharge to the atmosphere emissions from any metal melting furnace or group of all metal melting furnaces that exceed the applicable limits: (1) for an existing iron and steel foundry, 0.8 pounds of PM per ton of metal charged or 0.06 pounds of total metal HAP per ton of metal charged and (2) for a new iron and steel foundry, 0.1 pounds of PM per ton of metal charged or 0.008 pounds of total metal HAP

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[154] National Emissions Standards for Hazardous Air Pollutants (NESHAP) for Iron and Steel Foundries - Background Information for Proposed Standards. Document # EPA-HQ-OAR-2006-0359-0056-0002-1 (Published December 2002). Page 4-22.
[155] Id. at 4-23.
[156] Id. at 4-23.
[157] Id.
[158] Id.
[159] Id.
[160] Memorandum – Impact Estimates for Area Source Iron and Steel Foundries. From Conrad Chin. EPA/SPPD. To EPA Docket Number EPA-HQ-OAR-2006-0359-0005-1. September 4. 2007. Page 4.

per ton of metal charged.[161] The fact that EPA has recently decided that such controls are GACT for some area sources provides some support that such controls are reasonably available.

Moreover, such controls are required by the NESHAP for Iron and Steel Foundries Major Sources (40 CFR 63, Subpart EEEEE) for both new and existing sources. This further provides support that such controls are RACM, since such controls represent MACT standards that are 7 years old.[162]

The fact that some state regulations practically require such controls for EIFs might suggest that such controls are reasonable. Specifically, Table 6-3 lists state regulations from the six states with the highest foundry metal melting rates.[163] Four of the six states require PM emission limits that might practically require implementation of such control measures for EIFs.

California's SCAQMD Rule 1420 requires a control efficiency of 98% for all operations.[164] Consequently, this requirement would apply to control devices used to control the process emissions from EIFs during the melting operations at iron and steel foundries. Notwithstanding, this requirement only applies to facilities processing more than 2 tons of lead per year with daily emissions of lead greater than or equal to 0.5lbs/day.

6.4.5. Control devices (e.g., filters, wet scrubbers) to control the process emissions from the shakeout process.

The less widespread adoption of control devices used to control the process emissions from shakeout processes at iron and steel foundries suggests that such controls are less economically feasible for shakeout stations than for melting operations. For example, about 33% (384 of the 1156) of shakeout stations and about 40% (225 of 569) of foundries use no controls to control process emissions from shakeout stations.[165] Meanwhile, about 53% (602 of the 1156) of shakeout stations and about 63% (360 of the 569) foundries use filters to control process emissions from shakeout stations.[166] About 14% (161 of the 1156) of shakeout stations and 14% (79 of the 569) of foundries use wet scrubbers to control process emissions from shakeout stations. Less than 1% (9 of the 1156) of shakeout stations and less than 2% (7 of the 569) of foundries use other control devices (cyclones) to control process emissions from shakeout stations.

Available cost-effectiveness data suggest that such controls to control preheaters are not cost effective. Specifically, EPA determined from an assessment of the impacts of meeting different candidate control options using three different model plants (small model plant with capacity of 500 TPY, medium model plant with capacity of 5,000 TPY, and large model plant with capacity of 50,000 TPY) that add-on controls, such as filters (and cyclones or scrubbers) were not cost effective for reducing emissions of PM and HAP metal compounds from sources for shakeout processes.[167] This suggests that using such controls for controlling lead is also not cost effective.

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[161] NESHAP for Iron and Steel Foundries Area Sources, 40 CFR 63, Subpart ZZZZZ (Published April 22, 2004).

[162] NESHAP for Iron and Steel Foundries Major Sources, 40 CFR 63, Subpart EEEEE (Published April 22, 2004).

[163] National Emissions Standards for Hazardous Air Pollutants (NESHAP) for Iron and Steel Foundries - Background Information for Proposed Standards. Document # EPA-HQ-OAR-2006-0359-0056-0002-1 (Published December 2002). Page 4-49.

[164] California (South Coast Air Quality Management District). Rule 1420 - Emission Standards for Lead (Published September, 1992).

[165] Id. at 4-41

[166] Id.

[167] Memorandum – Impact Estimates for Area Source Iron and Steel Foundries, From Conrad Chin, EPA/SPPD, To EPA

Moreover, such controls are required by the NESHAP for Iron and Steel Foundries Major Sources (40 CFR 63, Subpart EEEEE) for both new and existing sources. This further provides support that such controls are RACM, since such controls represent MACT standards that are 7 years old.[168]

The lack of adoption of such controls in state regulations suggests that such controls are not highly reasonable for the shakeout process. Specifically, Table 6-3 lists state regulations from the six states with the highest foundry metal melting rates.[169] While one has a PM emission limit that applies to all foundry operations that might practically require implementation of such control measures for the shakeout process, no other of such states have such PM limits.

6.4.6. Improving current control devices used to control the process emissions from iron and steel foundries.

Several measures could possibly improve the efficiency of controls that control process lead emissions from iron and steel foundries. Such measures include increasing the pressure differential of Venturi scrubbers, increasing the air-to-cloth ratio of fabric filters, and using horizontally hanging instead of vertically hanging bags for fabric filters.

For example, pressure differential is a key factor affecting the efficiency of a scrubber in removing PM, and similarly, lead. As a rule of thumb, a high-efficiency scrubber is one with a pressure differential greater than 50 inches of water column.[170] The pressure differential at Venturi scrubbers used on cupolas is in Table 6-4.[171] Many of the pressure differentials are less than 50 inches of water column. Such pressure differentials might be increased to increase the efficiency of such controls.

Table 6-4. Pressure Differentials of Venturi Scrubbers used on Cupola Furnaces at Iron Foundries

Pressure differential, inches of water column	Number of Scrubbers
≤ 8	9
20 to 29	5
30 to 39	14
40 to 49	11
50 to 59	9
60 to 70	7

Similarly, the air-to-cloth ratio, which is the major design factor that affects the efficiency of fabric filters, might be decreased to increase the efficiency of fabric filters.

A more uncertain method of increasing the efficiency of fabric filters is to use horizontally hanging instead of vertically hanging bags. Specifically, two sources have implemented horizontally hanging bags rather than the traditional vertically hanging bags, and allege that such horizontally hanging bags are cheaper and more efficient. According to an operator of one of these novel fabric filters, a lighter

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Docket Number EPA-HQ-OAR-2006-0359-0005-1. September 4, 2007. Page 4.

[168] NESHAP for Iron and Steel Foundries Major Sources. 40 CFR 63. Subpart EEEEE (Published April 22, 2004).

[169] National Emissions Standards for Hazardous Air Pollutants (NESHAP) for Iron and Steel Foundries - Background Information for Proposed Standards. Document # EPA-HQ-OAR-2006-0359-0056-0002-1 (Published December 2002). Page 4-49.

[170] Id. at 4-12.

[171] National Emissions Standards for Hazardous Air Pollutants (NESHAP) for Iron and Steel Foundries - Background Information for Proposed Standards. Document # EPA-HQ-OAR-2006-0359-0056-0002-1 (Published December 2002). Page 4-16.

weight fabric can be used when the bags are horizontally supported. When bags hang vertically, the tops of the bags must be strong enough to hold up the weight of the entire bag, and the entire filter cake on that bag. A light-weight bag would not be able to support the weight, and would tear. By having the bags supported horizontally, they are able to reduce the weight that the bag material supports to only the small amount under the horizontal support. The light-weight bag is easier to clean and is more permeable, which allows for a more even distribution of the air flow. Heavier-weight bags tend to get more material caught in the bag material, and as a result need to be cleaned more frequently and more vigorously. One source indicated that, "since 80% of emissions are associated with cleaning," by lowering the cleaning frequency, the fabric filter emissions are lowered. The light-weight bag is also more permeable, so that pressure drop is reduced, and air flow is more evenly distributed. This, along with the low air-to-cloth ratio for these fabric filters, allows more of the PM material, and associated lead, to be collected on the bag surface, rather than becoming impregnated into the fabric, making it easier to clean the bags.[172]

6.4.7. Capture systems used for EAFs and EIFs including side draft hoods, direct evacuation control systems, fume rings, close-fitting hoods, canopy hoods, total furnace enclosures, and building and bay evacuation.

Capture systems consist of two general types: close capture and general capture. Close-capture systems, which are more effective, use techniques such as side draft hoods, direct evacuation systems, fume rings, and close-fitting hoods that capture emissions before they escape from the immediate vicinity of the furnace. These systems require only a small volume of air flow, which is drawn through attached ductwork to a control device that can be dedicated to specific operations. General-capture systems employ canopy hoods or total enclosures, both of which can be used with dedicated control devices but require a higher volume of air flow than close-capture systems, or building or bay evacuation systems, which also require large volumes of air and must serve the entire building or a large segment of it.[173]

Tables 6-5 and 6-6 show the extent of adoption of capture systems to control fugitive process emissions from control devices attached to EIFs and EAFs at foundries, respectfully.[174] Such tables demonstrate that capture devices are much more widely adopted for use on EAFs than EIFs. Moreover, for both EIFs and EAFs, close-captures are more generally adopted than other types of capture devices.[175]

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[172] Id. at 4-15 through 4.16.

[173] Id. at 4-30.

[174] In the following tables, close capture includes side draft hood, fume ring, close-fitting hood, and direct evacuation. Others include canopy hood, draft system or ventilation to a fabric filter, area ducting, section tube, and building evacuation to a fabric filter. No capture includes not reported, roof vent, exhaust fan, lid or cover, or general ventilation.

[175] Id. at 4-31.

Table 6-5. Use of Capture Systems on EIFs at Iron and Steel Foundries.

Capture system type	Melting furnace operation serviced		
	Charging	Melting	Tapping
Close Capture			
Number of furnaces	211	261	160
Number of foundries	66	78	53
Other Type			
Number of furnaces	185	200	169
Number of foundries	69	84	63
No Capture			
Number of furnaces	1001	936	1068
Number of foundries	334	315	353
Total number furnaces: 1397		**Total number foundries: 445**	

Table 6-6. Use of Capture Systems on EAFs at Iron and Steel Foundries.

Capture system type	Melting furnace operation serviced		
	Charging	Melting	Tapping
Close Capture			
Number of furnaces	32	120	33
Number of foundries	20	62	19
Other Type			
Number of furnaces	41	26	17
Number of foundries	18	9	11
No Capture			
Number of furnaces	92	17	113
Number of foundries	46	10	52
Total number furnaces: 168		**Total number foundries: 81**	

The NESHAP for Iron and Steel Foundries Area Sources (40 CFR 63, Subpart ZZZZZ) suggests that such controls are reasonably available. Specifically, such NESHAP requires that large foundries (existing source with annual metal melt production > 20,000 tons or new source with an annual metal melt capacity > 10,000 tons), but not small foundries (existing source with annual melt production of ≤ 20,000 tons or less or new source with an annual metal melt capacity of ≤ 10000 tons or less) must operate a capture and collection system for each metal melting furnace at a new or existing iron and steel foundry where each capture and collection system must meet accepted engineering standards.[176] The fact that EPA has recently decided that such controls are generally available for some area sources provides support that such controls are reasonably available.

The fact that many state regulations practically require such controls for EIFs suggests that such controls might be reasonable. Specifically, Table 6-3 lists state regulations from the six states with the highest foundry metal melting rates.[177] Five of the six states require opacity limits resulting from fugitive process emissions, and therefore might practically require implementation of such control measures to control fugitive process lead emissions.

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[176] NESHAP for Iron and Steel Foundries Area Sources. 40 CFR 63. Subpart ZZZZZ (Published April 22. 2004).

[177] National Emissions Standards for Hazardous Air Pollutants (NESHAP) for Iron and Steel Foundries - Background Information for Proposed Standards. Document # EPA-HQ-OAR-2006-0359-0056-0002-1 (Published December 2002). Page 4-49.

6.4.8. Pollution prevention measure of using scrap management practices and materials specifications to reduce HAP content of scrap.

EPA conducted an assessment of the impacts of meeting different candidate control options using three different model plants (small model plant with capacity of 500 TPY, medium model plant with capacity of 5,000 TPY, and large model plant with capacity of 50,000 TPY). One such control option was use of scrap management practices to reduce HAP content of scrap.[178] EPA decided such measure was cost effective enough to include as GACT for small and large area sources. Moreover, the source must prepare and operate at all times according to written material that (1) provides for the purchase and use of only iron and steel scrap that has been depleted (to the extent practicable) of HAP metals in the charge materials used by the iron and steel foundry; (2) provides for metallic scrap materials charged to a scrap preheater or metal melting furnace to be depleted (to the extent practicable) of the presence of accessible lead-containing components (such as batteries and wheel weights), except that for scrap charged to a cupola metal melting furnace that is equipped with an afterburner, specifications for metallic scrap materials to be depleted (to the extent practicable) of the presence of chlorinated plastics and accessible lead-containing components (such as batteries and wheel weights), and (3) must provide specifications of a program to ensure the scrap materials are drained of free liquids.[179]

6.4.9. Other control measures for controlling fugitive process and dust emissions.

The NESHAP for Iron and Steel Foundries Area Sources (40 CFR 63, Subpart ZZZZZ) prohibits discharging to the atmosphere fugitive emissions from foundry operations that exhibit a certain opacity limit. This suggests that there might be other fugitive control measures that might be reasonably available since EPA decided such a limit was generally available.

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[178] NESHAP for Iron and Steel Foundries Area Sources, 40 CFR 63, Subpart ZZZZZ (Published April 22, 2004).

[179] Memorandum – Impact Estimates for Area Source Iron and Steel Foundries, From Conrad Chin, EPA/SPPD, To EPA Docket Number EPA-HQ-OAR-2006-0359-0005-1, September 4, 2007, Page 4.

7.0. RACM DEVELOPMENT FOR THE INTEGRATED IRON AND STEEL MILLS SOURCE CATEGORY.

This section presents control measures to consider for RACM development for the Iron and Steel Mills source category. Section 7.1 provides an overview of the Iron and Steel Mills source category. Section 7.2 provides a summary of operations and lead emission points for iron and steel mill facilities. Section 7.3 provides a summary of the control measures utilized at iron and steel mill facilities, and Section 7.4 provides a more detailed application of the RACM criteria to each identified control measure.

7.1. Overview of Source Category.

The Iron and Steel Mills source category includes plants engaged in producing steel. A fully integrated facility produces steel from raw materials of coal, iron ore, and scrap; whereas non-integrated plants do not have all of the equipment to produce steel from coal, iron ore, and scrap on-site.[180] The corresponding NAICS Code for the Integrated Iron and Steel Mills source category is 331111. The NAICS Description for facilities with such NAICS Code is "establishments primarily engaged in one or more of the following: direct reduction of iron ore, manufacturing pig iron in molten or solid form, converting pig iron into steel, making steel, making steel and manufacturing shapes, and making steel and forming tube and pipe.[181]

As of 2001, there are roughly twenty integrated iron and steel mills in the United States. The highest geographic concentration of mills is in the Great Lakes Region. Large, fully-integrated iron and steel mills have declined considerably in the fifteen year time period before 2001. For example, of the iron and steel mills that were open during such fifteen year period and still open in 2001, such plants experienced a 61 percent reduction in the number of production employees over the 15 year period.[182]

7.2. Facility Operations and Lead Emission Points.

Integrated iron and steel mills engage in processes that include the following process units: (1) sinter production, (2) iron production (hot metal desulfurization), (3) steel production, (4) semi-finished product preparation, (6) finished product preparation, and (7) handling and treatment of raw, intermediate, and waste materials. The iron production process includes the production of iron in blast furnaces by reduction. The steel production process includes basic oxygen process furnaces (BOPF).

The discussion of emission points for lead will be discussed by the following three categories: sinter plants, blast furnaces, and BOPF shops.[183] Sintering is a process that recovers the raw material value of waste materials generated at iron and steel plants that would otherwise be landfilled or stockpiled. An important function of the sinter plant is to return waste iron-bearing materials to the blast furnace to produce iron and to also provide part or all of the flux material for the iron-making process.[184]
The sinter plant windbox serves as the capture system for the sintering machine and is the most critical source of emissions in the sinter plant. After the sinter materials are mixed, they are ignited on the

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[180] National Emission Standards for Hazardous Air Pollutants (NESHAP) for Integrated Iron and Steel Plants – Background Information for Proposed Standards, EPA-453/R-01-005 (Published January 2001), Page 2-1.

[181] The North American Industry Classification System Website.

[182] National Emission Standards for Hazardous Air Pollutants (NESHAP) for Integrated Iron and Steel Plants – Background Information for Proposed Standards, EPA-453/R-01-005 (Published January 2001), Page 2-3.

[183] Id. at 1-2.

[184] Id. at 3-1.

surface by gas burners, and as the materials move through the sinter bed, air is pulled down through the mixture to burn the fuel by downdraft combustions through a series of windboxes, and evacuated to a control device. The control devices used to control lead emissions from windboxes are fabric filters and wet scrubbers.[185]

The sinter plant emission points on the discharge end include sinter discharge, crusher, hot screen, sinter cooler, and cold screen. Such emissions points are generally hooded individually with an enclosed hood or a suspended hood and evacuated to one or more control devices. Possible control devices include fabric filters and water sprays at various transfer points. Possible controls for storage areas include chemical dust suppression.[186]

Casthouse emissions from molten iron and slag occur primarily at the tape hole of the blast furnace in the iron trough immediately adjacent to it. Emissions also result from the runner that transports the iron and slag and from the ladle that receives the molten iron. The capture and control systems in place for such emissions include a combination of flame suppression and covered runners, and also evacuation of such emissions to a control device, most commonly a fabric filter (which requires total enclosures of the casthouse) and scrubbers.[187]

The BOPH primary emissions refer to those emissions leaving the mouth of the furnace vessel during the oxygen blow that are captured by the primary hood. The associated controls for BOPH depend on whether the BOPH is associated with an open-hood design or a closed-hood design. Open-hood BOPF shops are controlled with scrubbers and ESP. Closed-hood designs are controlled with Venturi scrubbers.[188]

The BOPF secondary emissions include a hot metal transfer, desulfurization, slag skimming, charging, turndown, tapping, deslagging, teeming, ladle maintenance, flux handling slag handling and disposal, and ladle metallurgy operations. Fabric filters, and less frequently, wet scrubbers, are used to control secondary BOPF shop emissions.[189]

One source of secondary emissions are emissions that occur during the steps of the furnace cycle that require the vessel to be tipped out from the hood include scrap charging, hot metal charging, sampling, tapping, and deslagging. When the vessel is tipped, the primary control system may be rendered entirely ineffective. Such emissions are captured and controlled by furnace enclosures and partial building evacuation.[190]

Other sources of secondary emissions are ancillary operations, including hot metal transfer, desulfurization, and slag skimming. Such emissions are usually controlled by hooding ducted to a control device separate from the primary control device.[191]

After hot metal is refined into steel in the BOPH, further alloy additions and refining of the steel occur during ladle treatment and vacuum degassing. Most BOPF shops have a separate ladle metallurgy

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[185] Id. at 4-1.
[186] Id. at 4-7.
[187] Id. at 4-9.
[188] Id. at 4-17.
[189] Id. at 4-25.
[190] Id.
[191] Id.

stations. Such emissions are generally captured and controlled from ladle metallurgy operations using a fabric filter, although wet scrubbers are also used.[192]

7.3. Identification and Summary of Possible RACM Candidates.

Table 7-3 provides a summary of control measures used in the Iron and Steel Foundries source category for which the RACM criteria are applied in section 7.4 and the relative likelihood that each control measure is a RACM. Specifically, each control measure is assigned a rating of 1 through 3; where the higher the number, the more likely that the control measure is a RACM. Such assigned values are explained in Table 7-1.

Table 7-1. General Meanings of Assigned RACM Ratings.

RACM Rating	General Meaning of RACM Rating
1	There is limited support for identifying the control measure as a RACM.
2	There is some support for identifying the control measure as a RACM; more than for a control measure with a RACM Rating of "1."
3	There is substantial support for identifying the control measure as a RACM.
U (+ or -)	A "U" indicates that the likelihood that the control measure constitutes a RACM is undetermined due to incomplete information. A corresponding "+" indicates that despite incomplete information, an application of RACM criteria would likely suggest that the control measure is a RACM, while a "-" indicates that despite incomplete information, an application of the RACM criteria would likely suggest that the control measure is not a RACM.

Table 7-2. Iron and Steel Foundries Source Category - Summary of Known Control Measures and Relative Likelihood that each Control Measure is RACM.

RACM Rating	Control Measure	Brief Reasoning for RACM Rating
3	Control devices (e.g., fabric filters and wet scrubbers) to control process lead emissions from sinter plant windboxes.	1. Complete adoption by sources. 2. Cost data suggest cost effective. 3. Identified as MACT roughly 8 years ago. 4. All sources are subject to state regulations or permits that practically require such controls.
3	Control devices to control process lead emissions from sinter plant discharge end emissions points (e.g., discharges, crushers, hot screens, coolers, and cold screens).	1. Almost complete adoption by sources for such emissions points. 2. Cost data suggest cost effective. 3. Identified as MACT roughly 8 years ago. 4. All sources are subject to state regulations or permits that practically require such controls.
1.5	Control measures to control fugitive lead dust emissions from material handling (i.e., material storage, material mixing, and sinter storage) at sinter plants.	1. Low adoption of such measures by sources. 2. No cost data identified. 3. Not required by any known federal regulations. 4. Five of the 7 operating sinter plants are subject to a building opacity standard to limit releases of fugitive emissions that might practically require such controls.
3	Control measures (e.g., flame suppression, covered runners, and control devices) to control process	1. Widespread adoption of such measures by sources. 2. Cost data suggest cost effective.

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[192] Id. at 4-30.

RACM Rating	Control Measure	Brief Reasoning for RACM Rating
	lead emissions from casthouses at iron and steel mills.	3. Identified as MACT roughly 8 years ago. 4. 24/29 casthouses are subject to visible emissions standards that limit the opacity of emissions discharged from casthouse openings that might practically require such controls.
3	Control devices (e.g., scrubbers and ESPs) to control process lead emissions from BOPF shops at iron and steel mills.	1. Complete adoption by sources. 2. Cost data suggest cost effective. 3. Identified as MACT roughly 8 years ago. 4. All BOPH shops are subject to state regulations or permit requirements that might practically require such controls.
3	Control measures to control fugitive process lead emissions from BOPF shops at iron and steel mills for various operations (e.g., hot metal reladling, hot metal desulfurization, skimming, charging, tapping).	1. Complete adoption by sources. 2. Cost data suggest cost effective. 3. Identified as MACT roughly 8 years ago. 4. All BOPH shops are subject to state regulations or permit requirements that might practically require such controls.
3	Control devices (e.g., wet scrubbers and fabric filters) to control fugitive process lead emissions from ladle metallurgy stations at iron and steel mills.	1. Complete adoption by sources. 2. Cost data suggest cost effective. 3. Identified as MACT roughly 8 years ago. 4. All ladle metallurgy processes are subject to state regulations or permit requirements that might practically require such controls.
U +	Replacing old control devices with new control devices.	1. At least two sources have been identified as needing to replace old control devices (> 30 years old) to meet new emission standards. 2. No cost data identified. 3. Not required by any known federal regulations.

7.4. Application of RACM Criteria to Possible RACM Candidates.

7.4.1. Control devices (e.g., fabric filters and wet scrubbers) to control process lead emissions from sinter plant windboxes.

The complete adoption of control devices (e.g., fabric filters and wet scrubbers) for controlling process lead emissions from sinter plant windboxes suggests that such controls are economically feasible. Specifically, all nine sinter plants use a control device to control process lead emissions from sinter plant windboxes. Four plants use a fabric filter and five plants use a wet scrubber to control windbox emissions.[193]

In addition, the available data suggest that such controls are cost effective for regulating process lead emissions. Specifically, cost-effectiveness information for PM was available for selected control technologies in the source category of Iron and Steel Production, as shown in Table 7-3.[194] This information suggests that such controls are cost effective for regulating lead as well.

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[193] Id. at 4-1.

[194] EPA CoST database.

Table 7-3. Cost-Effectiveness Information for Selected Control Technologies for Controlling Particulate Matter with respect to the Iron and Steel Production Source Category.

Control Technology	Cost Effectiveness ($/ton PM)	Low/High Control Efficiency (%)
Dry Electrostatic Precipitator – Wire Plate Type	200	95/98
Fabric Filter – Reverse-Air Cleaned Type	250	99/99.5
Fabric Filter (Mech. Shaker Type)	200	99/99.5
Fabric Filter – (Pulse Jet Type)	200	99/99.5
Venturi Scrubber	3350	25/73
WESP – Wire Plate Type	350	99/99.5
* Rounded to the nearest $50 and escalated from 1999 to 2011 U.S. dollars.[195]		

Moreover, such controls are practically required by the NESHAP for Integrated Iron and Steel Plants (40 CFR 63, Subpart FFFFF) for both new and existing sources, as such NESHAP provides emissions limits for sinter plant windboxes. This might further provide some support that such controls are RACM, since such controls represent MACT standards that are over 8 years old.[196]

State regulations and permits further suggest such controls are reasonably available. Specifically, all sinter plants are subject to state regulations or permit requirements that practically require such control devices for sinter plant windoxes.[197]

7.4.2. <u>Control devices (e.g., fabric filters and wet scrubbers) to control process lead emissions from sinter plant discharge end emissions points (e.g., discharges, crushers, hot screens, coolers, and cold screens).</u>

The almost complete adoption of control devices (e.g., fabric filters and wet scrubbers) for controlling process lead emissions from sinter plant discharge and emission points (i.e., discharges, crushers, hot screens, coolers, and cold screens) suggests that such controls are economically feasible. Specifically, all 9 sinter plants with discharge emission points use a control device (7 fabric filters, 1 scrubber, 1 rotozone) to control process lead emissions from discharge emissions points; all 7 sinter plants with sinter plant crusher emission points use a control device (6 fabric filters, 1 scrubber) to control process lead emissions from crusher emission points; all 8 sinter plants with sinter plant hot screen emission points use a control device (6 fabric filters, 1 scrubber, 1 rotozone) to control process lead emissions from hot screen emission points; 5 of the 8 (3 fabric filters, 1 cyclone, 1 water sprays) sinter plants with sinter plant cooler emission points use a control to control process lead emissions from cooler emissions points; and 5 of the 7 sinter plants with sinter plant cold screen emission points control (3 fabric filters, 2 water sprays) cold screen emission points.[198]

In addition, the available data suggest that such controls are cost effective for regulating process lead emissions. Specifically, cost-effectiveness information for PM was available for selected control

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[195] In order to escalate from 1999 dollars to 2011 dollars, used the formula and approach presented in <u>EPA's Control Strategy Tool (CoST) Control Measures Database (CMDB) Documentation, Page 9</u>.

[196] <u>NESHAP for Integrated Iron and Steel Plants Major Sources, 40 CFR 63, Subpart FFFFF (Published May 20, 2003).</u>

[197] <u>National Emission Standards for Hazardous Air Pollutants (NESHAP) for Integrated Iron and Steel Plants – Background Information for Proposed Standards, EPA-453/R-01-005 (Published January 2001). Page 5-1.</u>

[198] <u>Id. at 4-30.</u>

technologies in the source category of Iron and Steel Production, as shown in Table 7-3.[199] This information suggests that such controls are cost effective for regulating lead as well.

Moreover, such controls are practically required by the NESHAP for Integrated Iron and Steel Plants (40 CFR 63, Subpart EEEEE) for both new and existing sources, as such NESHAP provides PM emissions limits for discharge ends at sinter plants. This provides some support that such controls are RACM, since such controls represent MACT standards that are over 8 years old.[200]

State regulations and permit requirements further suggest such controls are reasonably available. Specifically, sinter plants are subject to state regulations or permit requirements that practically require such control devices to control sinter plant discharge and emission points.[201]

7.4.3. Control measures to control fugitive lead dust emissions from material handling (i.e., material storage, material mixing, and sinter storage) at sinter plants.

The less widespread control of fugitive lead dust emissions from material handling (i.e., material storage, material mixing, and sinter storage) at sinter plants suggests that such controls are not economically feasible. Specifically, emissions from material handling are generally fugitive emissions and are usually uncontrolled. Only one sinter plant in the country uses a fabric filter to control emissions from material storage; the remaining plants use no control. One plant uses water sprays to wet the materials at the various transfer points. One plant uses chemical dust suppression on the product to control material storage.[202]

State regulations and permit requirements provide some support that there are control measures that might be reasonable. Specifically, 5 of the 7 operating sinter plants are subject to state regulation or permit requirements that require building opacity limits that might practically require such controls.[203]

7.4.4. Control measures (i.e., flame suppression, covered runners, and control devices) to control process lead emissions from casthouses at iron and steel mills.

The widespread use of control measures (i.e., flame suppression, covered runners, and control devices) to control process lead emissions from casthouses at iron and steel mills suggests that such control measures are economically feasible. Specifically, 12 of the 20 iron and steel mills use flame suppression at casthouses to control process lead emissions; 15 of the 20 iron and steel mills use covered runners at casthouses to control process lead emissions; and 13 of the 20 iron and steel mills evacuate process lead emissions to a control device (12 fabric filters, 1 scrubber).[204]

In addition, the available data suggest that the control devices used are cost effective for regulating process lead emissions. Specifically, cost-effectiveness information for PM was available for selected control technologies in the source category of Iron and Steel Production, as shown in Table 7-3, where

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[199] EPA CoST database.

[200] NESHAP for Integrated Iron and Steel Plants Major Sources (40 CFR 63, Subpart FFFFF).

[201] National Emission Standards for Hazardous Air Pollutants (NESHAP) for Integrated Iron and Steel Plants – Background Information for Proposed Standards. EPA-453/R-01-005 (Published January 2001). Page 5-1.

[202] Id. at 4-7 to 4-8.

[203] Id. at 5-1.

[204] Id. at 4-10.

cost-effectiveness values for fabric filters, ESPs and scrubbers all seem reasonable when used.[205] This information suggests that such controls are cost effective for regulating lead as well.

Moreover, such controls are practically required by the NESHAP for Integrated Iron and Steel Plants (40 CFR 63, Subpart EEEEE) for both new and existing sources, as such NESHAP provides PM emissions limits for casthouses at blast furnaces. This might further provide some support that such controls are RACM, since such controls represent MACT standards that are over 8 years old.[206]

State regulations and permit requirements suggest that such controls measures are reasonable. Specifically, 24 of the 29 casthouses are subject to visible emission standards by state regulations or permits that limit the opacity of emissions discharged from casthouse openings, and therefore that might practically require such control measures.[207]

7.4.5. Control devices (e.g., scrubbers and ESPs) to control process lead emissions from BOPF shops at iron and steel mills

The complete adoption of control measures to control process lead emissions from BOPH shops at iron and steel mill suggests that such controls are economically feasible. Specifically, all BOPH shops at iron and steel mills use a capture system and control device to control process lead emissions from BOPF shops. Specifically, all 16 open-hood BOPF shops use control devices (8 Venturi scrubbers, 8 ESPs) to control such emissions, and all 8 of the closed-hood BOPH shops use control devices (8 Venturi scrubbers) to control such emissions.[208]

In addition, the available data suggest that such controls are cost effective for regulating process lead emissions. Specifically, cost-effectiveness information for PM was available for selected control technologies in the source category of Iron and Steel Production, as shown in Table 7-3, where cost-effectiveness values for fabric filters, ESPs and scrubbers are reasonable when used.[209] This information suggests that such controls are cost effective for regulating lead as well.

Moreover, such controls are practically required by the NESHAP for Integrated Iron and Steel Plants (40 CFR 63, Subpart EEEEE) for both new and existing sources, which provides PM emissions limits for BOPFs. This might further provide some support that such controls are RACM, since such controls represent MACT standards that are over 8 years old.[210]

State regulations and permit requirements suggest that such controls measures are reasonable. Specifically, all BOPH shops are subject to states regulations or permit requirements that might practically require such controls.[211]

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[205] EPA CoST database.

[206] NESHAP for Integrated Iron and Steel Plants Major Sources, 40 CFR 63, Subpart FFFFF (Published May 20, 2003).

[207] Id. at 5-1.

[208] Id. at 4-20 to 4-21.

[209] EPA CoST database.

[210] NESHAP for Integrated Iron and Steel Plants Major Sources, 40 CFR 63, Subpart FFFFF (Published May 20, 2003).

[211] National Emission Standards for Hazardous Air Pollutants (NESHAP) for Integrated Iron and Steel Plants – Background Information for Proposed Standards, EPA-453/R-01-005 (Published January 2001), Page 5-9.

7.4.6. Control measures to control fugitive process lead emissions from BOPF shops at iron and steel mills for various operations (e.g., hot metal reladling, hot metal desulfurization, skimming, charging, tapping).

The widespread use of control measures to control fugitive process lead emissions from BOPH shops at iron and steel mills for various operations (e.g., hot metal reladling, hot meal desulfurization, skimming, charging, and tapping) suggests that such measures are economically feasible. Generally, iron and steel mills use control measures to control process fugitive lead emissions from BOPH shops for hot metal reladling, hot metal desulfurization, skimming, and charging. Specifically, 22 of the 23 BOPHs control such emissions for hot metal reladling (13 fabric filters, 4 fabric filters with hoods, 2 fume suppression, 1 flame suppression, 1 with two fabric filters); 23 of the 23 BOPHs control such emissions for hot metal desulfurization (17 fabric filters, 5 fabric filters with hoods, 1 with two fabric filters); 17 of the 23 BOPHs control such emissions for skimming (12 fabric filters, 5 fabric filters with hoods); 21 of the 23 BOPHs control such emissions for charging (4 fabric filters, 6 fabric filters with hoods, 5 scrubbers, 6 electrostatic precipitators).[212]

Moreover, such controls are practically required by the NESHAP for Integrated Iron and Steel Plants (40 CFR 63, Subpart EEEEE) for both new and existing sources, which provides PM emissions limits for each hot metal transfer, skimming, and desulfurization operation. This provides support that such controls are RACM, since such controls represent MACT standards that are over 8 years old.[213]

State regulations and permit requirements suggest that such controls measures are reasonable. Specifically, all BOPH shops are subject to states regulations or permit requirements that might practically require such controls.[214]

7.4.7. Control devices (e.g., wet scrubbers and fabric filters) to control fugitive process lead emissions from ladle metallurgy stations at iron and steel mills.

The complete adoption of control devices (e.g., wet scrubbers and fabric filters) to control fugitive process lead emissions from ladle metallurgy stations at iron and steel mills suggests that such controls are economically feasible. All ladle metallurgy stations at iron and steel mills control process lead emissions with control devices (3 wet scrubbers, 21 fabric filters).[215]

In addition, the available data suggest that such controls are cost effective for regulating process lead emissions. Specifically, cost-effectiveness information for PM was available for selected control technologies in the source category of Iron and Steel Production, as shown in Table 7-3, where cost-effectiveness values for fabric filters, ESPs and scrubbers are reasonable when used.[216] This information suggests that such controls are cost effective for regulating lead as well.

Moreover, such controls are practically required by the NESHAP for Integrated Iron and Steel Plants (40 CFR 63, Subpart EEEEE) for both new and existing sources, as such NESHAP provides PM emissions

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[212] Id. at 4-30.

[213] NESHAP for Integrated Iron and Steel Plants Major Sources, 40 CFR 63, Subpart FFFFF (Published May 20, 2003).

[214] National Emission Standards for Hazardous Air Pollutants (NESHAP) for Integrated Iron and Steel Plants – Background Information for Proposed Standards, EPA-453/R-01-005 (Published January 2001). Page 5-12.

[215] Id. at 4-35 to 4-37.

[216] EPA CoST database.

limits for each ladle metallurgy operation. This might further provide some support that such controls are RACM, since such controls represent MACT standards that are over 8 years old.[217]

State regulations and permit requirements suggest that such control measures are reasonable. Specifically, all ladle metallurgy stations are subject to state regulations or permit requirements that might practically require such controls.[218]

7.4.8. Replacing Old Control Devices with New Control Devices.

The age and recent identification of plants that need to replace old control devices with new control devices to meet emission standards suggests that such a measure may become more economically feasible. Specifically, scrubbers over 30 years old have been identified to be replaced in order to meet emission limits at two plants.[219]

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[217] NESHAP for Integrated Iron and Steel Plants Major Sources, 40 CFR 63, Subpart FFFFF (Published May 20, 2003).

[218] National Emission Standards for Hazardous Air Pollutants (NESHAP) for Integrated Iron and Steel Plants – Background Information for Proposed Standards, EPA-453/R-01-005 (Published January 2001), Page 5-15.

[219] Economic Impact Analysis of Final Integrated Iron and Steel NESHAP, EPA 452/R-02-009 (Published September 2002), Page 3.

8.0. RACM DEVELOPMENT FOR FUGITIVE DUST CONTROL MEASURES

Sections 4 through 7 supported RACM development with respect to certain source categories – Secondary Lead Smelting, Lead Acid Battery Manufacturing, Iron and Steel Foundries, and Iron and Steel Mills. Such previous sections generally provided an undetermined likelihood that fugitive dust control measures would be RACM for most of the source categories. This section applies the RACM criteria to fugitive dust control measures to glean what considerations are most vital for determining whether fugitive dust control measures, in general, are reasonably available.

8.1. The Economic Feasibility of Fugitive Dust Control Measures.

Support documents drafted from information collection requests for NESHAP development for the Secondary Lead Smelting, Lead Acid Battery Manufacturing, and Iron and Steel Foundries suggest that fugitive dust control measures are most economically feasible for the largest emitting sources.

Table 8.1 shows the average lead emissions emitted per facility for a given source category. Such table indicates that on average, there is 3 to greater than 10 times more lead being emitted per secondary lead smelting facility than from any typical source from one of other source categories included in Table 8.1. Table 8.2 shows the extent to which facilities have adopted fugitive dust control measures, as indicated from the most recent information collection requests for NESHAP development. The source category of secondary lead smelting is the only source category with sources to have adopted several fugitive dust control measures. This suggests that fugitive dust controls are most economically feasible for sources that emit a high level of emissions.

Table 8-1. Calculation of the Average Annual Lead Emissions Emitted per Facility in a Given Source Category.

Source Category	Annual Emission (Tons/Year) [220]	% of Total Emissions from All Source Categories[221]	Number of Sources	Calculated Average Lead Emissions per Facility (Tons/Year)
Iron and Steel Foundries	83	6.05	> 2000 [222]	0.04
Secondary Lead Smelting	14	3.21	15 [223]	1.00
Lead Acid Battery Manufacturing	17	1.24	60 [224]	0.12

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[220] The Regulatory Impact Analysis of the Proposed Revisions to the National Ambient Air Quality Standards for Lead (Published October 2008). Page 7.

[221] Id.

[222] National Emissions Standards for Hazardous Air Pollutants (NESHAP) for Iron and Steel Foundries - Background Information for Proposed Standards. Document # EPA-HQ-OAR-2006-0359-0056-0002-1 (Published December 2002). Page 1-2.

[223] Memorandum – Draft Summary of the Technology Review for the Secondary Lead Smelting. From Mike Burr, ERG. To Chuck French, EPA/OAQPS. April 2011.

[224] Memorandum – Lead Acid Battery Manufacturing Area Source Category Additional Information to Support Proposed Rule. From Nancy Jones, EC/R. To U.S. EPA Docket Number EPA-HQ-OAR-2006-0897. February 28, 2007.

Table 8-2. Extent of Known Adoption of Fugitive Dust Control Measures in the Secondary Lead Smelting, Lead Acid Battery Manufacturing, and Iron and Steel Foundry Source Categories.

	Secondary Lead Smelting[225]	Lead Acid Battery Manufacturing[226]	Iron and Steel Foundries[227]
Paving unpaved roads	Adoption by all sources	No known widespread adoption[228]	No known adoption
Cleaning paved road	Adoption by all sources	No known adoption	No known adoption
Chemical stabilization of unpaved roads	No known adoption	No known adoption	No known adoption
Paving of entire facility grounds	Adoption by several sources	No known adoption	No known adoption
Cleaning of building roofs and exteriors	Adoption by several sources	No known adoption	No known adoption
Enclosure hoods and partial enclosures for storage areas	Adoption by all sources	No known adoption	No known adoption
Wet suppression on storage piles	Adoption by all sources	No known adoption	No known adoption
Negative pressure total enclosures for storage areas	Adoption by 11 of the14 sources	No known adoption	No known adoption
Vehicle washing at each facility exit	Adoption by all sources	No known adoption	No known adoption
Vehicle washing inside building	Adoption by several sources	No known adoption	No known adoption
Use of daily ambient monitoring to diagnose activities that lead to NAAQS exceedances for lead.	Adoption by several sources	No known adoption	No known adoption

8.2. The Capital Costs, Annualized Costs, and Cost Effectiveness of Fugitive Dust Control Measures.

Cost-effectiveness data for fugitive dust control measures are not well-developed. This might be due to the fact that the cost effectiveness of a specific fugitive dust control measure is highly variable from plant-to-plant. The cost effectiveness will depend on many variables that can change from plant-to-plant with even similar levels of emissions, such as the length of roads to be paved, the historic use of emissions that might already be deposited around the plant, etc.

However, the available cost-effectiveness data indicate that process emission control measures are much more cost effective (by a factor of 2-4) than fugitive dust control measures. Table 8.3 displays the cost-effectiveness data for three fugitive dust control measures averaged for all sources in all source categories compared to cost effectiveness of mechanical shaker type fabric filters at iron and steel foundries, iron and steel mills, and lead processing facilities.[229] Such comparison indicates the fugitive dust control measures are much less cost effective than the use of fabric filters.

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[225] Memorandum – Draft Summary of the Technology Review for the Secondary Lead Smelting. From Mike Burr, ERG, To Chuck French, EPA/OAQPS. April 2011.

[226] Memorandum – Lead Acid Battery Manufacturing Area Source Category Additional Information to Support Proposed Rule. From Nancy Jones, EC/R, To U.S. EPA Docket Number EPA-HQ-OAR-2006-0897. February 28, 2007..

[227] National Emissions Standards for Hazardous Air Pollutants (NESHAP) for Iron and Steel Foundries - Background Information for Proposed Standards. Document # EPA-HQ-OAR-2006-0359-0056-0002-1 (Published December 2002). Page 1-2.

[228] One battery manufacturing facility - the Exide Battery Manufacturing facility in Salina, KS – has paved unpaved roads to control fugitive emissions. Stephanie Doolan / EPA Region 7.

[229] EPA CoST database.

Table 8-3. Cost Effectiveness of Fugitive Dust Control Measures Compared to Fabric Filters.

Control Measure	**Source Category**	**Cost Effectiveness ($/ton PM)**	**Control Efficiency (%)**
Vacuum Sweeping Paved Roads	Average of all	550	50.0
Hot Asphalt Paving of Unpaved Roads	Average of all	700	66.6
Chemical Stabilization of Unpaved Road	Average of all	3200	37.5
Fabric Filter (Mech. Shaker Type)	Average of Iron and Steel Foundries	200	99.5
Fabric Filter (Mech. Shaker Type)	Iron and Steel Production	200	99.5
Fabric Filter (Mech. Shaker Type)	Lead Processing	450	99.5

* Rounded to the nearest $100 and escalated from 1999 to 2011 U.S. dollars.[230]

8.3. Fugitive Dust Control Measures Adopted in Federal and State Regulations.

The extent to which state and federal regulations require fugitive dust control measures further suggest that such control measures are more reasonable for larger sources. Table 8.4 shows the extent of adoption of several fugitive control measures by California's SCAQMD and the NESHAPs for Secondary Lead Smelting Major Sources, Lead Acid battery Manufacturing Area Sources, Iron and Steel Foundry Area Sources, and Iron and Steel Foundry Major Sources. Several fugitive dust control measures are adopted by the NESHAP for Secondary Lead Smelting for Major Sources, where the average lead emissions per facility are highest; whereas no fugitive dust control measures are adopted by the NESHAP for Lead Acid Battery Manufacturing for Area Sources, where the average lead emitted per facility is smaller. Moreover, no fugitive dust control measures are required by the NESHAP for Iron and Steel Foundries Area Sources, but there is at least a limit that applies to fugitive dust lead emissions in the NESHAP for Iron and Steel Foundries Major Sources. This further indicates that the amount of lead emissions emitted for a facility is a key consideration when determining whether fugitive dust control measures are reasonable.

Moreover, California's SCAQMD Rule 1420, requires secondary lead smelting and lead acid battery manufacturing facilities to implement several fugitive dust control measures. The fact that California requires such adoption might suggest that fugitive dust control measures are not out of economic reach for small lead acid battery area sources. However, California's SCAQMD Rule 1420.1 applies only to large secondary lead smelting sources, and requires even more stringent fugitive dust control measures than Rule 1420, which further suggests that fugitive dust control measures are more cost effective for the largest lead emitting sources.

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[230] In order to escalate from 1999 dollars to 2011 dollars, used the formula and approach presented in EPA's Control Strategy Tool (CoST) Control Measures Database (CMDB) Documentation, Page 9.

Table 8-4. Extent of Known Adoption of Fugitive Dust Control Measures in Selected Federal and State Regulations

	1997 NESHAP Secondary Lead Smelting for Major Sources[231]	**NESHAP Lead Acid Battery Manufacturing Areas Sources**[232] **& NESHAP Iron and Steel Foundries Area Sources**[233]	**NESHAP Iron and Steel Foundries Major Sources**[234]	**California's SCAQMD Rule for Lead Processing Facilities (includes Lead Acid Battery Manufacturing Secondary Lead Smelting, Iron and Steel Foundries), Rule 1420** [235, 236]	**California's SCAQMD Rule for Lead from Large Lead Acid Battery Recycling Facilities, Rule 1420.1.** [237, 238]
Paving unpaved roads	Adopted	Not adopted	Not adopted	Not adopted	Requires paving facility grounds.
Cleaning paved road (e.g., vacuum sweeping)	Adopted			Requires that surfaces that accumulate lead-containing dust due to traffic be washed, vacuumed once / week or chemically suppressed.	Requires frequent cleaning by wet wash or vaccum of such areas.
Chemical stabilization of unpaved roads	Not adopted			Not adopted	Not adopted
Paving of entire facility grounds	Not adopted			Not adopted	Requires paving facility grounds.
Cleaning of building roofs and exteriors	Not adopted			Not adopted	Requires frequent cleaning of building roofs and exteriors.
Enclosure hoods and partial enclosures for storage areas	Adopted			Requires that dust forming material to be stored in an enclosed storage area.	Requires total enclosures under negative pressure for several areas.
Wet suppression on storage piles	Adopted			Not adopted	Requires total enclosures under negative pressure for several storage areas.
Cleaning of pavement around operation / storage area	Adopted			Requires surfaces that accumulate lead dust due to foot traffic be washed, vacuumed, or wet-	Requires frequent cleaning of such areas by wet wash or vacuum.

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[231] NESHAP for Secondary Lead Smelting, 40 CFR 63, Subpart X (Published June 13, 1997).

[232] NESHAP for Lead Acid Battery Manufacturing Plants, 40 CFR 63 Subpart PPPPPP (Published July 16, 2007)..

[233] NESHAP for Iron and Steel Foundries Area Sources, 40 CFR 63, Subpart ZZZZZ (Published April 22, 2004).

[234] NESHAP for Iron and Steel Foundries Major Sources, 40 CFR 63, Subpart EEEEE (Published April 22, 2004).

[235] California (South Coast Air Quality Management District), Rule 1420 - Emission Standards for Lead (Published September, 1992).

[236] The fugitive dust control requirements of California's SCAQMD Rule 1420 only apply to facilities that exceed specified processing thresholds (more than 2 tons of lead per year).

[237] California (South Coast Air Quality Management District), Rule 1420.1 - Emission Standards for Lead from Large Lead Acid Battery Recycling Facilities (Adopted November 5, 2010).

[238] California (South Coast Air Quality Management District), Rule 1420.1 - Emission Standards for Lead from Large Lead Acid Battery Recycling Facilities (Adopted November 5, 2010). Note that

	1997 NESHAP Secondary Lead Smelting for Major Sources[231]	**NESHAP Lead Acid Battery Manufacturing Areas Sources**[232] **& NESHAP Iron and Steel Foundries Area Sources**[233]	**NESHAP Iron and Steel Foundries Major Sources**[234]	**California's SCAQMD Rule for Lead Processing Facilities (includes Lead Acid Battery Manufacturing Secondary Lead Smelting, Iron and Steel Foundries), Rule 1420** [235, 236]	**California's SCAQMD Rule for Lead from Large Lead Acid Battery Recycling Facilities, Rule 1420.1.** [237, 238]
				mopped once per week or chemically suppressed	
Negative pressure total enclosures	Not adopted			Not adopted	Requires total enclosures under negative pressure for several areas.
Vehicle washing at each facility exit	Not adopted			Not adopted	Not adopted
Vehicle washing inside building	Not adopted			Not adopted	Not adopted
Daily ambient monitoring to diagnose activities that lead to NAAQS exceedances for lead	Not adopted			Requires 24 hour monitoring (once very six days) if a facility processes more than 2 tons of lead per year and emits lead equal to or greater than 0.5 lbs/day.[239]	Requires 24 hour monitoring once every three days, and daily monitoring if an exceedance is revealed.
Limit for fugitive dust emissions	Not adopted		Adopted an opacity limit that applies to fugitive dust sources.	Requires an opacity limit where emissions cannot exceed 0.5 or 10 percent opacity for more than three aggregate minutes in any 60-minute period.	Not adopted
Storage , disposal, recovery, or recycling of lead or lead-containing wastes generated from housekeeping activities using practices that do not lead to fugitive lead-dust emissions	Not adopted	Not adopted	Not adopted	Adopted.	Not adopted.

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[239] Facilities processing between 2-10 tons of lead per year may be exempted if modeling shows they are below half the standard.

8.4. Implications for RACM Development for Fugitive Dust Control Measures.

Available cost information suggests that process emission control measures (e.g., fabric filters) are generally 2 to 4 times more cost effective than fugitive dust control measures. Moreover, the extent of adoption of fugitive dust control measures by sources and federal/state regulations suggests that the most important consideration in determining whether fugitive dust control measures are reasonably available for a given source in a corresponding source category is the average amount of emissions emitted per source in a given source category. Specifically, as the average amount of emissions per source in a given source category increases, the more likely that fugitive dust control measures might be reasonably available.

Nevertheless, additional considerations may suggest that fugitive dust control measures are reasonably available for sources that have already adopted more cost-effective process emission controls (e.g., fabric filters). For example, EPA has indicated that where essential reductions are difficult to achieve because many sources are already being controlled, the cost per ton of control may necessarily be higher and be considered reasonable.[240] Consequently, if a source has adopted process emission controls, but is still contributing to a lead NAAQS violation, then fugitive dust controls might be the only viable option to eliminate the NAAQS violation and may, therefore, be reasonable despite being less cost effective than the initial cost of process emissions controls.

Also, additional considerations may suggest that fugitive dust control measures are RACM for sources that are area sources or smaller emitting sources. For example, the fact that an area source is in an area with more serious air quality problems may make it more reasonable and appropriate for such areas to impose emission reduction requirements that are less cost effective.[241] Consequently, if an area source is contributing to a lead NAAQS violation, and there are no other viable sources from which emissions can be reduced to get the area within attainment, then imposing less cost effective control measures to smaller area sources might be more reasonable and appropriate. Moreover, EPA has indicated that a large amount of historically deposited lead might increase the reasonableness of fugitive dust control measures.[242]

In addition, EPA encourages the development of innovative measures not previously employed which may also be technically and economically feasible.[243] Therefore, the fact that fugitive dust control measures have not been adopted by many facilities or federal/state regulations does not preclude the

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[240] "In addition, where essential reductions are more difficult to achieve (e.g., because many sources are already controlled), the cost per ton of control may necessarily be higher." National Ambient Air Quality Standards for Lead: Final Rule, 73 FR 66964, 67036 (Published November 12, 2008).

[241] "Areas with more serious air quality problems typically will need to obtain greater levels of emissions reductions from local sources than areas with less serious problems, and it would be expected that their residents could realize greater public health benefits from attaining the standard as expeditiously as practicable. For these reasons, we believe that it will be reasonable and appropriate for areas with more serious air quality problems and higher design values to impose emission reduction requirements with generally higher costs per ton of reduced emissions than the cost of emissions reductions in areas with lower design values." Id. at 67036

[242] "Some emissions that contribute to violations of the Lead NAAQS may also be attributed to smaller area sources. At primary lead smelters, the process of reducing concentrated ore to lead involves a series of steps, some of which are completed outside of buildings, or inside of buildings that are not totally enclosed. Over a period of time, emissions from these sources have been deposited in neighboring communities (e.g., on roadways, parking lots, yards, and off-plant property). This historically deposited lead, when disturbed, may be re-entrained into the ambient air and may contribute to violations of the Lead NAAQS in affected areas. "Id.

[243] "EPA also encourages the development of innovative measures not previously employed which may also be technically and economically feasible." Id.

possibility that such fugitive dust control measures are RACM. For example, many control measures such as bins, hoppers, totes, plastic curtains, moving stockpiles away from doors and traffic lanes, and soil stabilization measures (e.g., landscaping of areas where lead emissions have been historically deposited) are all measures that, on their faces, seem inexpensive and could lessen emissions. Consequently, such measures might constitute RACM, especially when emission reductions are necessary to attain the NAAQS and the availability of other control measures to implement is limited. California's SCAQMD Rule 1420.1 requires a list of many such fugitive dust control measures that facilities might consider. [244] A list of many of the fugitive dust control measures specified by Rule 1420.1 is provided in 4.4.9 of this document and in Table 8.4 of this document.

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[244] California (South Coast Air Quality Management District). Rule 1420.1 - Emission Standards for Lead from Large Lead Acid Battery Recycling Facilities (Adopted November 5, 2010).

United States Environmental Protection Agency	Office of Air Quality Planning and Standards Air Quality Policy Division Research Triangle Park, NC	EPA-457/R-12-001 March 2012

IN THE UNITED STATES DISTRICT COURT
FOR THE NORTHERN DISTRICT OF ILLINOIS

UNITED STATES OF AMERICA and THE STATE OF ILLINOIS, Plaintiffs, v. H. KRAMER & CO., Defendant.	)	Civil Action No. 13 CV 0771 CONSENT DECREE

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Plaintiff United States of America, on behalf of the United States Environmental Protection Agency ("EPA"), and the People of the State of Illinois by Lisa Madigan, Attorney General of the State of Illinois on her own motion and at the request of the Illinois Environmental Protection Agency ("Illinois EPA"), have filed a complaint in this action concurrently with this Consent Decree, alleging that Defendant H. Kramer & Co. ("H. Kramer" or "Defendant"), violated Sections 111 and 112 of the Clean Air Act ("Act"), 42 U.S.C. §§ 7411 and 7412, Section 9(a) of the Illinois Environmental Protection Act ("Illinois Act"), 415 ILCS 5/9(a) (2010), and Section 201.141 of the Illinois Pollution Control Board ("Board") Air Pollution Regulations, 35 Ill. Adm. Code 201.141. Separately, the State of Illinois also alleges that Defendant has created and maintained a common law public nuisance. H. Kramer owns and operates a secondary nonferrous metals facility ("Facility"), manufacturing primarily brass and bronze ingots, where a portion of the Facility's production capacity is devoted to lead-containing metal alloys. The Facility is located in the Pilsen neighborhood of Chicago and contains operations that emit lead.

The Complaint alleges that Defendant violated the Illinois State Implementation Plan ("SIP") at 35 Illinois Administrative Code § 201.141, which provides that no person shall cause or threaten or allow the discharge or emission of contaminants into the environment so as to cause or tend to cause air pollution or to prevent the attainment or maintenance of any applicable ambient air quality standard.

The Complaint also alleges that H. Kramer failed to comply with good air pollution practices so as to minimize emissions in violation of the General Provisions of the National Emissions Standards for Hazardous Air Pollutants ("NESHAPs") for Source Categories at 40 C.F.R. Part 63; the NESHAP for Secondary Nonferrous Metals Processing Area Sources at 40 C.F.R. Part 63, Subpart TTTTTT; and the General Provisions of the Standards of Performance for New Stationary Sources ("NSPS"), 40 C.F.R. Part 60, Subpart A.

On August 30, 2011, the State of Illinois filed a complaint ("State Complaint") against H. Kramer in the Circuit Court of Cook County, which alleges that Defendant created a substantial danger to the environment, public health and welfare; violated the Illinois Act and the Board Air Pollution Regulations; and created and maintained a common law public nuisance.

The State and Defendant entered in an Agreed Preliminary Interim Injunction Order ("Interim Order"), attached as Appendix A, which was approved by the State Court on September 2, 2011. Defendant has taken the following actions pursuant to the Interim Order: repaired and sealed all significant openings and holes in the metal roof of the South Foundry Building by September 30, 2011; removed the stack located in the southwest corner of the Facility on July 30, 2011; and replaced existing doors with five high speed custom vertical doors in areas of major ingress and egress from buildings at the Facility, including on the two entrances to the building housing the two rotary furnaces ("South Foundry Building") as of August 1, 2011.

Pursuant to the Interim Order, H. Kramer has also agreed, on an interim basis, (1) to collect and store baghouse dust in Super Sack containers, until a new method has been approved by Illinois EPA based upon the results from an evaluation by an outside consultant; (2) to continue to apply a dust suppressant agent on the gravel yard to reduce windblown dust, until the lead-contaminated gravels and soil are remediated and affected areas have been paved; and (3) to reduce rotary furnace production of two lead alloys, C-123 (81-3-7-9) and C-115 (85-5-5-

5) to a combined total of eight heats per week. Further, H. Kramer agreed, pursuant to the Interim Order and conditioned upon a final settlement agreement between the United States, the State, and H. Kramer, to replace existing pollution control technology serving the rotary furnaces in the South Foundry Building with state of the art pollution control technology, to include, but not be limited to, pulse jet baghouses, and all ancillary equipment, fans, motors, drives, foundations, inlet and outlet ductwork and electrical controls, and HEPA filters. Following approval by the State Court of the Interim Order, the United States, the State and Defendant began discussions regarding this Consent Decree.

On November 22, 2011, EPA designated the area in Chicago, Illinois bounded by Damen Avenue to the west, Roosevelt Road to the north, the Dan Ryan Expressway to the east, and the Stevenson Expressway to the south, as nonattainment for the 2008 National Ambient Air Quality Standard ("NAAQS") for lead. The Facility is located in the nonattainment area.

From February 2011 until October 30, 2012, data collected from the State's ambient air quality monitors in the Pilsen neighborhood indicate that the levels of lead in the ambient air have been below the lead NAAQS. Beginning in March 2011, the arithmetic mean concentration over each three-month rolling period has been below the NAAQS standard of 0.15 micrograms per meter cubed as recorded by the State's ambient air quality monitors.

In September 2011, H. Kramer moved its refractory brick crusher indoors. In May of 2012, H. Kramer connected the briquettor to a new cartridge baghouse located inside the compressor room. Before H. Kramer uses the refractory brick crusher, H. Kramer shall also connect it to the new cartridge baghouse located inside the compressor room.

From approximately April through June of 2012, H. Kramer conducted ventilation studies of the South Foundry and Northeast Buildings at the Facility, and subsequently submitted reports of the findings of such studies to EPA and Illinois EPA.

Defendant denies any liability to the United States or the State arising out of the transactions or occurrences alleged in the Complaint or the State Complaint.

The Parties recognize, and the Court by entering this Consent Decree finds, that this Consent Decree has been negotiated by the Parties in good faith and will avoid litigation among the Parties and that this Consent Decree is fair, reasonable, and in the public interest.

NOW, THEREFORE, before the taking of any testimony, without the adjudication or admission of any issue of fact or law except as provided in Section I (Jurisdiction and Venue), and with the consent of the Parties, IT IS HEREBY ADJUDGED, ORDERED, AND DECREED as follows:

I. JURISDICTION AND VENUE

1. This Court has jurisdiction over the subject matter of this action, pursuant to 28 U.S.C. §§ 1331, 1345, and 1355, and Section 113(b) of the Act, 42 U.S.C. § 7413(b), and over the Parties. This Court has supplemental jurisdiction over the State law claims asserted by the State of Illinois pursuant to 28 U.S.C. § 1367. Venue lies in this District pursuant to Section 113(b) of the Act, 42 U.S.C. § 7413(b); and 28 U.S.C. §§ 1391(b) and (c) and 1395(a), because the violations alleged in the Complaint are alleged to have occurred in, and Defendant conducts business in, this judicial district. For purposes of this Decree, or any action to enforce this Decree, Defendant consents to the Court's jurisdiction over this Decree and any such action and over Defendant and consents to venue in this judicial district.

2. For purposes of this Consent Decree, Defendant agrees that the Complaint states claims upon which relief may be granted pursuant to Sections 111 and 112 of the Act, 42 U.S.C. §§ 7411 and 7412.

II. APPLICABILITY

3. The obligations of this Consent Decree apply to and are binding upon the United States and the State, and upon Defendant and any successors, assigns, or other entities or persons otherwise bound by law.

4. No transfer of ownership or operation of the Facility, whether in compliance with the procedures of this Paragraph or otherwise, shall relieve Defendant of its obligation to ensure that the terms of the Decree are implemented. At least 30 Days prior to such transfer, Defendant shall provide a copy of this Consent Decree to the proposed transferee and shall simultaneously provide written notice of the prospective transfer, together with a copy of the proposed written agreement, to EPA Region 5, the United States Attorney for the Northern District of Illinois, the United States Department of Justice, Illinois EPA and the State of Illinois, in accordance with Section XIV of this Decree (Notices). Any attempt to transfer ownership or operation of the Facility without complying with this Paragraph constitutes a violation of this Decree.

5. Defendant shall provide a copy of this Consent Decree to all officers, employees, and agents whose duties include significant responsibility for compliance with any provision of this Decree, as well as any contractor retained by H. Kramer to perform work required under this Consent Decree. Defendant shall condition any such contract upon performance of the work in conformity with the terms of this Consent Decree.

6. In any action to enforce this Consent Decree, Defendant shall not raise as a defense the failure by any of its officers, directors, employees, agents, or contractors to take any actions necessary to comply with the provisions of this Consent Decree.

7. Objectives. It is the express purpose of the Parties in entering this Consent Decree to further the objectives of the Act, as enunciated in Section 101 of the Act, 42 U.S.C. § 7401 *et seq*., to protect and enhance the quality of the Nation's air resources so as to promote the public health and welfare and the productive capacity of its population, and the objectives of the Illinois Act, 415 ILCS 5/1 *et seq*. All plans, reports, construction, maintenance and other obligations in this Consent Decree or resulting from the activities required by this Consent Decree shall have the objective of causing H. Kramer to remain in full compliance with the Act and the Illinois Act at its Facility.

III. DEFINITIONS

8. Terms used in this Consent Decree that are defined in the Act or in regulations promulgated pursuant to the Act shall have the meanings assigned to them in the Act or such regulations, unless otherwise provided in this Decree. Whenever the terms set forth below are used in this Consent Decree, the following definitions shall apply:

a. "Channel Furnaces" shall mean the two 5,000 pound channel electric furnaces in the Northeast Building at the Facility.

b. "Complaint" shall mean the complaint filed by the United States and the State in this action;

c. "Consent Decree" or "Decree" shall mean this Decree and all appendices attached hereto;

d. "Coreless Electric Furnaces" shall mean the three 10,000 pound coreless electric furnaces in the Northeast Building at the Facility.

e. "Date of Lodging" shall mean the date that this Consent Decree is lodged with the Clerk of the Court for the United States District Court for the Northern District of Illinois pending public comment and Court action;

f. "Day" shall mean a calendar day unless expressly stated to be a business day. In computing any period of time under this Consent Decree, where the last day would fall on a Saturday, Sunday, or federal holiday, the period shall run until the close of business of the next business day;

g. "Defendant" or "H. Kramer" shall mean H. Kramer & Co.;

h. "EPA" shall mean the United States Environmental Protection Agency and any of its successor departments or agencies;

i. "Effective Date" shall have the definition provided in Section XV;

j. "Facility" shall mean Defendant's secondary nonferrous metals foundry located at 1345 West 21st Street in Chicago, Illinois;

k. "Heat" shall mean the cycle time of a furnace that commences after raw material is charged, and concludes when the molten metal is removed from the furnace;

l. "HEPA" shall mean a high efficiency particulate air filter that has been certified by the manufacturer to remove 99.97 percent of all particles 0.3 micrometers and larger, as defined in 40 C.F.R. § 63.542;

m. "Illinois EPA" shall mean the Illinois Environmental Protection Agency;

n. "Interim Order" shall mean the order dated September 2, 2011, in the case of *People of the State of Illinois v. H. Kramer & Co.*, Case No. 11 CH 30569 (Circuit Court, Cook County, Illinois);

o. "Lead NAAQS" shall mean the national primary and secondary ambient air quality standards for lead and its compounds promulgated by EPA on November 12, 2008. 73 Fed. Reg. 67,052;

p. "Malfunction" shall mean any sudden, infrequent, and not reasonably preventable failure of air pollution control and monitoring equipment, process equipment, or a process to operate in a normal or usual manner which causes, or has the potential to cause, the emission limitations in an applicable standard to be exceeded. Failures that are caused in part by poor maintenance or careless operation are not malfunctions;

q. "Northeast Building" shall mean the building at the Facility in which the three coreless electric furnaces and two channel electric furnaces are located;

r. "Paragraph" shall mean a portion of this Decree identified by an Arabic numeral;

s. "Parties" shall mean the United States, the State, and Defendant;

t. "Permit" shall mean the air emission source construction permit issued to H. Kramer by the Illinois Environmental Protection Agency on January 31, 2012 and any subsequent revisions to the January 31, 2012 construction permit.

u. "Rotary Furnaces" shall mean Rotary Furnace #1 and Rotary Furnaces #2 in the South Foundry Building at the Facility;

v. "Rotary Furnace #1" shall mean the 35 ton refractory-lined furnace in the South Foundry Building at the Facility;

w. "Rotary Furnace #2" shall mean the 65 ton refractory-lined furnace in the South Foundry Building at the Facility;

x. "Section" shall mean a portion of this Decree identified by a roman numeral;

y. "South Foundry Building" shall mean the building at the Facility in which Rotary Furnace #1 and Rotary Furnace #2 are located;

z. "Startup" shall mean the setting in operation of an affected source or portion of an affected source for any purpose;

aa. "Shutdown" shall mean the cessation of operation of an affected source or portion of an affected source for any purpose;

bb. "State" shall mean the State of Illinois; and

cc. "United States" shall mean the United States of America, acting on behalf of EPA.

IV. CIVIL PENALTY

9. Within 30 Days after the Effective Date of this Consent Decree, Defendant shall pay the sum of $35,000 as a civil penalty, together with interest accruing from the date on which the Consent Decree is lodged with the Court, at the rate specified in 28 U.S.C. § 1961 as of the date of lodging, of which $17,500 (plus accrued interest on that amount) shall be paid to the United States in accordance with Paragraph 10 and $17,500 (plus accrued interest on that amount) shall be paid to the State in accordance with Paragraph 12.

10. Defendant shall pay the civil penalty due by FedWire Electronic Funds Transfer ("EFT") to the U.S. Department of Justice in accordance with written instructions to be provided to Defendant, following entry of the Consent Decree, by the Financial Litigation Unit of the U.S. Attorney's Office for the Northern District of Illinois, 219 S. Dearborn Street, Fifth Floor, Chicago, IL 60604. At the time of payment, Defendant shall send a copy of the EFT authorization form and the EFT transaction record, together with a transmittal letter, which shall state that the payment is for the civil penalty owed pursuant to the Consent Decree in *United States, et al. v. H. Kramer & Co.*, and shall reference the civil action number and DOJ case number 90-5-2-1-2177/2, to the United States in accordance with Section XIV of this Decree (Notices); by email to acctsreceivable.CINWD@epa.gov; and by mail to:

EPA Cincinnati Finance Office
26 Martin Luther King Drive
Cincinnati, Ohio 45268

11. Defendant shall not deduct any penalties paid under this Decree pursuant to this Section or Section VIII (Stipulated Penalties) in calculating its federal or State or local income tax.

12. H. Kramer shall pay the civil penalty due to the State by certified check payable to the Illinois EPA for deposit into the Environmental Protection Trust Fund ("EPTF"). Payments shall be sent by first class mail and delivered to:

Illinois Environmental Protection Agency
Fiscal Services
1021 North Grand Avenue East
P.O. Box 19276
Springfield, IL 62794-9276

The name and case number shall appear on the face of the check. A copy of the certified check and any transmittal letter shall be sent to:

Krystyna Bednarczyk
Environmental Bureau
Illinois Attorney General's Office
69 West Washington Street, Suite 1800
Chicago, IL 60602

V. COMPLIANCE REQUIREMENTS

13. H. Kramer shall maintain and operate the Rotary Furnaces, including all Rotary Furnace melting operations and all existing air pollution control equipment and monitoring equipment, at all times (including periods of startup, shutdown, and malfunction) and in a manner consistent with good air pollution control practices for minimizing emissions, and all new pollution control equipment in compliance with the Permit, which is attached hereto as Appendix B.

Interim Measures.

14. At all times until 30 Days after H. Kramer begins operation of all new pollution control equipment installed pursuant to Paragraph 16, H. Kramer shall reduce Rotary Furnace production of the two lead alloys, C-123 (81-3-7-9) and C-115 (85-5-5-5) to a combined total of eight Heats per week. H. Kramer shall at all times retain records reflecting the number of heats produced per day of each alloy at the Facility. Such records shall be available to EPA and Illinois EPA for inspection upon request.

15. H. Kramer has remediated lead-contaminated soils in the back gravel yard of the Facility pursuant to Section V.3 of the Interim Order, which is attached hereto as Appendix A and incorporated herein. H. Kramer has submitted a remedial action completion report to Illinois EPA. Illinois EPA issued a no further remediation letter on March 29, 2012.

Installation of New Pollution Control Technology at the South Foundry Building.

16. Before September 1, 2013, H. Kramer shall replace the existing pollution control equipment serving the two Rotary Furnaces of the South Foundry Building at the Facility with new pollution control technology as described in the Permit. H. Kramer shall operate and maintain the new pollution control equipment required by this Paragraph 16 and in compliance with the Permit. H. Kramer shall initiate construction of the pollution control equipment within twelve months of the issuance of the Permit. H. Kramer shall design, construct, install and operate two identical emission control systems, one to control particulate emissions from Rotary Furnace #1, and one to control particulate emissions from Rotary Furnace #2. Each emission control system shall include a spark arrestor, two pulse jet dust collector modules, two HEPA filter boxes, two fans (one fan shall be for back up), related drives and motors and one stack, each of which is connected to a baghouse. H. Kramer shall operate the new pollution control technology as described in the Permit for at least four (4) years after entry of this Consent Decree, unless H. Kramer is no longer operating the Rotary Furnaces in the South Foundry Building.

Parametric Monitoring.

17. Before September 1, 2013, H. Kramer shall install the parametric monitoring equipment (pressure drop and bag leak detection) required in the Permit on the new pollution control technology that will be installed on the Rotary Furnaces at the Facility. The parametric monitoring equipment requirements are specified in Paragraphs 18 to 22, below. H. Kramer shall operate and maintain all parametric monitoring equipment required by Paragraphs 17 to 22.

18. H. Kramer shall install, operate, and maintain a bag leak detection system ("BLDS") for the outlet of each baghouse in the new pollution control system for the South Foundry Building as required by the Permit.

19. H. Kramer shall develop and maintain at the Facility a monitoring plan for each BLDS in the South Foundry Building ("BLDS Monitoring Plan") as required by the Permit. H. Kramer shall submit the BLDS Monitoring Plan to EPA and Illinois EPA for approval pursuant to Paragraphs 32 to 36 of the Consent Decree. Upon approval of the BLDS Monitoring Plan by EPA, as provided in Paragraphs 32 to 36, below, H. Kramer shall operate and maintain each BLDS according to the approved BLDS Monitoring Plan at all times.

20. For each BLDS, H. Kramer shall initiate and maintain all procedures required by the Permit to determine the cause of every alarm.

21. H. Kramer shall install and operate a continuous monitor to measure the pressure drops across each baghouse and HEPA filter of each new pollution control system for the South Foundry Building as required by the Permit.

22. H. Kramer shall install and operate a continuous monitor that measures: 1) amperage for each variable speed motor; and 2) instrumentation for each fixed speed motor for each fan at the South Foundry Building as required by the Permit or, alternatively, record the measured data specified in this Paragraph at least twice during each Heat, at least once during charging and at least once during tapping, as required by the Permit. H. Kramer shall measure pressure drop across each control device for the three Coreless Electric Furnaces at the Northeast Building once per shift.

Recordkeeping.

23. The records generated by parametric monitoring devices identified in Paragraphs 18 to 22 and in the Parametric Monitoring Plan shall be maintained by H. Kramer for a period of three years and be made available to EPA and Illinois EPA upon request as provided in Section XI of this Consent Decree (Information Collection and Retention).

24. H. Kramer shall maintain records and supporting documentation, containing the following information for the baghouses and HEPA filters in each control system at the South Foundry Building as required by the Permit.

a. Design capacity (scfm) and performance of the device (*i.e.*, outlet PM concentration, in gr/dscf or mg/dscm) as specified by the manufacturer;

b. Operating procedures for each device recommended by the manufacturer, including recommended range of pressure drop, maximum operating temperature, and, for the baghouses, practices for cleaning of bags; and

c. Maintenance and inspection procedures recommended by the manufacturer.

25. H. Kramer shall maintain an operating log or other records for each Rotary Furnace that, at a minimum, contains the following information for each batch of material or heat processed in a furnace as required by the Permit:

a. Amount of raw material charged (tons) and description of raw materials processed (*i.e.*, estimated percentage of different components in the raw materials, such as vehicle radiators, water meters, manufacturing byproducts and miscellaneous scrap);

b. Start time and duration of the heat (hours);

c. Final batch size (tons), product type or grade, and lead content (percent by weight); and

d. Average charge rate per batch based on amount charged divided by batch time (tons/hour).

26. H. Kramer shall maintain an operating log or other records for each control system that, at a minimum, includes the following information for each Heat in a Rotary Furnace as required by the Permit:

a. Information confirming that the capture system was operational and did not malfunction, including proper settings for dampers in the ductwork during different phases of the Heat and the parametric monitoring information required by Paragraph 22, above;

b. Information confirming that the baghouse was operational and did not malfunction; and

c. Information confirming that the HEPA filter was operational and did not malfunction.

27. H. Kramer shall maintain an inspection and maintenance log or other records for each control system that, as required by the Permit, at a minimum, includes:

a. Inspection data (in accordance with the requirements of the Permit) including: (i) date and time of inspection; (ii) identification of personnel that performed each inspection; (iii) observed condition of control equipment; and (iv) recommendations based on inspection.

b. Maintenance and repair records (in accordance with the requirements of the Permit) including replacement of filters and: (i) dates maintenance and repairs were initiated and completed; (ii) identification of personnel that performed each maintenance and repair; (iii) reason for the maintenance or repair (*e.g.*, regularly scheduled preventive maintenance or activity to respond to observed defect); and (iv) description of the maintenance and repairs.

28. H. Kramer shall maintain a log or other records of any malfunction and/or breakdown of the Rotary Furnaces and associated control equipment as required by the Permit. At a minimum, as required by the Permit, these records shall include:

a. Date and duration of malfunction or breakdown;

b. Detailed description of the malfunction or breakdown, with likely cause of the malfunction or breakdown;

c. Effect of the malfunction or breakdown on emissions and, if any applicable emission limits may have been exceeded, an estimate of the quantity of additional emissions with supporting analysis;

d. Measures used to reduce the quantity of emissions and the duration of the malfunction or breakdown; and

e. Steps taken to prevent similar malfunctions or breakdowns or reduce their frequency and severity.

Testing.

29. Within 90 Days after initial startup of new pollution control equipment required by Paragraph 16 of this Consent Decree, H. Kramer shall conduct a stack test to measure PM and PM_{10} in accordance with EPA Methods 1-5, metals emissions (excluding mercury) in accordance with EPA Method 29, and opacity in accordance with EPA Method 9,

from the exhaust of the new pollution control equipment under conditions which are representative of maximum operating conditions and maximum emissions. The maximum emission conditions shall include testing during operation with only one of the two dust collector modules in each of the baghouse systems in operation (representing one possible worst case situation with the other dust collector module in each baghouse system shut down for repair or maintenance). At least 60 Days prior to each proposed stack test, H. Kramer shall submit a written stack test protocol to EPA and Illinois EPA for approval pursuant to Paragraphs 32 to 36 (Approval of Deliverables) of this Consent Decree. The protocol shall be submitted as provided in Section XIV of this Consent Decree (Notices) and in accordance with this Paragraph. The test protocol shall describe in detail the proposed test methods and procedures, the operating parameters, and include the name and qualifications of the person conducting the stack test. Within 60 Days of approval of the test protocol by EPA, H. Kramer shall perform the stack test. H. Kramer shall provide EPA and Illinois EPA with at least 30 Days written notice of the actual test date to provide an opportunity to observe the stack test pursuant to Section XI of this Consent Decree (Information Collection and Retention). If testing is delayed, H. Kramer shall promptly notify EPA and Illinois EPA by e-mail, at least five Days prior to the scheduled date of testing or immediately, if the delay occurs within five Days of the scheduled date. This notification shall also include the new date and time for testing, if scheduled, or H. Kramer shall send a separate notification with this information as soon as practicable and in no event later than 24 hours before the rescheduled date for the testing.

30. Within 30 Days after the completion of the stack test, H. Kramer shall submit a complete report of the stack test to EPA and Illinois EPA. The report shall describe all

steps taken to comply with the test protocol, the conditions under which the stack test was carried out, and all stack test results. The report shall be addressed as provided in Section XIV of this Consent Decree (Notices) and in accordance with the Permit.

31. To the extent that the Permit conditions relating to testing are modified in the future and in the event of conflict between the requirements of the Permit and H. Kramer's obligations to conduct testing pursuant to Paragraph 29 of this Consent Decree, above, such testing shall be controlled by the then current Permit.

32. Approval of Deliverables. After review of any plan, report, or other item that is required to be submitted pursuant to this Consent Decree, EPA, after consultation with the State, shall in writing: a) approve the submission; b) approve the submission upon specified conditions; c) approve part of the submission and disapprove the remainder; or d) disapprove the submission, pursuant to the provisions of this Consent Decree.

33. If the submission is approved pursuant to Paragraph 32.a, Defendant shall take all actions required by the plan, report, or other document, in accordance with the schedules and requirements of the plan, report, or other document, as approved. If the submission is conditionally approved or approved only in part, pursuant to Paragraph 32.b or .c, Defendant shall, upon written direction from EPA, after consultation with the State, take all actions required by the approved plan, report, or other item that EPA, after consultation with the State, determines are technically severable from any disapproved portions, subject to Defendant's right to dispute only the specified conditions or the disapproved portions, under Section X of this Decree (Dispute Resolution).

34. If the submission is disapproved in whole or in part pursuant to Paragraph 32.c or .d, Defendant shall, within 45 Days or such other time as the Parties agree to in writing, correct all deficiencies and resubmit the plan, report, or other item, or disapproved portion thereof, for approval, in accordance with the preceding Paragraphs. If the resubmission is approved in whole or in part, Defendant shall proceed in accordance with the preceding Paragraph.

35. Any stipulated penalties applicable to the original submission, as provided in Section VIII of this Decree, shall accrue during the 45-Day period or other specified period but shall not be payable unless the resubmission is untimely or is disapproved in whole or in part; provided that, if the original submission was so deficient as to constitute a material breach of Defendant's obligations under this Decree, the stipulated penalties applicable to the original submission shall be due and payable notwithstanding any subsequent resubmission.

36. If a resubmitted plan, report, or other item, or portion thereof, is disapproved in whole or in part, EPA, after consultation with the State, may again require Defendant to correct any deficiencies, in accordance with the preceding Paragraphs, or may itself correct any deficiencies, subject to Defendant's right to invoke Dispute Resolution and the right of EPA and the State to seek stipulated penalties as provided in the preceding Paragraphs.

37. Permits. Where any compliance obligation under this Section requires Defendant to obtain a federal, state, or local permit or approval, Defendant shall submit timely and complete applications and take all other actions reasonably necessary to obtain all such permits or approvals. Defendant may seek relief under the provisions of Section IX of this Consent Decree (Force Majeure) for any delay in the performance of any such obligation

resulting from a failure to obtain, or a delay in obtaining, any permit or approval required to fulfill such obligation, including any building or other permits from the City of Chicago or any other permitting authority, if Defendant has submitted timely and complete applications and has taken all other actions reasonably necessary to obtain all such permits or approvals.

VI. SUPPLEMENTAL ENVIRONMENTAL PROJECT

38. Defendant shall implement a Diesel Retrofit Supplemental Environmental Project ("Diesel Retrofit SEP"), in accordance with all provisions of Appendix C of this Consent Decree. The Diesel Retrofit SEP shall be completed in accordance with the schedule set forth in Appendix C. The Diesel Retrofit SEP involves retrofitting school bus diesel vehicles operating in the Pilsen neighborhood and surrounding areas of Chicago, Illinois with emissions control equipment designed to reduce emissions of particulates and/or ozone precursors in diesel vehicle exhaust.

39. Defendant is responsible for the satisfactory completion of the SEP in accordance with the requirements of this Decree. "Satisfactory completion" means completion of the SEP in accordance with the provisions of this Section VI of the Consent Decree and Appendix C. Defendant may use contractors or consultants in planning and implementing the SEP.

40. With regard to the SEP, Defendant certifies the truth and accuracy of each of the following:

a. that, as of the date of executing this Decree, Defendant is not required to perform or develop the SEP by any federal, state, or local law or regulation and is not required to perform or develop the SEP by agreement, grant, or as injunctive relief awarded in any other action in any forum;

b. that the SEP is not a project that Defendant was planning or intending to construct, perform, or implement other than in settlement of the claims resolved in this Decree;

c. that Defendant has not received and will not receive credit for the SEP in any other enforcement action; and

d. that Defendant will not receive any reimbursement for any portion of the SEP from any other person.

41. Defendant also certifies the following:

> I certify that I am not a party to any open federal financial assistance that is funding or could be used to fund the same activity as the SEP. I further certify that, to the best of my knowledge and belief after reasonable inquiry, there is no such open federal financial transaction that is funding or could be used to fund the same activity as the SEP, nor has the same activity been described in an unsuccessful federal financial assistance transaction proposal to EPA within two years of the date of this settlement (unless the project was barred from funding as statutorily ineligible). For purposes of this certification, the term "open federal financial assistance" refers to a grant, cooperative agreement, loan, federally-guaranteed loan guarantee, or other mechanism for providing for providing federal financial assistance whose performance period has not yet expired.

42. <u>SEP Completion Report</u>

a. Within 45 Days after the date set for completion of the SEP, Defendant shall submit a SEP Completion Report to the United States and the State, in accordance with Section XIV of this Consent Decree (Notices). The SEP Completion Report shall contain the following information:

i. a detailed description of the SEP as implemented;

ii. a description of any problems encountered in completing the SEP and the solutions thereto;

iii. an itemized list of all eligible SEP costs expended;

iv. certification that the SEP has been fully implemented pursuant to the provisions of this Decree; and

v. a description of the environmental and public health benefits resulting from implementation of the SEP (with a quantification of the benefits and pollutant reductions, if feasible).

43. EPA and/or Illinois EPA pursuant to Section XI (Information Collection and Retention) of the Consent Decree may require information in addition to that described in the preceding Paragraph, in order to evaluate Defendant's completion report. After receiving the SEP Completion Report, the United States shall notify Defendant whether or not Defendant has satisfactorily completed the SEP. If Defendant has not completed the SEP in accordance with this Consent Decree, stipulated penalties may be assessed under Section VIII of the Consent Decree.

44. Disputes concerning the satisfactory performance of the SEP and the amount of eligible SEP costs may be resolved under Section X of this Decree (Dispute Resolution). No other disputes arising under this Section shall be subject to Dispute Resolution.

45. Each submission required under this Section shall be signed by an official with knowledge of the SEP and shall bear the certification language set forth in Paragraph 50.

46. Any public statement, oral or written, in print, film, or other media, made by Defendant making reference to the SEP under this Decree shall include the following language: "This project was undertaken in connection with the settlement of an enforcement action, *United States, et al. v. H. Kramer & Co.*, taken on behalf of the U.S. Environmental Protection Agency under the Clean Air Act and on behalf of the People of the State of Illinois under the Illinois Environmental Protection Act."

47. For federal income tax purposes, Defendant agrees that it will neither capitalize into inventory or basis nor deduct any costs or expenditures incurred in performing the SEP.

VII. REPORTING REQUIREMENTS

48. Defendant shall submit the following reports:

a. Within 30 Days after the end of each calendar-year quarter (*i.e.*, by April 30, July 30, October 30, and January 30) after lodging of this Consent Decree, until termination of this Decree pursuant to Section XVIII (Termination), Defendant shall submit a written quarterly report for the preceding quarter that shall include the status of any construction or compliance measures; completion of milestones; problems encountered or anticipated, together with implemented or proposed solutions; status of permit applications; operation and maintenance; and reports to state agencies; and a discussion of Defendant's progress in satisfying its obligations in connection with the Diesel Retrofit SEP under Section VI of this Decree including, at a minimum, a narrative description of activities undertaken; status of any construction or compliance measures, including the completion of any milestones set forth in the SEP Work Plan attached as Appendix C to this Decree, and a summary of costs incurred since the previous report.

b. The report shall also include a description of any non-compliance with the requirements of this Consent Decree and an explanation of the violation's likely cause and of the remedial steps taken, or to be taken, to prevent or minimize such violation. If Defendant violates, or has reason to believe that it may violate, any requirement of this Consent Decree, Defendant shall notify the United States and the State of such violation and its likely duration, in writing, within ten working Days of the Day Defendant first becomes aware of the violation, with an explanation of the violation's likely cause and of the remedial steps taken, or to be taken, to prevent or minimize such violation. If the cause of a violation cannot be fully explained at the time the report is due, Defendant shall so state in the report. Defendant shall investigate the cause of the violation and shall then submit an amendment to the report, including a full explanation of the cause of the violation, within 30 Days of the Day Defendant becomes aware of the cause of the violation. Nothing in this Paragraph or the following Paragraph relieves Defendant of its obligation to provide the notice required by Section IX of this Consent Decree (Force Majeure).

49. Whenever any violation of the Consent Decree or any other event affecting Defendant's performance under this Decree, or the performance of its Facility, may pose an immediate threat to the public health or welfare of the environment, Defendant shall notify EPA and the State orally or by electronic or facsimile transmission as soon as possible, but no later than 24 hours after Defendant first knew of the violation or event.

50. All reports shall be submitted to the persons designated in Section XIV of this Consent Decree (Notices). Each report submitted by Defendant under this Section shall be signed by an official of the submitting party and include the following certification:

> I certify under penalty of law that this document and all attachments were prepared under my direction or supervision in accordance with a system designed to assure that qualified personnel properly gather and evaluate the information submitted. Based on my inquiry of the person or persons who manage the system, or those persons directly responsible for gathering the information, the information submitted is, to the best of my knowledge and belief, true, accurate, and complete. I am aware that there are significant penalties for submitting false information, including the possibility of fine and imprisonment for knowing violations.

This certification requirement does not apply to emergency or similar notifications where compliance would be impractical.

51. The reporting requirements of this Consent Decree do not relieve Defendant of any reporting obligations required by the Act or Illinois Act or their implementing regulations, or by any other federal, state, or local law, regulation, permit, or other requirement.

52. Any information provided pursuant to this Consent Decree may be used by the United States or the State in any proceeding to enforce the provisions of this Consent Decree and as otherwise permitted by law.

VIII. STIPULATED PENALTIES

53. Defendant shall be liable for stipulated penalties to the United States and the State for violations of this Consent Decree as specified below, unless excused under Section IX (Force Majeure). A violation includes failing to perform any obligation required by the terms of this Decree, including any work plan or schedule approved under this Decree, according to all

applicable requirements of this Decree and within the specified time schedules established by or approved under this Decree.

54. Late Payment of Civil Penalty. If Defendant fails to pay the civil penalty required to be paid under Section IV of this Consent Decree (Civil Penalty) when due, Defendant shall pay a stipulated penalty of $1,500 per Day for each Day that the penalty is late.

55. Interim Requirements. The following stipulated penalties shall accrue per violation per Day for each violation of an interim requirement of Paragraph 14:

Penalty Per Violation Per Day	Period of Noncompliance
$1,250	1st through 14th Day
$2,500	15th through 30th Day
$3,000	31st Day and beyond

56. Compliance Milestones

a. The following stipulated penalties shall accrue per violation per Day for each violation of the requirements identified in subparagraph b:

Penalty Per Violation Per Day	Period of Noncompliance
1st through 14th Day	$300
15th through 30th Day	$500
31st Day and beyond	$1,000

b. Failure to install and operate new pollution control technology at the South Foundry Building in accordance with the requirements of Paragraph 16; failure to implement the Parametric Monitoring Plan in accordance with the requirements of Paragraphs 17 to 22; and failure to perform the testing in accordance with the requirements of Paragraphs 29 and 30.

57. Reporting Requirements. The following stipulated penalties shall accrue per violation per Day for each violation of the reporting requirements of Section VII of this Consent Decree (Reporting) and the recordkeeping requirements of Paragraphs 23 to 28:

Penalty Per Violation Per Day	Period of Noncompliance
$250	1st through 14th Day
$300	15th through 30th Day
$500	31st Day and beyond

58. SEP Compliance.

a. If Defendant fails to satisfactorily complete the Diesel Retrofit SEP by the deadline set forth in Appendix C, Defendant shall pay stipulated penalties for each Day for which it fails to satisfactorily complete the SEP, as follows:

Penalty Per Violation Per Day	Period of Noncompliance
1st through 14th Day	$300
15th through 30th Day	$500
31st Day and beyond	$1,000

b. If Defendant fails to implement the Diesel Retrofit SEP, or halts or abandons work on the SEP, Defendant shall pay a stipulated penalty of $52,000 minus all other stipulated penalties paid under Paragraph 58a. The penalty under Paragraph 58b. shall accrue as of the date specified for completing the SEP or the date performance ceases, whichever is earlier.

c. If Defendant has not satisfactorily completed the SEP but Defendant has made good faith and timely efforts to complete the SEP, Defendant shall pay a stipulated penalty amounting to $52,000 minus the amount of money Defendant spent in eligible costs on the Diesel Retrofit SEP.

59. Except as provided in Paragraph 58, stipulated penalties under this Section shall begin to accrue on the Day after performance is due or on the Day a violation occurs, whichever is applicable, and shall continue to accrue until performance is satisfactorily completed or until the violation ceases. Stipulated penalties shall accrue simultaneously for separate violations of this Consent Decree.

60. Defendant shall pay stipulated penalties to the United States and the State within 30 Days of a written demand by either Plaintiff. Defendant shall pay fifty percent of the total stipulated penalty amount due to the United States and fifty percent to the State. The Plaintiff making a demand for payment of a stipulated penalty shall simultaneously send a copy of the demand to the other Plaintiff.

61. Either Plaintiff may in the unreviewable exercise of its discretion, reduce or waive stipulated penalties otherwise due it under this Consent Decree.

62. Stipulated penalties shall continue to accrue as provided in Paragraph 60, during any Dispute Resolution, but need not be paid until the following:

a. If the dispute is resolved by agreement or by a decision of EPA or the State that is not appealed to the Court, Defendant shall pay accrued penalties determined to be owing, together with interest, to the United States or the State within 30 Days of the effective date of the agreement or the receipt of EPA's or the State's decision or order.

b. If the dispute is appealed to the Court and the United States or the State prevails in whole or in part, Defendant shall pay all accrued penalties determined by the Court to be owing, together with interest, within 60 Days of receiving the Court's decision or order, except as provided in subparagraph c., below.

c. If any Party appeals the District Court's decision, Defendant shall pay all accrued penalties determined to be owing, together with interest, within 15 Days of receiving the final appellate court decision.

63. Defendant shall pay stipulated penalties owing to the United States in the manner set forth and with the confirmation notices required by Paragraph 10, except that the transmittal letter shall state that the payment is for stipulated penalties and shall state for which violation(s) the penalties are being paid. Defendant shall pay stipulated penalties owing to the State by the method set forth in Paragraph 12.

64. If Defendant fails to pay stipulated penalties according to the terms of this Consent Decree, Defendant shall be liable for interest on such penalties, as provided for in 28 U.S.C. § 1961, accruing as of the date payment became due. Nothing in this Paragraph shall be construed to limit the United States or the State from seeking any remedy otherwise provided by law for Defendant's failure to pay any stipulated penalties.

65. Subject to the provisions of Section XII of this Consent Decree (Effect of Settlement/Reservation of Rights), the stipulated penalties provided for in this Consent Decree shall be in addition to any other rights, remedies, or sanctions available to the United States for Defendant's violation of this Consent Decree or applicable law. Where a violation of this

Consent Decree is also a violation of the Clean Air Act, Defendant shall be allowed a credit, for any stipulated penalties paid, against any statutory penalties imposed for such violation.

IX. FORCE MAJEURE

66. "Force majeure," for purposes of this Consent Decree, is defined as any event arising from causes beyond the control of Defendant of any entity controlled by Defendant, or of Defendant's contractors, that delays or prevents the performance of any obligation under this Consent Decree despite Defendant's best efforts to fulfill the obligation. The requirement that Defendant exercise "best efforts to fulfill the obligation" includes using best efforts to anticipate any potential force majeure event and best efforts to address the effects of any such event (a) as it is occurring and (b) after it has occurred to prevent or minimize any resulting delay to the greatest extent possible. "Force Majeure" does not include Defendant's financial inability to perform any obligation under this Consent Decree.

67. Potential Force Majeure Event: Depending upon the circumstances and H. Kramer's response to such circumstances, failure of a permitting authority to issue a necessary permit in a timely fashion may constitute a Force Majeure Event where the failure of the permitting authority to act is beyond the control of H. Kramer and H. Kramer has taken all steps available to it to obtain the necessary permit, including, but not limited to: submitting a complete permit application; responding to requests for additional information by the permitting authority in a timely fashion; and accepting lawful permit terms and conditions after expeditiously exhausting any legal right to appeal terms and conditions imposed by the permitting authority.

68. If any event occurs or has occurred that may delay the performance of any obligation under this Consent Decree, whether or not caused by a force majeure event, Defendant shall provide notice orally or by electronic or facsimile transmission to Krystyna Bednarczyk at KBednarczyk@atg.state.il.us and Kushal Som at Som.Kushal@epa.gov, within 48 hours of when Defendant first knew that the event might cause a delay. Within seven Days thereafter, Defendant shall provide in writing to EPA and the State an explanation and description of the reasons for the delay; the anticipated duration of the delay; all actions taken or to be taken to prevent or minimize the delay; a schedule for implementation of any measures to be taken to prevent or mitigate the delay or the effect of the delay; Defendant's rationale for attributing such delay to a force majeure event if it intends to assert such a claim; and a statement as to whether, in the opinion of Defendant, such event may cause or contribute to an endangerment to public health, welfare or the environment. Defendant shall include with any notice all available documentation supporting the claim that the delay was attributable to a force majeure. Failure to comply with the above requirements shall preclude Defendant from asserting any claim of force majeure for that event for the period of time of such failure to comply, and for any additional delay caused by such failure. Defendant shall be deemed to know of any circumstance of which Defendant or any entity controlled by Defendant or Defendant's contractors knew or should have known.

69. If EPA, after a reasonable opportunity for review and comment by the State, agrees that the delay or anticipated delay is attributable to a force majeure event, the time for performance of the obligations under this Consent Decree that are affected by the force majeure event will be extended by EPA, after a reasonable opportunity for review and comment

by the State, for such time as is necessary to complete those obligations. An extension of the time for performance of the obligations affected by the force majeure event shall not, of itself, extend the time for performance of any other obligation. EPA will notify Defendant in writing of the length of the extension, if any, for performance of the obligations affected by the force majeure event.

70. If EPA, after a reasonable opportunity for review and comment by the State, does not agree that the delay or anticipated delay has been or will be caused by a force majeure event, EPA will notify Defendant in writing of its decision.

71. If Defendant elects to invoke the dispute resolution procedures set forth in Section X (Dispute Resolution), it shall do so no later than 15 Days after receipt of EPA's notice. In any such proceeding, Defendant shall have the burden of demonstrating by a preponderance of the evidence that the delay or anticipated delay has been or will be caused by a force majeure event, that the duration of the delay or the extension sought was or will be warranted under the circumstances, that best efforts were exercised to avoid and mitigate the effects of the delay, and that Defendant complied with the requirements of Paragraphs 66 and 68, above. If Defendant carries this burden, the delay at issue shall be deemed not to be a violation by Defendant of the affected obligation of this Consent Decree identified to EPA and the Court.

X. DISPUTE RESOLUTION

72. Unless otherwise expressly provided for in this Consent Decree, the dispute resolution procedures of this Section shall be the exclusive mechanism to resolve disputes arising under or with respect to this Consent Decree. Defendant's failure to seek resolution of a dispute under this Section shall preclude Defendant from raising any such issue as

a defense to an action by the United States or the State to enforce any obligation of Defendant arising under this Decree.

73. Informal Dispute Resolution. Any dispute subject to Dispute Resolution under this Consent Decree shall first be the subject of informal negotiations. The dispute shall be considered to have arisen when Defendant sends the United States and the State a written Notice of Dispute. Such Notice of Dispute shall state clearly the matter in dispute. The period of informal negotiations shall not exceed 20 Days from the date the dispute arises, unless that period is modified by written agreement. If the Parties cannot resolve a dispute by informal negotiations, then the position advanced by the United States, after consultation with the State, or the State, if the United States is not a party to the dispute, shall be considered binding unless, within 20 Days after the conclusion of the informal negotiation period, Defendant invokes formal dispute resolution procedures as set forth below.

74. Formal Dispute Resolution. Defendant shall invoke formal dispute resolution procedures, within the time period provided in the preceding Paragraph, by serving on the United States and the State a written Statement of Position regarding the matter in dispute. The Statement of Position shall include, but need not be limited to, any factual data, analysis, or opinion supporting Defendant's position and any supporting documentation relied upon by Defendant.

75. The United States and/or the State shall serve its Statement of Position within 45 Days of receipt of Defendant's Statement of Position. The United States' or the State's Statement of Position, as applicable, shall include, but need not be limited to, any factual data, analysis, or opinion supporting that position and any supporting documentation relied upon

by the United States and/or the State. The United States' or the State's Statement of Position, as applicable, shall be binding on Defendant, unless Defendant files a motion for judicial review of the dispute in accordance with the following Paragraph.

76. Defendant may seek judicial review of the dispute by filing with the Court and serving on the United States and the State, in accordance with Section XIV of this Consent Decree (Notices), a motion requesting judicial resolution of the dispute. The motion must be filed within 10 Days of receipt of the United States' or the State's Statement of Position pursuant to the preceding Paragraph. The motion shall contain a written statement of Defendant's position on the matter in dispute, including any supporting factual data, analysis, opinion, or documentation, and shall set forth the relief requested and any schedule within which the dispute must be resolved for orderly implementation of the Consent Decree.

77. The United States and/or the State shall respond to Defendant's motion within the time period allowed by the Local Rules of this Court. Defendant may file a reply memorandum, to the extent permitted by the Local Rules.

78. Standard of Review

a. Disputes Concerning Matters Accorded Record Review. Except as otherwise provided in this Consent Decree, in any dispute brought under Paragraph 74 pertaining to the adequacy or appropriateness of plans, procedures to implement plans, schedules or any other items requiring approval by EPA and/or Illinois EPA under this Consent Decree; the adequacy of the performance of work undertaken pursuant to this Consent Decree; and all other disputes that are accorded review on the administrative record under applicable principles of administrative law, Defendant shall have the burden of demonstrating, based on the administrative record, that the position of the United States or the State, as applicable, is arbitrary and capricious or otherwise not in accordance with law.

b. Other Disputes. Except as otherwise provided in this Consent Decree, in any other dispute brought under Paragraph 74, Defendant shall bear the burden of demonstrating that its position complies with this Consent Decree and better furthers the Objectives of the Consent Decree.

79. The invocation of dispute resolution procedures under this Section shall not, by itself, extend, postpone, or affect in any way any obligation of Defendant under this Consent Decree, unless and until final resolution of the dispute so provides. Stipulated penalties with respect to the disputed matter shall continue to accrue from the first Day of noncompliance, but payment shall be stayed pending resolution of the dispute as provided in Paragraph 67. If Defendant does not prevail on the disputed issue, stipulated penalties shall be assessed and paid as provided in Section VIII (Stipulated Penalties).

XI. ACCESS AND INFORMATION COLLECTION AND RETENTION

80. During the term of this Consent Decree, the United States, the State, and their representatives, including attorneys, contractors, and consultants, shall have the right of entry into any facility covered by this Consent Decree, at all reasonable times, upon presentation of credentials, to:

a. monitor the progress of activities required under this Consent Decree;

b. verify any data or information submitted to the United States or the State in accordance with the terms of this Consent Decree;

c. obtain samples and, upon request, splits of any samples taken by Defendant or its representatives, contractors, or consultants;

d. obtain documentary evidence, including photographs and similar data; and

e. assess Defendant's compliance with this Consent Decree.

81. Upon request, during the term of this Consent Decree, Defendant shall provide EPA and the State or their authorized representatives, splits of any samples taken by Defendant. Upon request, EPA and the State shall provide Defendant splits of any samples taken by EPA or the State, or their agents.

82. Until five years after the termination of this Consent Decree, Defendant shall retain, and shall instruct its contractors and agents to preserve, all non-identical copies of all documents, records, or other information (including documents, records, or other information in electronic form) in its or its contractors' or agents' possession or control, or that come into its or its contractors' or agents' possession or control, and that relate in any manner to Defendant's performance of its obligations under this Consent Decree. This information-retention requirement shall apply regardless of any contrary corporate or institutional policies or procedures. At any time during this information-retention period, upon request by the United States or the State, Defendant shall provide copies of any documents, records, or other information required to be maintained under this Paragraph.

83. At the conclusion of the information-retention period provided in the preceding Paragraph, Defendant shall notify the United States and the State at least 90 Days prior to the destruction of any documents, records, or other information subject to the requirements of

the preceding Paragraph and, upon request by the United States or the State, Defendant shall deliver any such documents, records, or other information to EPA or the State. Defendant may assert that certain documents, records, or other information is privileged under the attorney-client privilege or any other privilege recognized by federal law. If Defendant asserts such a privilege, it shall provide the following: (1) the title of the document, record, or information; (2) the date of the document, record, or information; (3) the name and title of each author of the document, record, or information; (4) the name and title of each addressee and recipient; (5) a description of the subject of the document, record, or information; and (6) the privilege asserted by Defendant. However, no documents, records, or other information created or generated pursuant to the requirements of this Consent Decree shall be withheld on grounds of privilege.

84. Defendant may also assert that information required to be provided under this Section is protected as Confidential Business Information ("CBI") under 40 C.F.R. Part 2, Section 7 of the Illinois Act, 415 ILCS 5/7 (2010), and/or 2 Ill. Adm. Code Part 1828, and/or 35 Ill. Adm. Code Part 130. As to any information that Defendant seeks to protect as CBI, Defendant shall follow the procedures set forth in 40 C.F.R. Part 2 as to the United States, and the procedures at 35 Ill. Adm. Code Part 130 or 2 Ill. Adm. Code Part 1828 as to the State.

85. This Consent Decree in no way limits or affects any right of entry and inspection, or any right to obtain information, held by the United States or the State pursuant to applicable federal or state laws, regulations, or permits, nor does it limit or affect any duty or obligation of Defendant to maintain documents, records, or other information imposed by applicable federal or state laws, regulations, or permits.

XII. EFFECT OF SETTLEMENT/RESERVATION OF RIGHTS

86. This Consent Decree is entered into as a full and final settlement of this action to the following extent: the Decree resolves the civil claims of the United States and the State for the violations alleged in the Complaint filed in this action and the civil claims of the State for the violations alleged in the State Complaint filed in the State Court action through the Date of Lodging.

87. The United States and the State reserve all legal and equitable remedies available to enforce the provisions of this Consent Decree, except as expressly stated in Paragraph 86. This Consent Decree shall not be construed to limit the rights of the United States or the State to obtain penalties or injunctive relief under the Act or implementing regulations, under the Illinois Act or implementing regulations, or under other federal or state laws, regulations, or permit conditions, except as expressly specified in Paragraph 86. The United States and the State further reserve all legal and equitable remedies to address any imminent and substantial endangerment to the public health or welfare or the environment arising at, or posed by, Defendant's Facility, whether related to the violations addressed in this Consent Decree or otherwise.

88. In any subsequent administrative or judicial proceeding initiated by the United States or the State for injunctive relief, civil penalties, other appropriate relief relating to the Facility or Defendant's violations, Defendant shall not assert, and may not maintain, any defense or claim based upon the principles of waiver, res judicata, collateral estoppel, issue preclusion, claim preclusion, claim-splitting, or other defenses based upon any contention that the claims raised by the United States or the State in the subsequent proceeding were or should

have been brought in the instant case, except with respect to claims that have been specifically resolved pursuant to Paragraph 86 of this Section.

89. This Consent Decree is not a permit, or a modification of any permit, under any federal, State, or local laws or regulations. Defendant is responsible for achieving and maintaining complete compliance with all applicable federal, State, and local laws, regulations, and permits; and Defendant's compliance with this Consent Decree shall be no defense to any action commenced pursuant to any such laws, regulations, or permits, except as set forth herein. The United States and the State do not, by their consent to the entry of this Consent Decree, warrant or aver in any manner that Defendant's compliance with any aspect of this Consent Decree will result in compliance with provisions of the Act, 42 U.S.C. § 7401 *et seq*., or the Illinois Act, 415 ILCS 5/1 *et seq*., or with any other provisions of federal, State, or local laws, regulations, or permits.

90. This Consent Decree does not limit or affect the rights of Defendant or of the United States or the State against any third parties, not party to this Consent Decree, nor does it limit the rights of third parties, not party to this Consent Decree, against Defendant, except as otherwise provided by law.

91. This Consent Decree shall not be construed to create rights in, or grant any cause of action to, any third party not party to this Consent Decree.

XIII. COSTS

92. The Parties shall bear their own costs of this action, including attorneys' fees, except that the United States and the State shall be entitled to collect the costs (including attorneys' fees) incurred in any action necessary to collect any portion of the civil penalty or any stipulated penalties due but not paid by Defendant.

XIV. NOTICES

93. Unless otherwise specified herein, whenever notifications, submissions, or communications are required by this Consent Decree, they shall be made in writing and addressed as follows:

To the United States:

Chief, Environmental Enforcement Section
Environment and Natural Resources Division
U.S. Department of Justice
Box 7611 Ben Franklin Station
Washington, D.C. 20044-7611
Re: DOJ No. 90-5-2-1-2177/2

To EPA:

Air and Radiation Division
U.S. Environmental Protection Agency
Region 5
77 W. Jackson Blvd. (AE-17J)
Chicago, IL 60604
Attn: Compliance Tracker

and

Office of Regional Counsel
U.S. Environmental Protection Agency
Region 5
77 W. Jackson Blvd. (C-14J)
Chicago, IL 60604

To the State:

Chief, Environmental Bureau
Illinois Attorney General's Office
69 W. Washington Street, Suite 1800
Chicago, IL 60602

To Illinois EPA:

Deputy Counsel – Air Enforcement
Division of Legal Counsel
Illinois Environmental Protection Agency

1021 North Grand Avenue East
Springfield, Illinois 62702

Manager, Division of Air Pollution Control
Illinois Environmental Protection Agency
1021 North Grand Avenue East
Springfield, Illinois 62702

To Defendant:

H. Kramer & Co.
1345 West 21st Street
Chicago, Illinois 60608
Attn: President

and

Todd R. Wiener, Esq.
McDermott Will & Emery LLP
227 West Monroe Street
Chicago, Illinois 60606

94. Any Party may, by written notice to the other Parties, change its designated notice recipient or notice address provided above.

95. Notices submitted pursuant to this Section shall be deemed submitted upon mailing, unless otherwise provided in this Consent Decree or by mutual agreement of the Parties in writing.

XV. EFFECTIVE DATE

96. The Effective Date of this Consent Decree shall be the date upon which this Consent Decree is entered by the Court or a motion to enter the Consent Decree is granted, whichever occurs first, as recorded on the Court's docket.

XVI. RETENTION OF JURISDICTION

97. The Court shall retain jurisdiction over this case until termination of this Consent Decree, for the purpose of resolving disputes arising under this Decree or entering

orders modifying this Decree, pursuant to Sections X and XVII, or effectuating or enforcing compliance with the terms of this Decree.

XVII. MODIFICATION

98. The terms of this Consent Decree, including any attached appendices, may be modified only by a subsequent written agreement signed by all the Parties. Where the modification constitutes a material change to this Decree, it shall be effective only upon approval by the Court.

99. Any disputes concerning modification of this Decree shall be resolved pursuant to Section X of this Decree (Dispute Resolution), provided, however, that, instead of the burden of proof provided by Paragraph 78, the Party seeking the modification bears the burden of demonstrating that it is entitled to the requested modification in accordance with Federal Rule of Civil Procedure 60(b).

XVIII. TERMINATION

100. After Defendant has completed the requirements of Section V (Compliance Requirements) of this Decree, has complied with all other requirements of this Consent Decree, including those relating to the SEP required by Section VI of this Consent Decree, has paid the civil penalty and any accrued stipulated penalties as required by this Consent Decree, and three years have passed since the Effective Date of this Consent Decree, Defendant may serve upon the United States and the State a Request for Termination, stating that Defendant has satisfied those requirements, together with any necessary supporting documentation.

101. Following receipt by the United States and the State of Defendant's Request for Termination, the Parties shall confer informally concerning the Request and any

disagreement that the Parties may have as to whether Defendant has satisfactorily complied with the requirements for termination of this Consent Decree. If the United States, after consultation with the State, agrees that the Decree may be terminated, the Parties shall submit, for the Court's approval, a joint stipulation or motion terminating the Decree.

102. If the United States, after consultation with the State, does not agree that the Decree may be terminated, Defendant may invoke Dispute Resolution under Section X of this Decree. However, Defendant shall not seek Dispute Resolution of any dispute regarding termination, under Paragraph 74 of Section X, until 30 Days after service of its Request for Termination.

XIX. PUBLIC PARTICIPATION

103. This Consent Decree shall be lodged with the Court for a period of not less than 30 Days for public notice and comment in accordance with 28 C.F.R. § 50.7. The United States reserves the right to withdraw or withhold its consent if the comments regarding the Consent Decree disclose facts or considerations indicating that the Consent Decree is inappropriate, improper, or inadequate. Defendant consents to entry of this Consent Decree without further notice and agrees not to withdraw from or oppose entry of this Consent Decree by the Court or to challenge any provision of the Decree, unless the United States has notified Defendant in writing that it no longer supports entry of the Decree.

XX. SIGNATORIES/SERVICE

104. Each undersigned representative of Defendant, the State of Illinois and the Assistant Attorney General for the Environment and Natural Resources Division of the Department of Justice or her designee certifies that he or she is fully authorized to enter into the

terms and conditions of this Consent Decree and to execute and legally bind the Party he or she represents to this document.

105. This Consent Decree may be signed in counterparts, and its validity shall not be challenged on that basis. Defendant agrees to accept service of process by mail with respect to all matters arising under or relating to this Consent Decree and to waive the formal service requirements set forth in Rules 4 and 5 of the Federal Rules of Civil Procedure and any applicable Local Rules of this Court including, but not limited to, service of a summons.

XXI. INTEGRATION

106. This Consent Decree constitutes the final, complete, and exclusive agreement and understanding among the Parties with respect to the settlement embodied in the Decree and supersedes all prior agreements and understandings, whether oral or written, concerning the settlement embodied herein. Other than deliverables that are subsequently submitted and approved pursuant to this Decree, no other document, nor any representation, inducement, agreement, understanding, or promise, constitutes any part of this Decree or the settlement it represents, nor shall it be used in construing the terms of this Decree.

XXII. FINAL JUDGMENT

107. Upon approval and entry of this Consent Decree by the Court, this Consent Decree shall constitute a final judgment of the Court as to the United States, the State, and Defendant. The Court finds that there is no just reason for delay and therefore enters this judgment as a final judgment under Fed. R. Civ. P. 54 and 58.

XXIII. APPENDICES

108. The following appendices are attached to and part of this Consent Decree:

"Appendix A" is the Interim Order.

"Appendix B" is the Permit.

"Appendix C" is the Supplemental Environmental Project Plan.

Dated and entered this 28 day of March, 2013.

Charles Norgle

UNITED STATES DISTRICT JUDGE FOR
THE NORTHERN DISTRICT OF ILLINOIS

THE UNDERSIGNED PARTY enters into this Consent Decree in the matter of *United States and State of Illinois v. H. Kramer & Co. (N.D. Illinois)*, subject to public notice and comment.

FOR PLAINTIFF UNITED STATES OF AMERICA:

Date: January 28, 2013

s/Robert E. Maher, Jr.
ROBERT E. MAHER, JR.
Acting Deputy Chief
Environmental Enforcement Section
Environment and Natural Resources Division
U.S. Department of Justice

Date: January 28, 2013

s/Annette M. Lang
CATHERINE BANERJEE ROJKO
Senior Attorney
ANNETTE M. LANG
Senior Counsel
Environmental Enforcement Section
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U.S. Department of Justice
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GARY S. SHAPIRO
Acting United States Attorney
Northern District of Illinois

Date: January 28, 2013

s/Kurt N. Lindland
LINDA A. WAWZENSKI
KURT N. LINDLAND
Assistant United States Attorneys
Northern District of Illinois
219 South Dearborn Street, Suite 500
Chicago, Illinois 60604
(312) 353-1994 (phone: L. Wawzenski)
(312) 353-4163 (phone: K. Lindland)
kurt.lindland@usdoj.gov

THE UNDERSIGNED PARTY enters into this Consent Decree in the matter of *United States and State of Illinois v. H. Kramer & Co. (N.D. Illinois)*, subject to public notice and comment.

FOR THE UNITED STATES ENVIRONMENTAL PROTECTION AGENCY:

DATE: January 16, 2013

s/Susan Hedman***
SUSAN HEDMAN
Regional Administrator
U.S. Environmental Protection Agency
Region 5

DATE: December 31, 2012

s/Robert A. Kaplan***
ROBERT A. KAPLAN
Regional Counsel
U.S. Environmental Protection Agency
Region 5

DATE: December 28, 2012

s/Christine M. Liszewski***
CHRISTINE M. LISZEWSKI
Associate Regional Counsel
U.S. Environmental Protection Agency
Region 5
77 W. Jackson Blvd.
Chicago, IL 60604

*** Signed with permission.

THE UNDERSIGNED PARTY enters into this Consent Decree in the matter of *United States and State of Illinois) v. H. Kramer & Co. (N.D. Illinois)*

FOR PLAINTIFF THE STATE OF ILLINOIS:

LISA MADIGAN, Attorney General

MATTHEW J. DUNN, Chief
Environmental Enforcement/Asbestos Litigation Division

DATE: January 30, 2013

s/Elizabeth Wallace***
ELIZABETH WALLACE, Chief
Environmental Bureau
Assistant Attorney General
69 West Washington Street, Suite 1800
Chicago, IL 60602

THE ILLINOIS ENVIRONMENTAL
PROTECTION AGENCY

JOHN J. Kim, Interim Director
Illinois Environmental Protection Agency

DATE: January 29, 2013

s/John J. Kim***
JOHN J. KIM
Interim Director
Illinois Environmental Protection Agency
1021 North Grand Avenue East
P.O. Box 19276
Springfield, IL 62794-9276

*** Signed with permission.

THE UNDERSIGNED PARTY enters into this Consent Decree in the matter of *United States and State of Illinois v. H. Kramer & Co. (N.D. Illinois)*:

FOR H. KRAMER & CO.:

DATE: December 24, 2012

s/Randall K. Weil***
RANDALL K. WEIL
Executive Vice President
H. Kramer & Co.

*** Signed with permission.

EMISSION MEASUREMENT CENTER
GUIDELINE DOCUMENT (GD-042)

PREPARATION AND REVIEW

OF

SITE-SPECIFIC EMISSION TEST PLANS

Revised March 1999

PREFACE

This guideline document is made available to promote consistency in the preparation and review of site-specific emission test plans for emission test programs performed for the U.S. Environmental Protection Agency (EPA), State and local agencies, and private sector interests.

The site specific test plan comprises written descriptions, summary tables, and figures that encompass all aspects of a planned emission test program at a particular facility location. After the test is performed, an emission test report is prepared to provide the information necessary to document the data collected and provide evidence that proper procedures were used to accomplish the test objectives. The emission test report presents the information gathered according to the emission test plan. Therefore, the contents of the test plan serve as the foundation for the test report.

This guideline document presents a standard format for preparing the test plan. The standard test plan contains a table of contents, nine sections, and appendices if needed. Rather than providing a general discussion of the standard format, this document lists the contents for each section. Then an example is given to illustrate the intent of each item in the list. The list at the beginning of each section serves a dual purpose: (1) as a guide to the preparer and (2) as a checklist for both the preparer and the reviewer of the test plan.

Readers may reproduce any part of this guideline.

TABLE OF CONTENTS

TABLE OF CONTENTS

The site-specific test plan must contain:

- *Table of contents*
- *List figures*
- *List of tables*

EXAMPLE: *At a minimum, the table of contents must include the items shown below:*

TABLE OF CONTENTS

1.0 Introduction

2.0 Source Description

3.0 Test Program

4.0 Sampling Locations

5.0 Sampling and Analytical Procedures

6.0 QA/QC Activities

7.0 Reporting and Data Reduction Requirements

8.0 Plant Entry and Safety

9.0 Personnel Responsibilities and Test Schedule

Appendix A - Test Methods

1.0 INTRODUCTION

1.1 SUMMARY OF TEST PROGRAM

*In this section, write a **brief summary** that identifies or states, as applicable, the following:*

- *Responsible groups or organizations*
- *Overall purpose of the emission test*
- *Regulations, if applicable*
- *Industry*
- *Name of plant*
- *Plant location*
- *Processes of interest*
- *Air pollution control equipment, if applicable*
- *Emission points and sampling locations*
- *Pollutants to be measured*
- *Expected dates of test*

EXAMPLE:

1.1 SUMMARY

The U.S. Environmental Protection Agency (EPA), Office of Air Quality Planning and Standards (OAQPS), Emission Inventory Branch (EIB) is responsible for developing and maintaining air pollution emission factors for industrial processes. EIB in collaboration with the **[Trade Organization]** is presently studying the wood products industry. The purpose of this study is to develop emission factors for oriented strand board (OSB) production facilities. The Emission Measurement Branch (EMB) of OAQPS will coordinate the emission measurement activities. **[Contractor]** and **[Trade Organization]** will conduct the emission measurements.

EPA/EIB and **[Trade Organization]** considered the **[Plant]** in **[City, State]** to be one of four facilities that represent the diversity in wood species and dryer control devices. This test is the second of the four and is scheduled for **[Date]**. Plans are to conduct simultaneous measurements at the inlet and outlet of the electrified filter bed (EFB) for the No. 1 wood wafer dryer exhaust and at the press vents. Pollutants to be measured are: particulate matter (PM), condensible particulate matter (CPM), carbon monoxide (CO), nitrogen oxides (NO_X), hydrocarbons (HC), formaldehyde, other aldehydes, and ketones (F/A/K), and volatile and semivolatile organic compounds.

1.2 TEST PROGRAM ORGANIZATION

In this section, include the following:

- *Test program organizational chart with lines of communication*
- *Names and phone numbers of responsible individuals*
- *If necessary, a discussion of the specific organizational responsibilities*

EXAMPLE:

1.2 TEST PROGRAM ORGANIZATION

Figure 1-1 presents the OSB test program organization, major lines of communication, and names and phone numbers of responsible individuals.

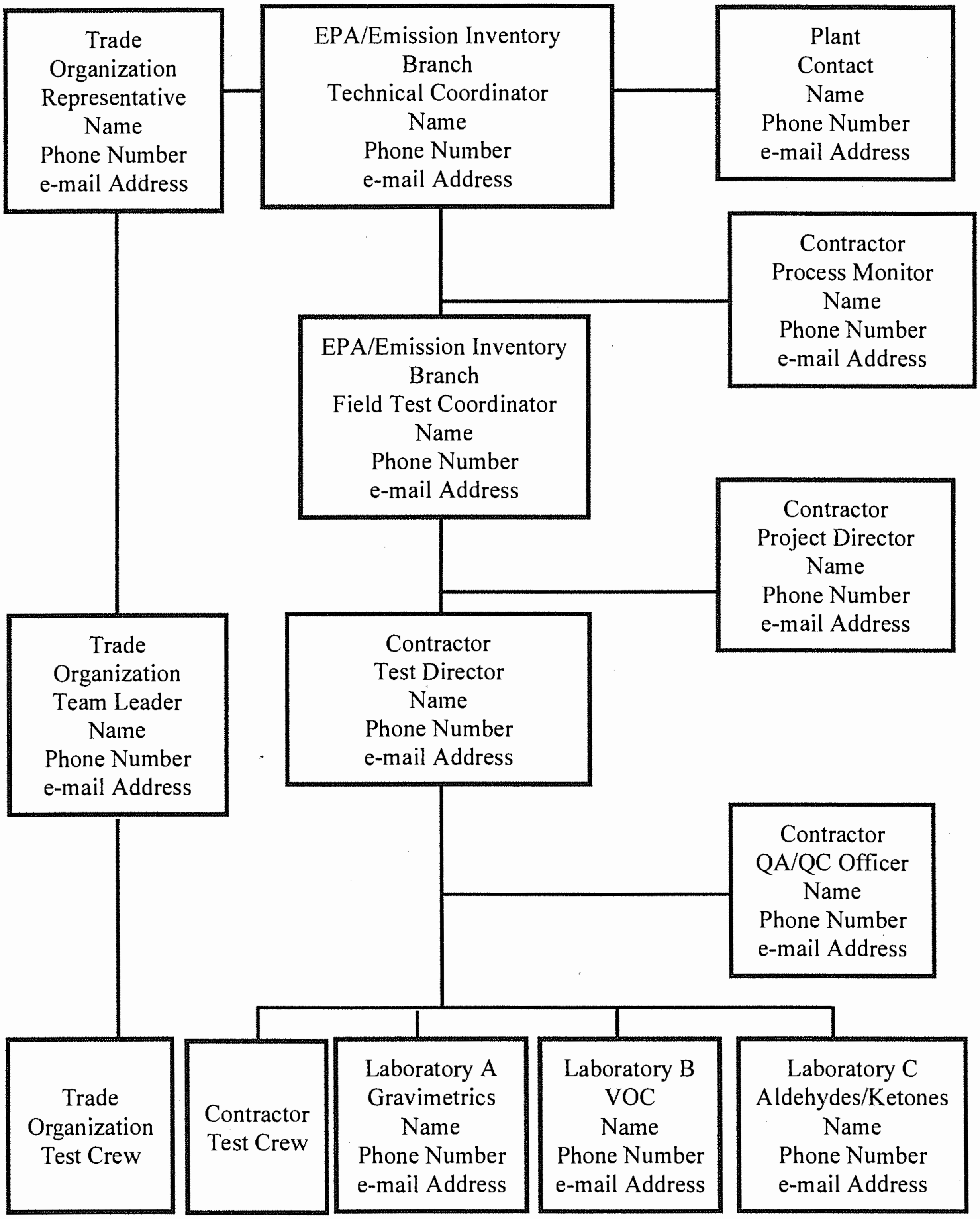


Figure 1-1. Example test program organization.

2.0 SOURCE DESCRIPTION

2.1 PROCESS DESCRIPTION

In this section, include the following:

- *Flow diagram (indicate emission and process stream test points) and general description of the basic process*
- *Discussion of unit or equipment operations that might affect testing or test results, e.g., batch operations, high moisture or temperature effluents, presence of interfering compounds, and plant schedule*
- *List of key operating parameters and standard operating ranges, production rates, or feed rates, if available*

In the flow diagram, trace the process from the beginning to the end. Identify the major operations. Show only those gas, liquid, and solid flow streams that relate to the emissions test.

EXAMPLE:

2.1 PROCESS DESCRIPTION

Figure 2-1 illustrates the basic processing steps for OSB production. The steps are:

- Logs are slashed, debarked, cut into shorter lengths, and sliced into thin wafers.
- The wafers are dried, classified, blended and mixed with resin, oriented, and formed into a mat.
- The formed mats are separated into desired lengths, heated, and pressed to activate the resin and bond the wafers into a solid sheet.
- Sheets are trimmed, edge treated, and packaged for shipping.

At this **[Plant]**, the wood mix is about 60 percent soft wood (e.g., pine), 30 percent soft hardwood (e.g., sweet gum), and 10 percent hardwood. Two 12-foot diameter dryers process 30,000 to 32,000 lb/hr of flakes. The moisture content of the flakes leaving the dryer is about 3 to 4 percent. Inlet temperatures to the dryer run about 750 to 900°F and the exit temperatures about 235 to 255°F. A McConnel burner fired with recycled waste, such as wood trim, fines, and resinated sander dust, heats the dryers. An oil-fired Wellens burner serves as a backup.

The emission test points are EFB inlet and outlet (stack) and the roof vents from the press (see Figure 2–1)

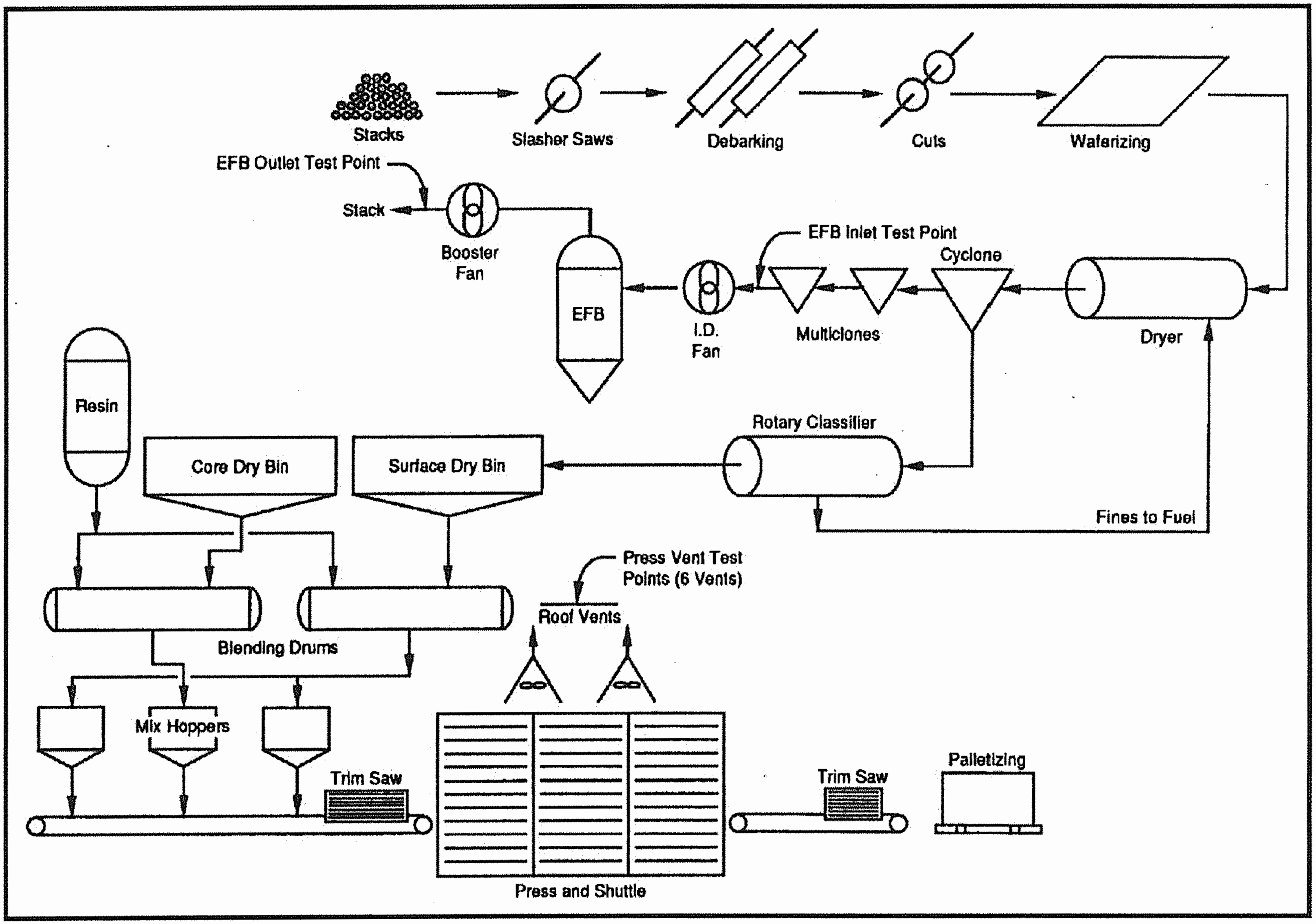


Figure 2-1 Oriented strand board (OSB) process flow diagram.

2.2 CONTROL EQUIPMENT DESCRIPTION

In this section, include the following:

- *Description of all air pollution control systems*
- *Discussion of typical control equipment operation and, if necessary, a schematic*
- *Normal operating ranges of key parameters, if available*

EXAMPLE: *This example covers only the electrified filter bed. In the actual case, the cyclones would also be discussed.*

2.2 CONTROL EQUIPMENT DESCRIPTION

Particulate matter from the wafer dryer is controlled by cyclones and an electrified filter bed (EFB) manufactured by **[Manufacturer]**. Figure 2-2 is a schematic of an ionizer and gravel bed assembly. The EFB is an electrostatic precipitator (ESP) that uses pea-gravel as its collection electrodes.

The gases enter the EFB into an annular region formed by two concentric cylinders. The inner cylinder is the ionizer. Ions formed by the ionizer stream toward the adjacent cylinder wall and impart electrostatic charges on dust particles.

After passing through the ionizer, the gas flows down the chamber into the filter bed section. The filter bed consists of pea-shaped gravel held between two cylindrical louvers. A high DC positive voltage polarizes the gravel and induces regions of positive and negative charge on the pebbles. As the gases pass through the pebble bed, the negatively charged dust particles are collected on the positively charged regions on the gravel.

As dust accumulates in the filter bed, the resistance to gas flow increases. To maintain constant flow and remove collected particles, the EFB slowly and continu-ously removes gravel from the bottom. The removed gravel is agitated to remove the dust particles and is recycled into the EFB at the top.

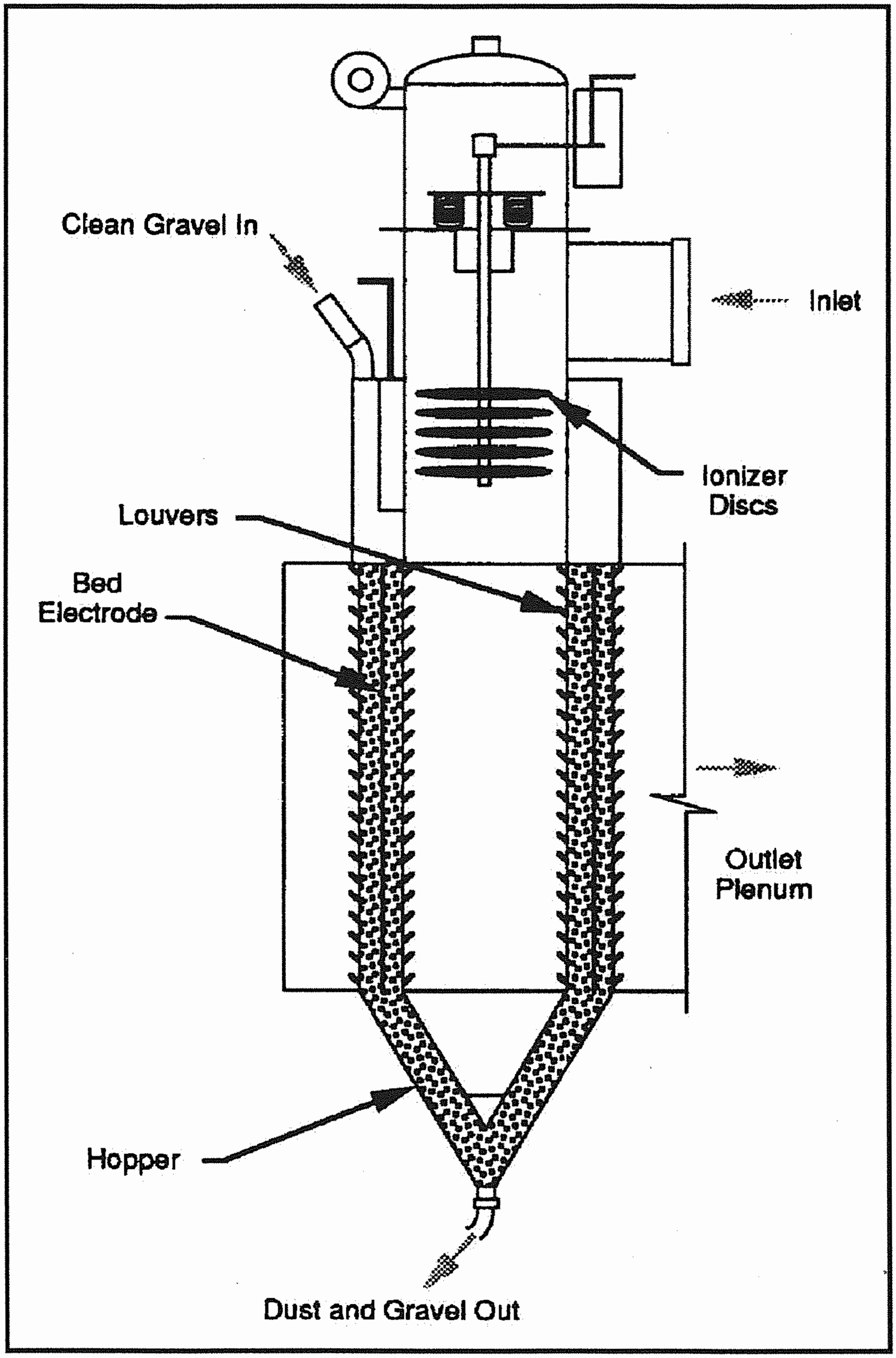


Figure 2-2 Ionizer and gravel bed assembly.

3.0 TEST PROGRAM

3.1 OBJECTIVES

In this section:

- *Restate the overall purpose of the test program.*
- *List (in order of priority) the specific objectives for both emissions and process operation data.*

EXAMPLE:

3.1 OBJECTIVES

The purpose of the test program is to develop emission factors for OSB production facilities from the wood products industry. The specific objectives in order of priority are:

- Measure simultaneously the emissions of PM, CPM, CO, NO_X, HC, formaldehyde (plus other aldehydes and ketones), and volatile and semi-volatile organics at the wood wafer dryer EFB inlet and outlet locations.

- Measure formaldehyde (plus other aldehydes and ketones) emissions from the press vents.

- During the test period, obtain production rates (number of press loads and belt speed), inlet and outlet dryer temperatures, drying rates, EFB bed voltage and current, and EFB voltage and ionizer current.

- Determine the relationship between Method 25 and Method 25A for HC, and between Method 202 and the Oregon Department of Environmental Quality (ODEQ) Method 7 for particulates (PM and CPM).

- Assess the suitability of deriving a correction factor for Method 25A.

- Obtain normal plant operation in hours/day, days/per week, and weeks/year, overall plant design capacity, and average production rates.

3.2 TEST MATRIX

Include a table showing the following (include schematics, if helpful):

- *Sampling locations*
- *Number of runs*
- *Sample type/pollutant*
- *Sampling method*
- *Sample run time*
- *Analytical method*
- *Analytical laboratory*

EXAMPLE:

3.2 TEST MATRIX

Table 3-1 presents the sampling and analytical matrix. Table 3-2 shows all the measurements being made at each test location.

TABLE 3-1. **[PLANT, LOCATION]** TEST MATRIX

Sampling Location	No. of Runs	Sample/Type Pollutant[a]	Sampling Method[b]	Sampling Org	Sample Run Time (min)	Analytical Method[c]	Analytical Laboratory
Outlet Stack	3	PM/CPM	M202 (M5 Filter and Backup Filter)[d]	Ctr-A	60	Gravimetric (PM-M5, CPM-M202, Backup Filter-ODEQ M7)	PM/CPM-Ctr-A Backup Filter-Trade Org
Outlet Stack	3	O_2/CO_2	M3 (bag)	Ctr-A	60	Orsat (M3)	Ctr-A
Outlet Stack	3	CO	M10 (CEM)	Ctr-A	60	NDIR (M10)	Ctr-A
Outlet Stack	3	NO_x	M7E (CEM)	Ctr-A	60	Chemiluminescence (M7E)	Ctr-A
Outlet Stack	6[e]	THC	M25A (CEM)	Ctr-A	60	FID (M25A)	Ctr-A
Outlet Stack	6[e]	TGNMO (dual train)	M25	Trade Org	60	Catalysis, GC/FID, NDIR (M25)	Trade Org
Outlet Stack	3	Formaldehyde/ Aldehydes/ Ketones	SW-846 M0011	Ctr-A	60	HPLC (M0011)	Lab-A
Outlet Stack	3	VOC[f]	SW-846 M0010 (MM5)	Ctr-A	60	HRGC/LRMS (M8270), HPLC	Lab-B/ Lab-A
Outlet Stack	3	VOC[g]	SW-846 M0030 (VOST)	Ctr-A	60	HRGC/LRMS (M5040 and M8240)	Lab-B
Outlet Stack	3[h]	TOC	Evacuated Cylinder	Ctr-B	60	Catalytic FID	Ctr-B
Inlet	3	PM/CPM	M202 (M5 Filter and Backup Filter)[d]	Ctr-A	60	Gravimetric (PM-M5, CPM-M202, Backup Filter-ODEQ M7)	PM/CPM Ctr-A Backup Filter-Trade Org
Inlet	6[e]	O_2/CO_2	M3	Ctr-A	60	Orsat (M3)	Ctr-A
Inlet	6[e]	THC	M25A (CEM)	Ctr-A	60	FID (M25A)	Ctr-A
Inlet	3	TGNMO (dual train)	M25	Trade Org	60	Catalysis, GC/FID (M25)	Trade Org
Inlet	3	Formaldehyde/ Aldehydes/ Ketones	SW-846 M0011	Ctr-A	60	HPLC (M0011)	Lab-A

Sampling Location	No. of Runs	Sample/Type Pollutant[a]	Sampling Method[b]	Sampling Org	Sample Run Time (min)	Analytical Method[c]	Analytical Laboratory
Press Vents	3[i]	Formaldehyde/ Aldehydes/ Ketones	SW-846 M0011	Ctr-A	60	HPLC (M0011)	Lab-A
	3	O_2/CO_2	M3	Ctr-A	60	Orsat	Ctr-A

[a] PM-particulate matter, CPM - condensible particulate matter, TGNMO - total gaseous nonmethane organics, VOC - volatile organic compounds, TOC - total organic carbon.

[b] M - EPA Method, CEM - EPA Instrumental Method using continuous emission monitors.

[c] NDIR - Nondispersive infrared, FID - flame ionization detector, GC - gas chromatograph, HPLC - high performance liquid chromatography.

[d] Backup filter to approximate Oregon Department of Environmental Quality (ODEQ) Method 7.

[e] Three additional runs are tentatively planned following the main test program; if possible, the process parameters will be varied during this additional testing.

[f] Semivolatile organic compounds, including target compounds and tentatively identified compounds, plus oxygenated compounds caught in aqueous fractions.

[g] Volatile organic compounds.

[h] To be conducted with final three of six runs for M25 and M25A; sample acquisition to evaluate proposed analytical technique for total organic carbon measurements.

[i] Each run will be conducted on two of eight vents.

TABLE 3-2. MEASUREMENTS AT EACH TEST LOCATION

RUNS 1, 2, AND 3	
EFB Inlet	**EFB Outlet**
PM/CPM (M-202)	PM/CPM (M-202)
O_2/CO_2 (M-3)	O_2/CO_2 (M-3)
HC (M-25A)	HC (M-25A)
TGNMO (dual) (M-25)	TGNMO (dual) (M-25)
F/A/K (M-0011)	F/A/K (M-0011)
	CO (M-10)
	NO_X (M-7E)
	TOC (Evac. Cont.)
RUNS 4, 5, AND 6	
	HC (M-25A)
	TGNMO (dual) (M-25)

RUN 1	RUN 2	RUN 3
Press Vents 2 & 3	Press Vents 4 & 5	Press Vents 6 & 7
F/A/K (M-0011)	F/A/K (M-0011)	F/A/K (M-0011)
O_2/CO_2 (M-3)	O_2/CO_2 (M-3)	O_2/CO_2 (M-3)

Note: All sampling trains are to be conducted simultaneously within each run. For example, during Run 1, all trains under EFB inlet, EFB outlet, and Press Vents 2&3 are to be run simultaneously.

4.0 SAMPLING LOCATIONS

4.1 FLUE GAS SAMPLING LOCATIONS

In this section:

- *Provide a schematic of each location. Include:*
  - *duct diameter*
  - *direction of flow*
  - *dimensions to nearest upstream and downstream disturbances (include number of duct diameters)*
  - *location and configuration of the sampling ports*
  - *nipple length and port diameters*
  - *number and configuration of traverse points*
- *Confirm that the sampling location meets EPA criteria. If not, give reasons and discuss effect on results.*
- *Discuss any special traversing or measurement schemes.*

EXAMPLE:

4.1 FLUE GAS SAMPLING LOCATIONS

Emission sampling will be conducted at: (1) the EFB inlet on dryer No. 1, (2) the EFB outlet stack on dryer No. 1, and (3) the press vents. Figures 4-1, 4-2, and 4–3 are schematics of these sampling locations.

4.1.1 EFB Inlet. See Figure 4-1. Four 4-inch ports will be installed at Sections XX and YY as shown. Because of obstructions around the site, Section XX was the only practical location for Methods 202 and 0011. Method 1 requires that Section XX have 24 traverse points; each point will be sampled for 2.5 minutes for a total time of 60 minutes. One train will traverse into the duct while the other traverses out. At Section YY, about 2 feet below Section XX, one port will be used for the paired Method 25 single-point sampling and the second for Methods 25A and 3.

4.1.2 EFB Outlet. See Figure 4-2. The outlet stack for the EFB presently has two 4-inch sampling ports A and B. Additional 4-inch ports C through H will be installed as shown. Methods 202, 0011, and MM5 will be conducted at Section XX at 24 points (2.5 minutes at each point), the VOST train will be conducted at port E, and Methods 25 (dual), 10, 7E, and 3 will be conducted at Section YY.

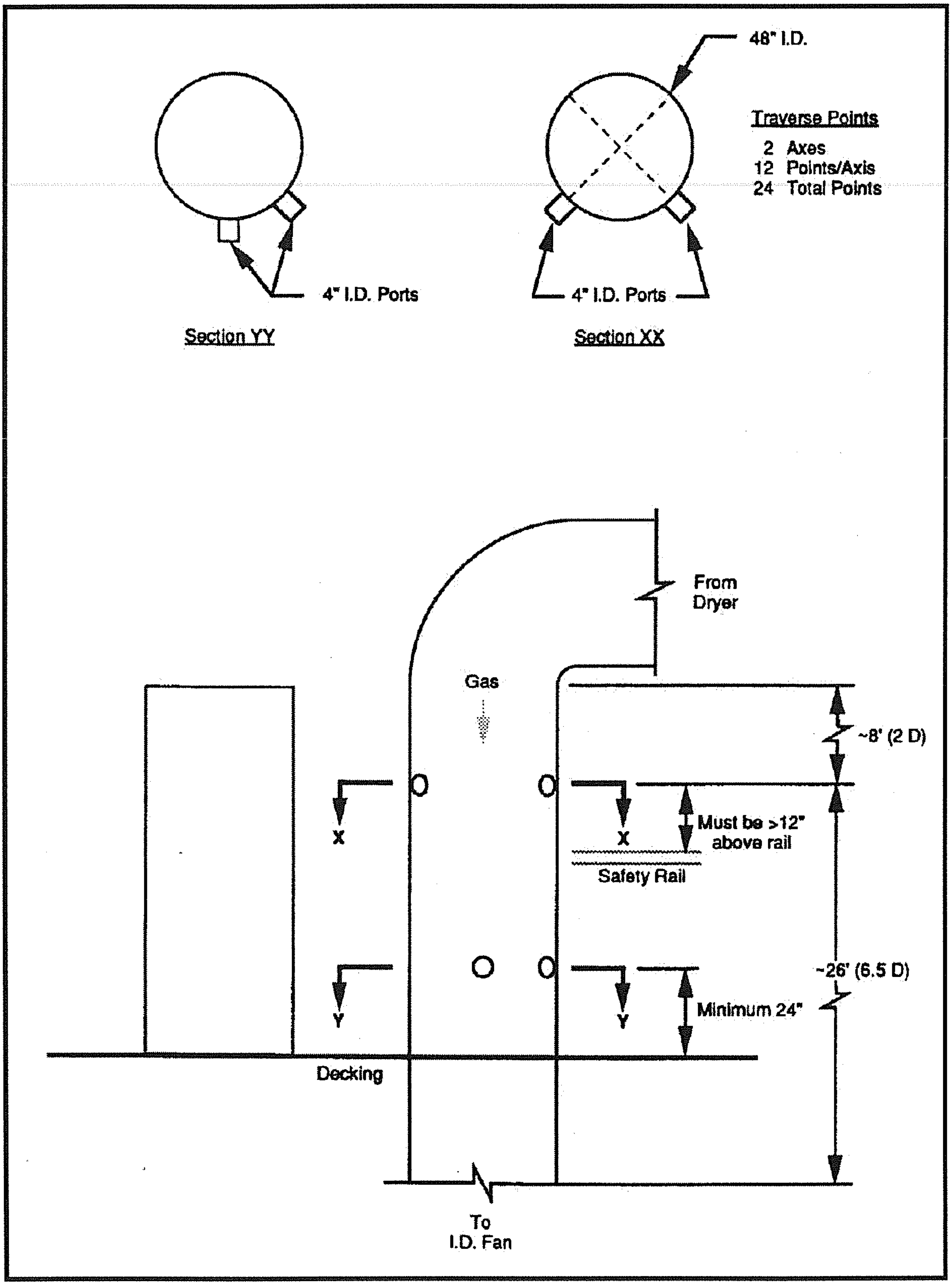


Figure 4-1 Schematic of Unit No, 1EFB inlet sampling location.

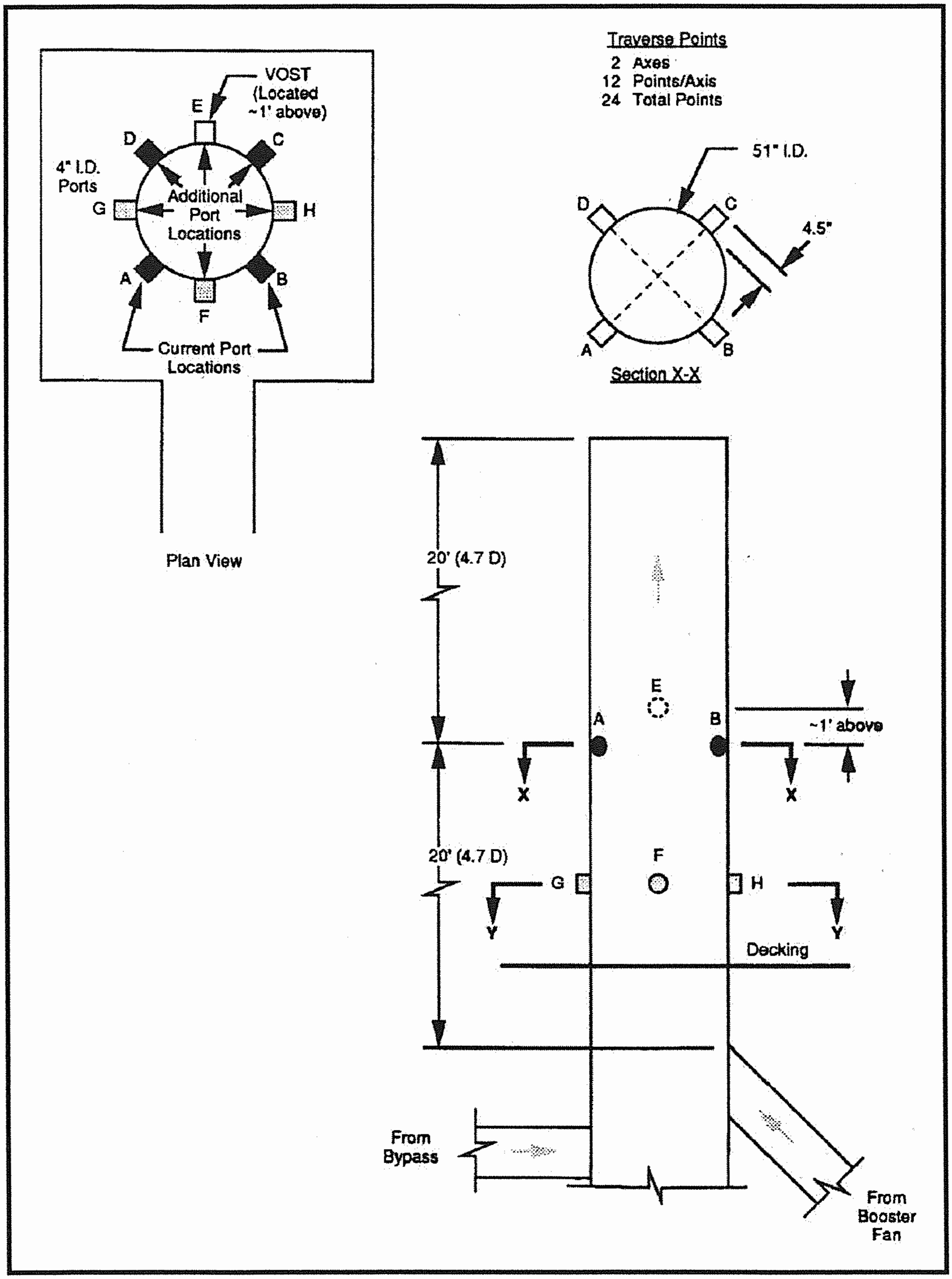


Figure 4-2 Schematic of Unit 1 EFB outlet stack sampling location.

4.1.3 Press Vents. See Figure 4-3. The press has eight roof vents as shown in the figure. The two vents on the ends (1 and 8) will not be tested because they are not directly over the press and little or no emissions are expected from these vents. Different pairs of the other six vents will be sampled for formaldehyde emissions (Method 0011) during each of the three test runs.

At this location, a 4-foot stack extension to improve flow conditions will be constructed. The extension will contain one 4-inch port. Each vent "stack" will be traversed (12 points) in only one direction. The traverse of the second vent of a pair will be in the direction perpendicular to the first vent traverse. Although the location does not meet Method 1 requirements, the results will not be affected since no particulate sampling is conducted at the press vents. The flow will be checked for non-parallel flow using the procedure in Section 2.5 of Method 1 before the tests to ensure that velocity can be measured accurately.

4.2 PROCESS SAMPLING LOCATIONS

If process stream samples will be taken, include the following:

- *Schematic of locations, if helpful (location can be shown in figure in Section 2.0)*
- *Description of each sampling or measurement location*
- *Discussion on the representativeness of each of the process stream sampling locations*

EXAMPLE: *The OSB test plan did not require any process samples to be taken. Therefore, the example below was taken from a site-specific test plan for a drum mix asphalt plant. At this plant, a tank of waste fuel is used to supply the burners for the drum mixer. The plan required one grab sample per run of the waste fuel.*

4.2 WASTE FUEL SAMPLE LOCATION

The sample for each test run will be taken from a tap at the outlet of the waste fuel supply tank to the burners. The sample is this point is expected to be homogeneous.

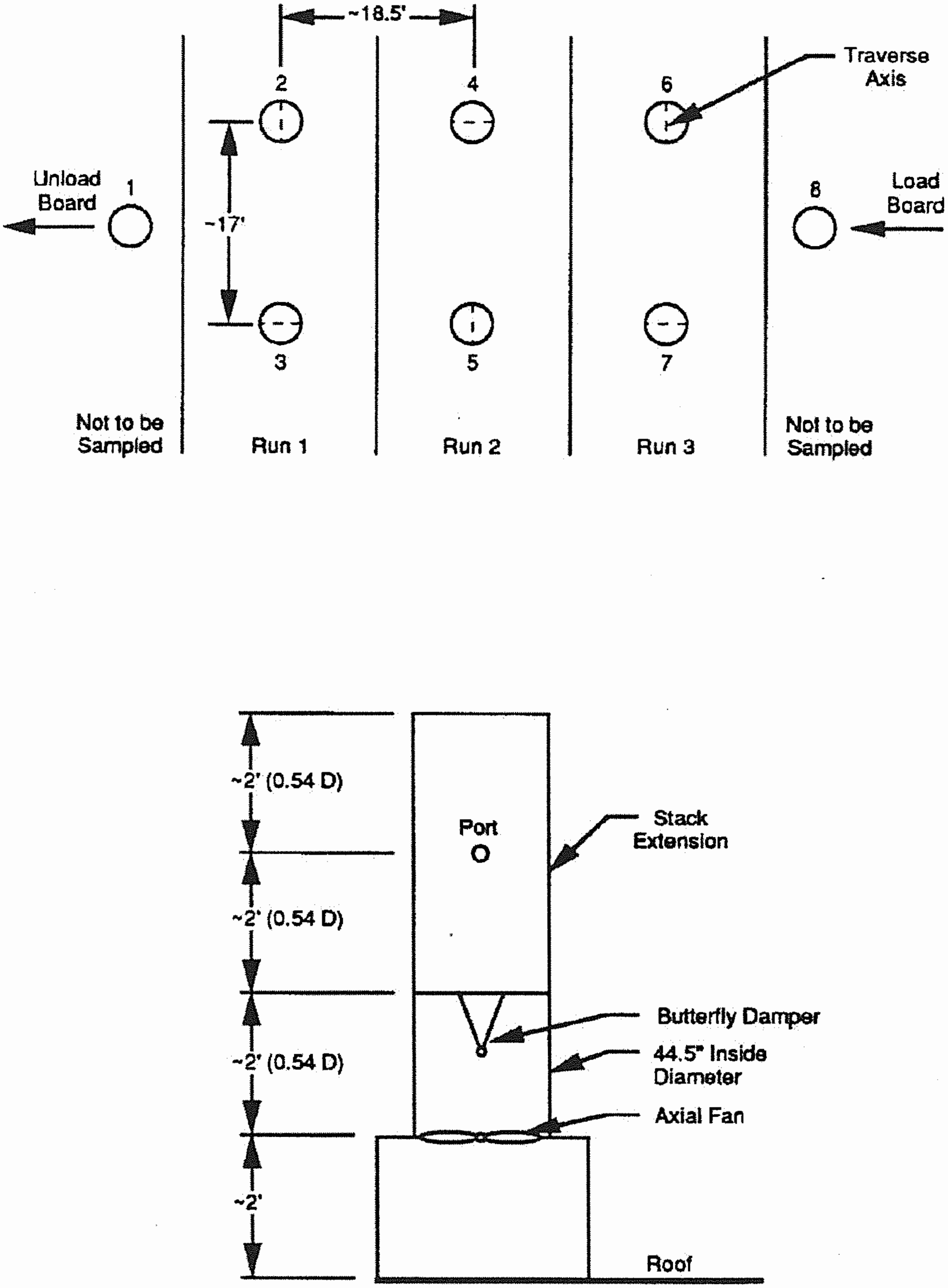


Figure 4-3 Press Vents sampling location configuration and testing scheme.

5.0 SAMPLING AND ANALYTICAL PROCEDURES

5.1 TEST METHODS

In this section, include the following:

- *Schematic of each sampling train*
- *Flow diagram of the sample recovery*
- *Flow diagram of sample analysis*
- *Description of any modifications and reasons for them*
- *Discussion of any problematic sampling or analytical conditions*

If a non-EPA method is used instead of an EPA method, explain the reason. Place a copy of all methods in Appendix A. Be sure that non-EPA methods are written in detail similar to that of the EPA methods.

EXAMPLE: *This example is for just one of the test methods. The site-specific test plan should include similar schematics and flow diagrams for each of the test methods.*

5.1 TEST METHODS

5.1.1 Particulate Matter/Condensible Particulate Matter. PM/CPM at the inlet and outlet of the EFB will be determined by Method 202. One of the objectives of this test is to compare Method 202 with ODEQ Method 7, which is identical to Method 202 except for the following:

- A second filter is placed just before the silica gel impinger.
- Acetone rather than methylene chloride is used in the final rinse of the impingers and connecting glassware.
- An optional out-of-stack filter is used before the impingers.

Because of space limitations, Method 202 will be modified by inserting a second filter in the same position as that in the ODEQ Method 7. This back-up filter will be analyzed gravimetrically according to the ODEQ procedure. All other procedures will be those of Method 202. These modifications will not affect the results from Method 202. Figures 5-1 and 5-2 are schematics of Method 202 (showing modification) and ODEQ Method 7, respectively.

Figures 5-3 and 5-4 illustrate the sample recovery procedure and analysis schemes, respectively.

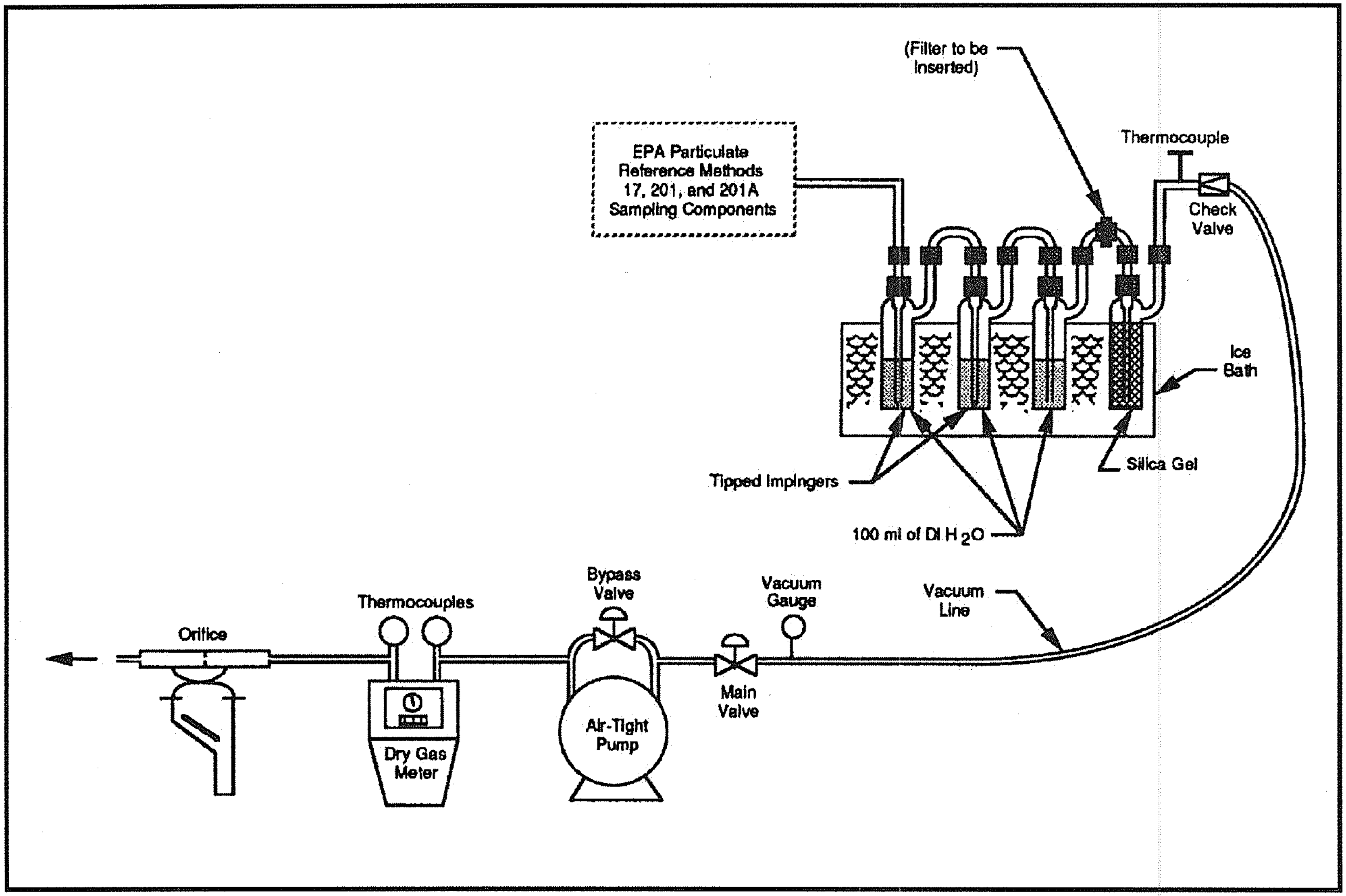


Figure 5-1 EPA Method 202 condensable particulate sampling train.

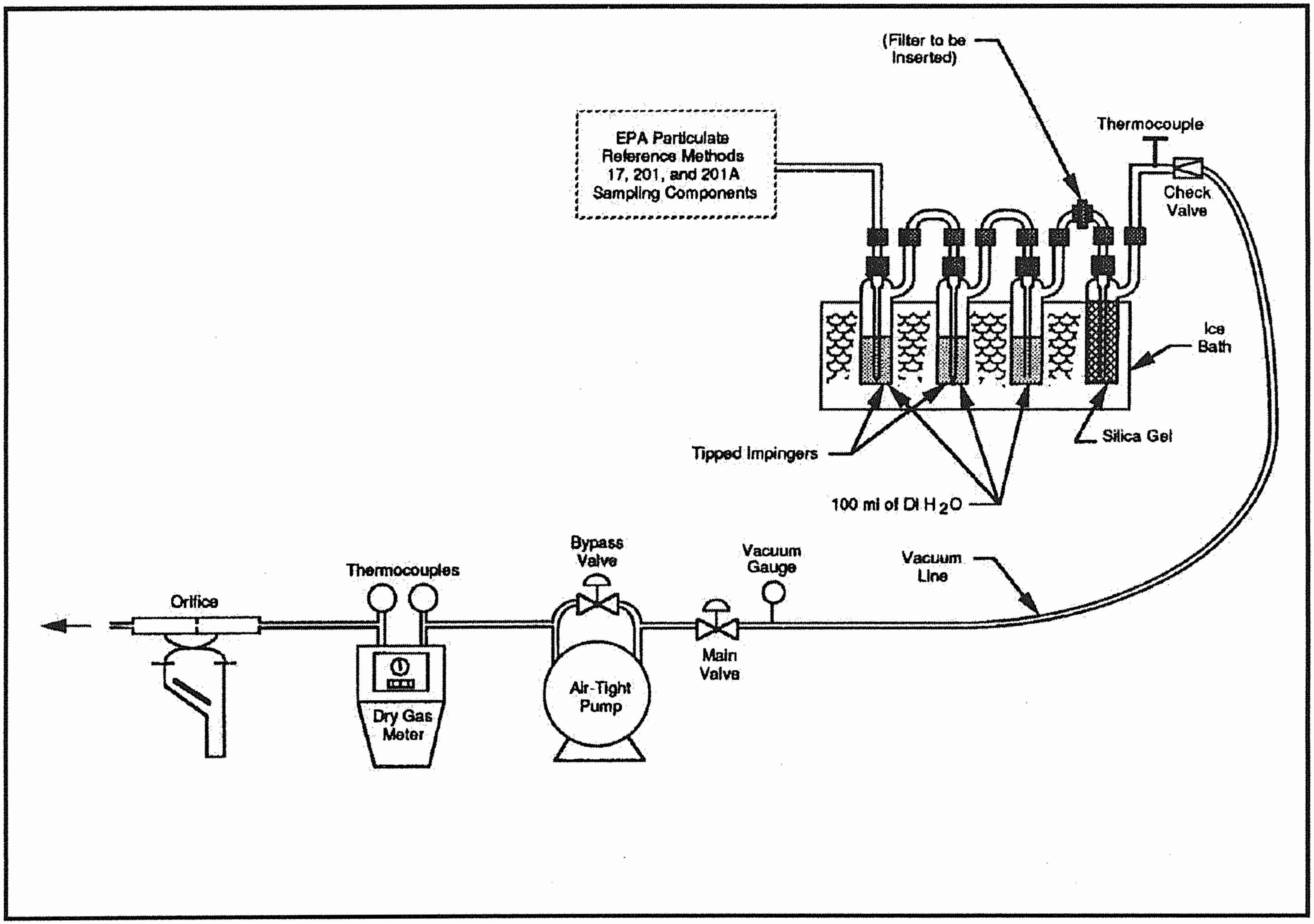


Figure 5-2 EPA Method 202 condensable particulate sampling train.

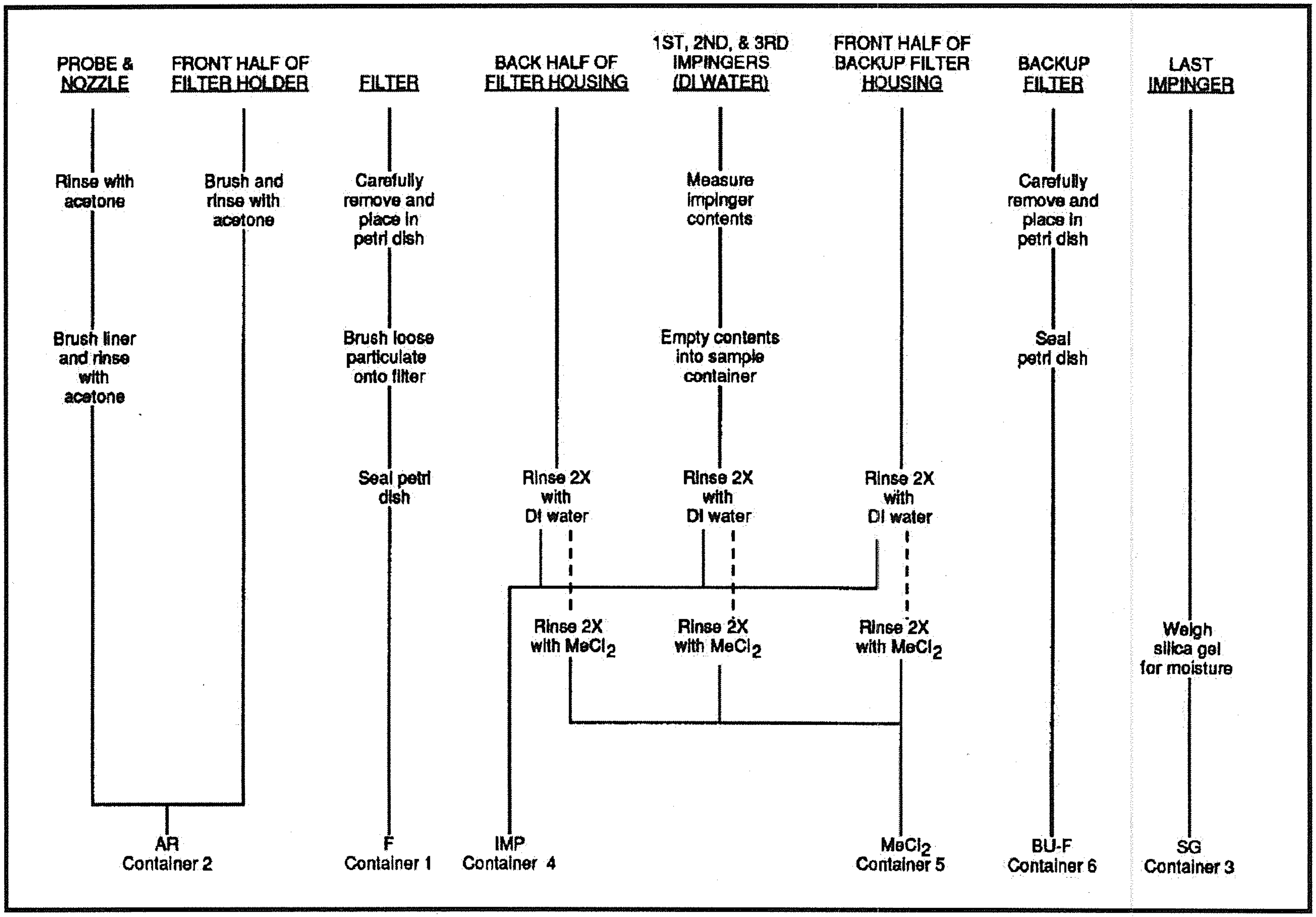


Figure 5-3 Sample recovery scheme for particulate/condensables samples.

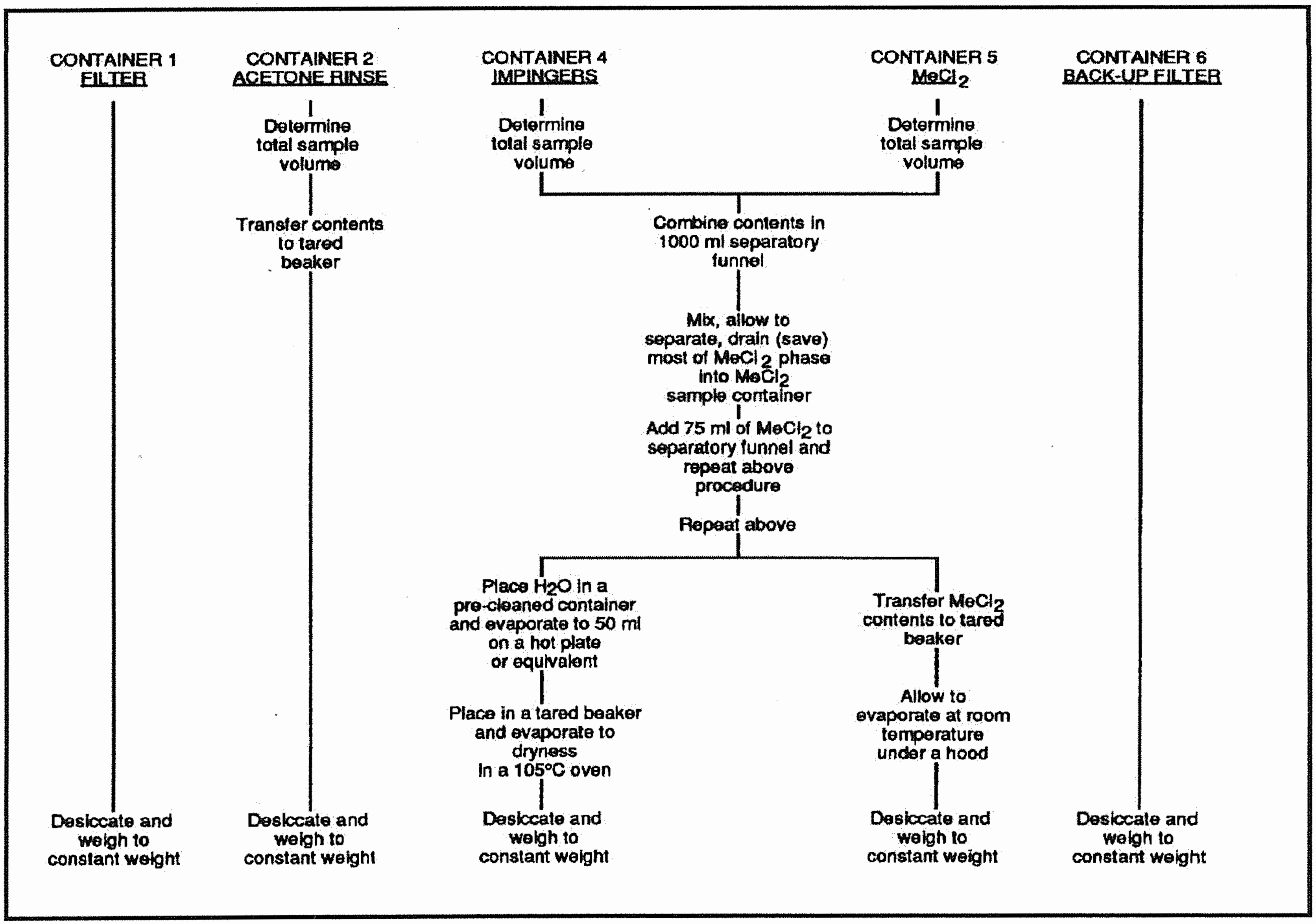


Figure 5-4 Analytical scheme for particulate/condensables samples.

5.2 PROCESS DATA

In this section, include the following:

•Description of analytical, sampling, or other procedures for obtaining process stream and control equipment data

EXAMPLE:

5.2 PROCESS DATA

The following process operation data will be collected:

- Number of press loads during EFB inlet/outlet testing
- Number of press loads during press vent testing
- Dryer inlet and outlet temperatures
- Belt speed
- EFB bed voltage and current
- EFB ionizer voltage and current

The **[Process Monitor]** will count the number of press loads, and obtain the dryer data from the central control panel and the EFB data from the EFB control panel.

6.0 QA/QC ACTIVITIES

6.1 QC PROCEDURES

In this section, provide the following for each test method:

- *Data sheets*
- *QC check lists, which could be part of the data sheets*
- *QC control limits*
- *Discussion of any special QC procedures*

Examples of QC checks would be calibration of instruments, matrix spikes, duplicate analyses, internal standards, blanks, linearity checks, drift checks, response time checks, and system bias checks.

EXAMPLE: *Examples for Method 1 and Method 2 are provided below. Other examples of data sheets/QC check lists may be obtained through EMTIC.*

6.1 QC PROCEDURES

Data sheets that also act as QC check lists and include QC control limits for Methods 1 and 2 are shown in Figures 6-1 and 6-2.

6.2 QA AUDITS

For each of the test methods for which an audit is to be conducted, list (if applicable) the following:

- *Type of audits to be conducted*
- *Limits of acceptability*
- *Supplier of audit material*
- *Audit procedure*
- *Audit data sheet/QC check list*

EXAMPLE: *An example for Method 5 dry gas meter is provided below. Other examples of data audit sheets/QC check lists may be obtained from EMTIC.*

6.2 QA AUDITS

Calibrated critical orifices (about 0.5 cfm) supplied by EPA will be used to audit the Method 5 dry gas meter calibration. The dry gas meter value must agree to within ±5 percent of the critical orifice value. The procedure in Section 7.2 of Method 5 will be used. The data sheet provided by EPA will be used.

Sampling and Velocity Traverse Point Determination
EPA Method 1

PLANT NAME ____________________

CITY, STATE ____________________

SAMPLING LOCATION ____________________

NO. OF PORTS AVAILABLE ____________________

NO. OF PORTS USED ____________________

PORT INSIDE DIAMETER ____________________

DISTANCE FROM FAR WALL TO OUTSIDE OF PORT ________

NIPPLE LENGTH AND/OR WALL THICKNESS ________

DEPTH OF STACK OR DUCT ________

STACK OR DUCT WIDTH (IF RECTANGULAR) ________

EQUIVALENT DIAMETER:

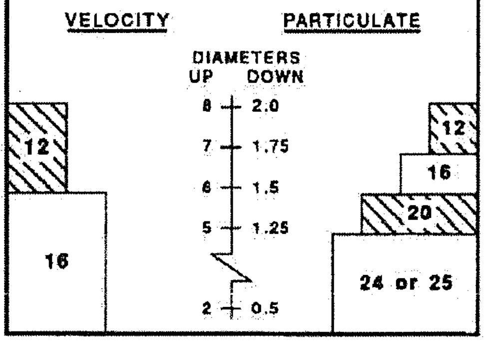
$$D_E = \frac{2 \times \text{DEPTH} \times \text{WIDTH}}{\text{DEPTH} + \text{WIDTH}} = \frac{2\,(\quad)\,(\quad)}{(\quad + \quad)} = \_\_\_\_\_\_$$

DISTANCE FROM PORTS TO FLOW DISTURBANCES	UPSTREAM	DOWNSTREAM
	________	________
DIAMETERS	________	________

STACK/DUCT AREA = ________ = ________ IN^2
(must be > $113 in.^2$)

DRAW HORIZONTAL LINE THROUGH DIAMETERS

If more than 8 and 2 diameters and if duct dia. is 12 - 24, use 8 or 9 points.



POINT	% OF DUCT DEPTH	DISTANCE FROM INSIDE WALL	DISTANCE FROM OUTSIDE OF PORT
1			
2			
3			
4			
5			
6			
7			
8			
9			
10			
11			
12			

LOCATION OF POINTS IN CIRCULAR STACKS OR DUCTS

	4	6	8	10	12
1	6.7	4.4	3.2	2.6	2.1
2	25.0	14.6	10.5	8.2	6.7
3	75.0	29.6	19.4	14.6	11.8
4	93.3	70.4	32.3	22.6	17.7
5		85.4	67.7	34.2	25.0
6		95.6	80.6	65.8	35.6
7			89.5	77.4	64.4
8			96.8	85.4	75.0
9				91.8	82.3
10				97.4	88.2
11					93.3
12					97.9

LOCATION OF POINTS IN RECTANGULAR STACKS OR DUCTS

	3	4	5
1	16.7	12.5	10.0
2	50.0	37.5	30.0
3	83.3	62.5	50.0
4		87.5	70.0
5			90.0

Do not place points closer to stack walls than
1.0 in. for stack dia. >24 in.
0.5 in. for stack dia. 12 to <24 in.

For rectangular stacks, use only the following matrices:

No. Pts.	Matrix
9	3 x 3
12	4 x 3
16	4 x 4
25	5 x 5

Check for completeness ________

Checked by (Signature) ____________________

Figure 6-1

FIGURE 6-2. EXAMPLE VELOCITY DATA SHEET

Date ____________________ Run No. _______ Test Location ________________
Plant ______________________________ Operator ______________________________

Schematic: Cross-Section

Pitot ID No. __________________________
Pitot coeff: C_p = _____________________
Last calibrated: Date: ________________
Pitot condition: ______________________
____

Gauge sensitivity:
Req'd _____________________ in. H_2O
Actual _____________________ in. H_2O
Calibration:
Pre-test ________________
Post-test _______________
Leak check: (None)
Pre-test: _______________
Post-test: ______________

Temp. ID No. _______________
Temp. calibration: (1.5% abs)
Pre-test ________________
Post-test _______________

Barometric presssure gauge calibration:
(0.1 in. Hg)
Pre-test ________________
Post-test _______________
Barometric pressure: P_b = _________ in. Hg

Static pressure: P_s = ____________ in. Hg

Pitot configuration/assembly:
Sketch/dimensions

Start Time: ______________________

Port/ Trav. Pt.	Δp in. H_2O	Stk temp. °F

Checked for completeness by (Signature/Title) ______________________________

6.3 QA/QC CHECKS OF DATA REDUCTION

In this section, describe the following:

- *Procedure for assuring accurate transfer of raw data and accuracy of calculations*
- *Data quality indicators, such as*
  - *Using F_0 factors to validate Orsat, CEM CO_2/O_2 data*
  - *Comparing process O_2 monitor and CEM O_2 data*
  - *Comparing flow rates measured at different locations or by different sampling trains*
  - *Comparing relative concentrations at different sampling locations*
  - *Comparison of data with previous field test results (if applicable)*
  - *Running mass balances*

EXAMPLE:

6.3 QA/QC CHECKS OF DATA REDUCTION

The **[QA Officer]** will run an independent check (using a validated computer program) of the calculations with predetermined data before the field test. This will ensure that calculations done in the field are accurate. The **[QA Officer]** will also conduct a spot check on-site to assure that data are being recorded accurately. After the test, the **[QA Officer]** will check the data input to assure that the raw data have been transferred to the computer accurately.

The F_0 factors from Method 3 will be used to validate the CO_2/O_2 data. Since the fuel consists of wood trim, fines, and resinated sander dust, the F_0 factor is expected to be within 1.000 and 1.120.

The inlet and outlet volumetric flow rates will be compared. In addition, the volumetric flow rates from the Method 202 and MM5 trains will be compared. Agreement within these two trains should be ±10 percent.

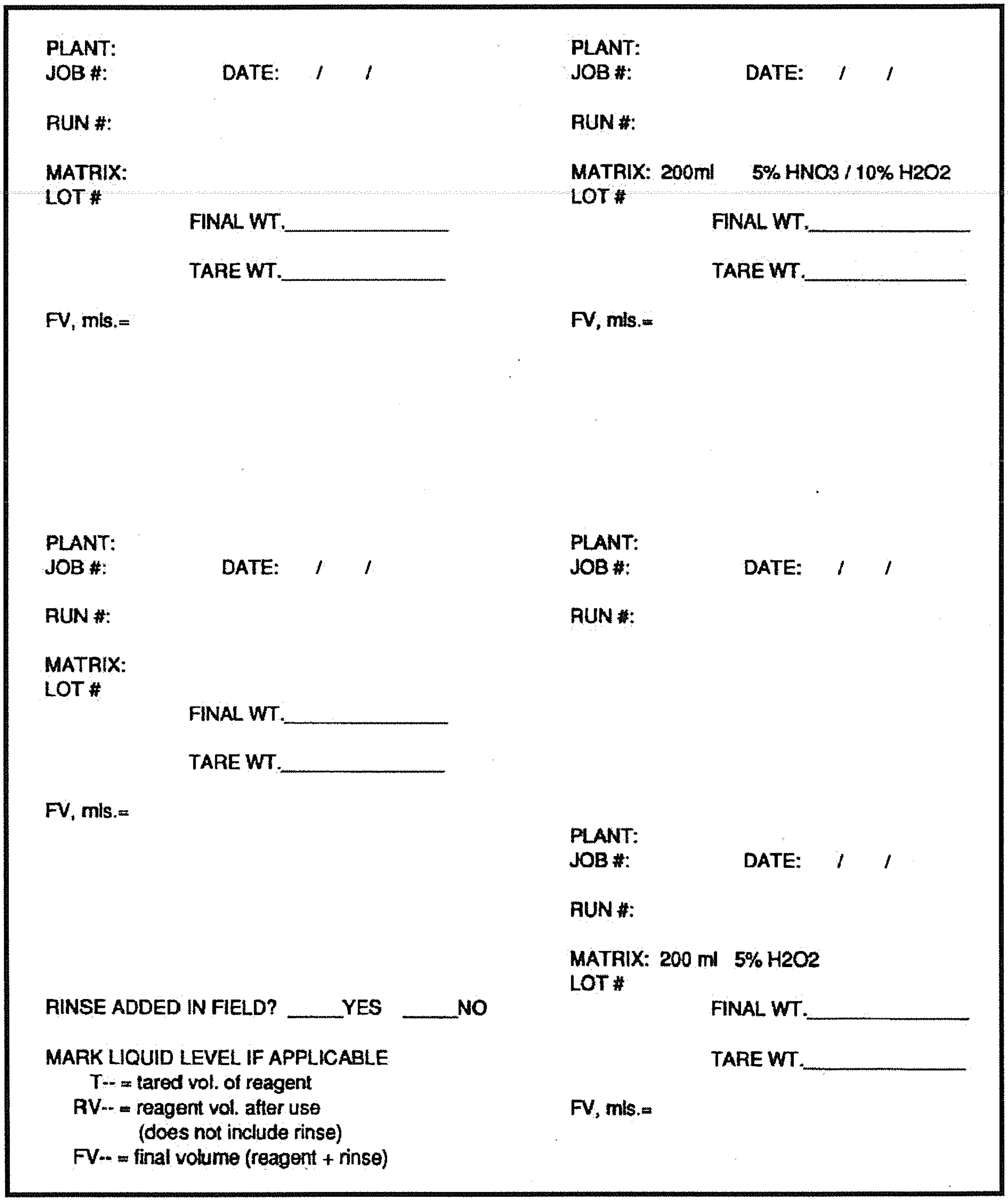
6.4 SAMPLE IDENTIFICATION AND CUSTODY

- *Person responsible*
- *Sample identification and chain-of-custody procedure*
- *Sample identification label*
- *Chain-of-custody form*
- *Sample log sheet*

EXAMPLE: *The scheme for identifying samples should be logical and easily deciphered, e.g., 2I-PM-F means Run No. 2, inlet, particulate matter sample, filter.*

6.4 SAMPLE IDENTIFICATION AND CUSTODY

The **[Task Leader]** is responsible to ensure that all samples are accounted for and that proper custody procedures are followed. After collecting and recovering the sample, the **[QA Officer]** will supply sample labels and integrity seals, maintain inventory records of all the samples taken, and ensure that chain-of-custody forms are filled. Figures 6-3 through 6-6 show some examples.



PLANT:
JOB #: DATE: / /

RUN #:

MATRIX:
LOT #
FINAL WT.______________

TARE WT.______________

FV, mls.=

PLANT:
JOB #: DATE: / /

RUN #:

MATRIX:
LOT #
FINAL WT.______________

TARE WT.______________

FV, mls.=

RINSE ADDED IN FIELD? _____YES _____NO

MARK LIQUID LEVEL IF APPLICABLE
T-- = tared vol. of reagent
RV-- = reagent vol. after use
(does not include rinse)
FV-- = final volume (reagent + rinse)

PLANT:
JOB #: DATE: / /

RUN #:

MATRIX: 200ml 5% HNO3 / 10% H2O2
LOT #
FINAL WT.______________

TARE WT.______________

FV, mls.=

PLANT:
JOB #: DATE: / /

RUN #:

PLANT:
JOB #: DATE: / /

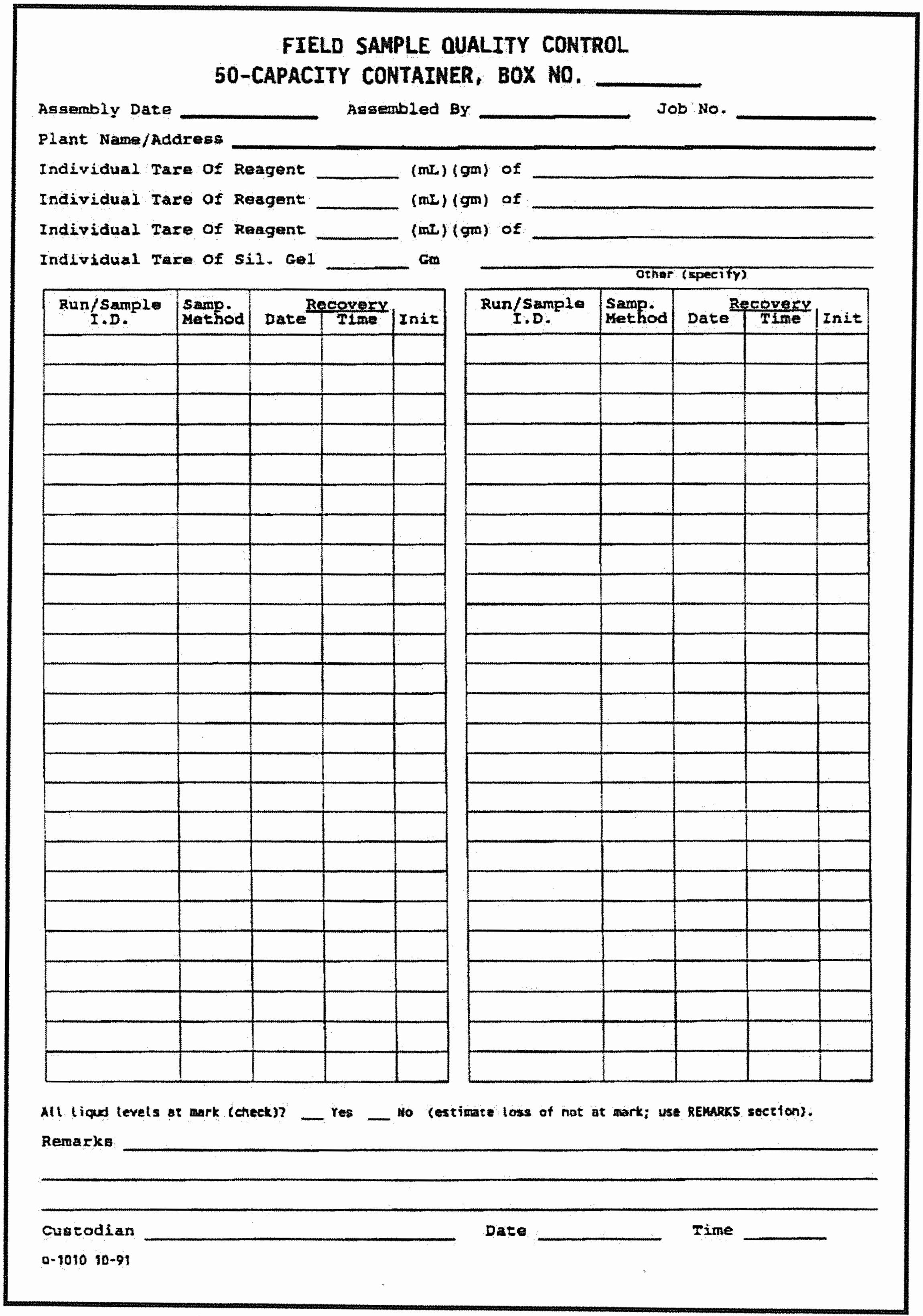
RUN #:

MATRIX: 200 ml 5% H2O2
LOT #
FINAL WT.______________

TARE WT.______________

FV, mls.=

Figure 6-3. Example sample labels.



FIELD SAMPLE QUALITY CONTROL
50-CAPACITY CONTAINER, BOX NO. ________

Assembly Date ____________ Assembled By ____________ Job No. ____________

Plant Name/Address ____

Individual Tare Of Reagent ________ (mL)(gm) of ____________________

Individual Tare Of Reagent ________ (mL)(gm) of ____________________

Individual Tare Of Reagent ________ (mL)(gm) of ____________________

Individual Tare Of Sil. Gel ________ Gm ____________________
Other (specify)

Run/Sample I.D.	Samp. Method	Recovery			Run/Sample I.D.	Samp. Method	Recovery		
		Date	Time	Init			Date	Time	Init

All liquid levels at mark (check)? ___ Yes ___ No (estimate loss of not at mark; use REMARKS section).

Remarks ____
____
____

Custodian ____________________ Date ____________ Time ________

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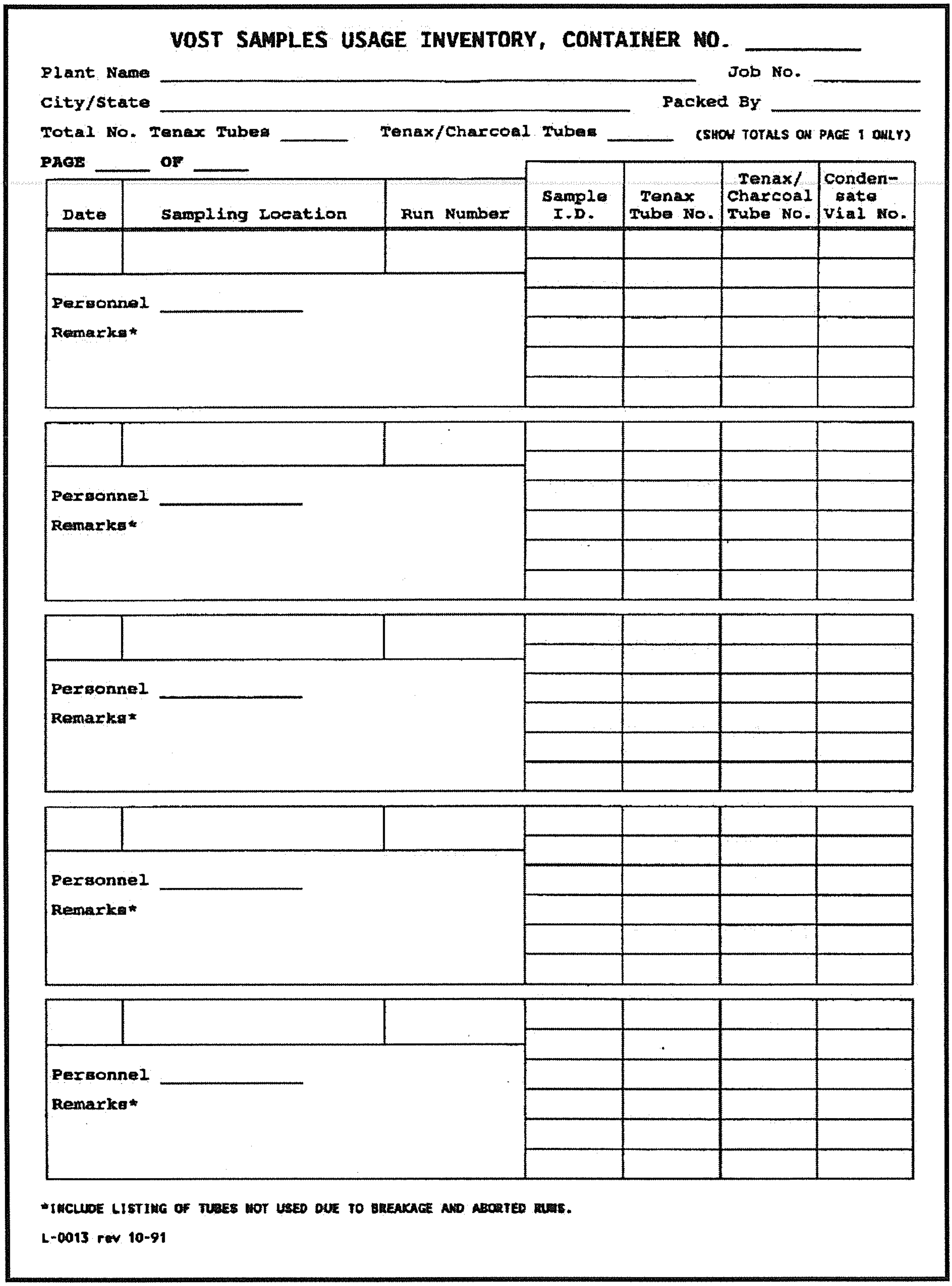
Figure 6-4. Example field sample quality control sheet.



VOST SAMPLES USAGE INVENTORY, CONTAINER NO. ________

Plant Name ________________________________ Job No. ________

City/State ________________________________ Packed By ________

Total No. Tenax Tubes ______ Tenax/Charcoal Tubes ______ (SHOW TOTALS ON PAGE 1 ONLY)

PAGE _____ OF _____

Date	Sampling Location	Run Number	Sample I.D.	Tenax Tube No.	Tenax/ Charcoal Tube No.	Conden- sate Vial No.
Personnel ____________						
Remarks*						
Personnel ____________						
Remarks*						
Personnel ____________						
Remarks*						
Personnel ____________						
Remarks*						
Personnel ____________						
Remarks*						

*INCLUDE LISTING OF TUBES NOT USED DUE TO BREAKAGE AND ABORTED RUNS.

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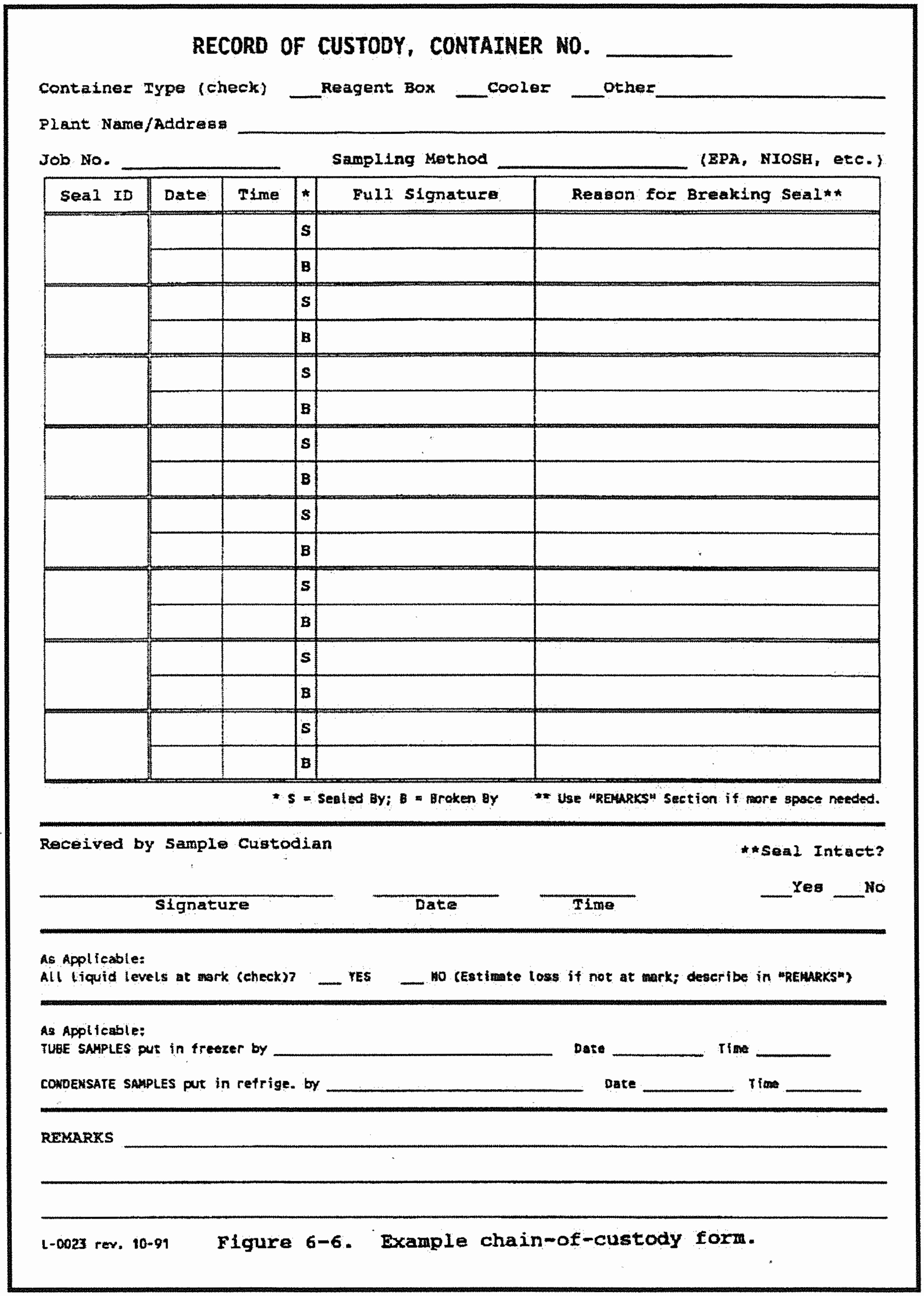
Figure 6-5. Example sample inventory sheet.



RECORD OF CUSTODY, CONTAINER NO. ____________

Container Type (check) ___Reagent Box ___Cooler ___Other_____________________

Plant Name/Address ____

Job No. _______________ Sampling Method ________________ (EPA, NIOSH, etc.)

Seal ID	Date	Time	*	Full Signature	Reason for Breaking Seal**
			S		
			B		
			S		
			B		
			S		
			B		
			S		
			B		
			S		
			B		
			S		
			B		
			S		
			B		
			S		
			B		

* S = Sealed By; B = Broken By ** Use "REMARKS" Section if more space needed.

Received by Sample Custodian **Seal Intact?

_____________________ Signature _________ Date _______ Time ___Yes ___No

As Applicable:
All liquid levels at mark (check)? ___ YES ___ NO (Estimate loss if not at mark; describe in "REMARKS")

As Applicable:
TUBE SAMPLES put in freezer by ______________________ Date __________ Time ________

CONDENSATE SAMPLES put in refrige. by ____________________ Date __________ Time ________

REMARKS ____

____

____

L-0023 rev. 10-91 Figure 6-6. Example chain-of-custody form.

Figure 6-6. Example chain-of-custody form.

7.0 REPORTING AND DATA REDUCTION REQUIREMENTS

7.1 REPORT FORMAT

In this section, include:

- *Table of contents for the test report*

EXAMPLE:

7.1 REPORT FORMAT

The Table of Contents for the report will be:

TABLE OF CONTENTS

7.2 DATA REDUCTION AND SUMMARY

In this section, include:

- *Data summary tables; include units (e.g., lb/mmBtu, lb/ton of product, dscm corrected to 6% O_2)*

EXAMPLE: *The example is for only one of the sets of measurements. Similar tables should be made for all sets of data.*

7.2 DATA REDUCTION AND SUMMARY

Table 7-1 shows the format to be used to summarize the data.

TABLE 7-1. SUMMARY TABLE FORMAT OF EMISSION DATA

Method/Component	Units	EFB Inlet				EFB Outlet				Press Vents			
		Run 1	Run 2	Run 3	Avg	Run 1	Run 2	Run 3	Avg	Run 1	Run 2	Run 3	Avg
Method 202										▨	▨	▨	▨
PM	mg/dscm									▨	▨	▨	▨
CPM	mg/dscm									▨	▨	▨	▨
Back-up Filter	mg/dscm									▨	▨	▨	▨
Total	mg/dscm									▨	▨	▨	▨
Method 25A, HC	ppm C									▨	▨	▨	▨
Method 25 - A										▨	▨	▨	▨
TGNMO	ppm C									▨	▨	▨	▨
Condensibles	ppm C									▨	▨	▨	▨
Non-condensibles	ppm C									▨	▨	▨	▨
Method 25 - B										▨	▨	▨	▨
TGNMO	ppm C									▨	▨	▨	▨
Condensibles	ppm C									▨	▨	▨	▨
Non-condensibles	ppm C									▨	▨	▨	▨
M0011													
Formaldehyde	mg/dscm												
Other aldehydes	mg/dscm												
Ketones	mg/dscm												
Total	mg/dscm												
Method 3													
O_2	%												
CO_2	%												
Method 10, CO	ppm	▨	▨	▨	▨					▨	▨	▨	▨
Method 7E, NO_X	ppm	▨	▨	▨	▨					▨	▨	▨	▨
TOC	ppm C	▨	▨	▨	▨					▨	▨	▨	▨

8.0 PLANT ENTRY AND SAFETY

8.1 SAFETY RESPONSIBILITIES

Identify the following individuals:

- *Person responsible for ensuring compliance with plant entry, health, and safety requirements*
- *Facility person or safety officer who has the authority to impose or waive facility restrictions*
- *Tester who has authority to negotiate with facility person any deviations from the facility restrictions*

EXAMPLE:

8.1 SAFETY RESPONSIBILITIES

The **[Test Director]** is responsible for ensuring compliance with plant entry, health, and safety requirements. The **[Facility Person]** has the authority to impose or waive facility restrictions. The **[Project Director]** has the authority to negotiate with facility person any deviations from the facility restrictions.

8.2 SAFETY PROGRAM

Briefly describe:

- *Test contractor's health and safety program*

EXAMPLE:

8.2 SAFETY PROGRAM

[Contractor] has a comprehensive health and safety program that satisfies Federal OSHA requirements. The basic elements include: (1) written policies and procedures, (2) routine training of employees and supervisors, (3) medical monitoring, (4) use of personal protection equipment, (5) hazard communication, (6) pre-mobilization meetings with **[facility]** personnel and **[contractor]** test team personnel, and (7) routine surveillance of the on-going test work.

8.3 SAFETY REQUIREMENTS

In this section:

- *List the facility's safety requirements and emergency response plan.*
- *Note any deviations from the safety requirements, discussions with the plant, and outcome of the discussions concerning the deviations.*

Requirements may include such items as personnel safety equipment, first aid gear, smoking restrictions, vehicle traffic rules, escorts, entrance and exit locations, required communications during and after business hours, e.g., times when testing crew arrives and leaves site, or evacuation procedure for various alarms.

EXAMPLE:

8.3 SAFETY REQUIREMENTS

All test personnel will adhere to the following standard safety and precautionary measures as follows:

- Confine selves to test area only.
- Wear hard hats at all times on-site, except inside sample recovery trailers and mobile CEM laboratory.
- Wear protective shoes or boots in test area.
- Wear protective glasses or goggles at the EFB inlet and outlet test sites, and other areas as designated.
- Have readily available first aid equipment and fire extinguishers.

Before or on the first day on-site, the **[Test Director]** will fill out the Emergency Response Procedure form (see Figure 8-1) and provide copies to be posted at each test site.

Figure 8-1. On-Site Emergency Response Procedures[*]

Project:______________________________ Date:_____________________

Location:_____________________________ By:_______________________

Evacuation Signal:____

When it sounds:____

____

____

____

Gather with other test personnel at (location):_____________________

____

____

All clear signal: ____

____

First aid station location and phone number:________________________

Ambulance phone number:____

Fire Department phone number:____

Hospital phone number:____

[*] Post or secure at your work station for easy reference in the event of an emergency.

9.0 PERSONNEL RESPONSIBILITIES AND TEST SCHEDULE

9.1 TEST SITE ORGANIZATION

In this section:

- *List the key tasks and task leaders.*

EXAMPLE:

9.1 TEST SITE ORGANIZATION

The key tasks and task leaders are:

- Management: **[Name]**
- Test Preparation/Site Restoration: **[Name]**
- Modifications to Facility/Services: **[Name]**
- Sampling Site Accessibility: **[Name]**
- Sample Recovery: **[Name]**
- Daily Sampling Schedule: **[Name]**

9.2 TEST PREPARATIONS

In this section, describe or identify the following:

- *Construction of special sampling and analytical equip-ment*
  - *Description*
  - *Dates for completion of work*
  - *Responsible group*
- *Modifications to the facility, e.g., adding ports, building scaffolding, installing instrumentation, and calibrating and maintaining existing equipment*
  - *Description*
  - *Dates for completion*
  - *Responsible group*
- *Services provided by the facility, such as electrical power, compressed air, and water*
  - *List of all services to be provided by the facility*
  - *Description of modifications or added requirements, if necessary*
- *Access to sampling sites*
  - *Description*
  - *If modifications are required, requirements and responsible group*
- *Sample recovery area*
  - *Description*

- *If a mobile recovery area or laboratory is used, installation location, dates for installation, and responsible group*

EXAMPLE:

9.2 TEST PREPARATIONS

9.2.1 Construction of Special Sampling and Analy-tical Equipment. There are no equipment modifications or special analytical equipment required for this site.

9.2.2 Modifications to Facility. The **[Plant]** crew will install additional 4-inch ID sampling ports as shown in Figures 4-1 and 4-2. In addition, the decking at the outlet stack will be extended to circumvent the stack to allow access to the new sampling port locations. All work will be completed during the scheduled plant shutdowns on July 11 and 25, 1991.

9.2.3 Services Provided by Facility. The **[Plant]** agreed to furnish additional temporary 110 volts, 20 amp power as follows:

• EFB inlet	5 outlets
• EFB outlet stack	5 outlets
• Press vents	2 outlets
• Mobile CEM lab	5 outlets

[Contractor] will provide all other services.

9.2.4 Access to Sampling Sites. There are no special problems or safety issues in gaining access to the testing locations.

9.2.5 Sample Recovery Areas. **[Contractor]** will provide an office trailer (32 ft, 2 foot tongue) and a smaller trailer for sample recovery areas. The office trailer requires a single phase 220 volt power supply for lighting and air conditioning and the smaller trailer requires two 110 volt, 20 amp circuits. The sample recovery task leader will be responsible for locating both sample recovery units in areas as free as possible from ambient dust contamination. The office unit will be used for recovering the M202 and MM5 samples, and the smaller unit will be used for the M0011 (formaldehyde) samples.

9.3 TEST PERSONNEL RESPONSIBILITIES AND DETAILED SCHEDULE

In this section:

- *Describe pre-test activities.*
- *Provide a table that lists staff assignments and responsibilities.*
- *Provide a table or text detailing the test schedule.*

EXAMPLE:

9.3 TEST PERSONNEL RESPONSIBILITIES AND DETAILED SCHEDULE

[Contractor] personnel will arrive at the plant about 1.5 hours before the start of the first test run on each of the two days scheduled for sampling. Pre-test activities on these days will include:

- Meet with the plant contact and the EPA WAM to review the daily test objectives.
- Prepare and set-up (including leak checks) the manual method trains at all test locations.
- Calibrate instrumental analyzers and verify that the data acquisition systems are functioning properly.
- Verify communication links between team members/leaders/plant personnel.

Table 9-1 lists the test personnel and their specific responsibilities. Figure 9-1 and Table 9-2 present a detailed test schedule.

TABLE 9-1. TEST PERSONNEL AND RESPONSIBILITIES

	Staff Assignment	Responsibility
1.	Project Manager/Field Coordinator	Coordinate all test activities. Maintain communications between all test participants, plant personnel, and the EPA Work Assignment Manager. Collect EFB process data
2.	Sampling Location Leader (EFB inlet)	Coordinate and monitor all testing activities at the EFB inlet location. Ensure all field calculations are completed. Prepare and operate the M0011 train.
3.	Sampling Team Leader (EFB inlet)	Prepare and operate the M202 train at the inlet. Record data. Assist in sample recovery as required.
4.	Field Technician (EFB inlet)	Assist in preparation and operation of M202 and M0011 trains as required at EFB inlet location.
5.	Sampling Location Leader (EFB outlet)	Coordinate and monitor all testing activities at outlet stack location. Ensure all field calculations and data are completed. Prepare and operate the MM5 train.
6.	Sampling Team Leader (EFB outlet)	Prepare and operate the M202 train. Record data. Assist in sample recovery as required.
7.	Sampling Team Leader (EFB outlet)	Prepare and operate the M0011 train. Record data. Assist in sample recovery as required.
8.	Sampling Team Leader (EFB outlet)	Prepare and operate VOS train. Record data. Recover VOST samples.
9.	Field Technician (EFB outlet)	Assist in preparation and operation of the MM5, M0011, M202, and VOS trains as required.
10.	Field Technician (EFB outlet)	Assist in preparation and operation of the MM5, M0011, M202, and VOS trains as required.
11.	CEM Inorganics Team (EFB outlet)	Prepare and operate M7E and M10 monitoring systems at EFB outlet stack location. Coordinate with M25A and manual methods testing efforts.
12.	CEM Organics Team (EFB inlet and outlet)	Prepare and operate the M25A monitoring systems at EFB inlet and outlet locations. Coordinate with other CEM and the manual methods testing efforts.
13.	Sampling Location Leader (press vents)	Coordinate testing activities at the press vents. Ensure all field calculations are completed. Prepare and operate the M0011 train.
14.	Field Technician (press vents)	Assist in preparation and operation of M0011 at press vents.
15.	Field Laboratory Team Leader	Coordinate preparation and recovery of sampling trains. Maintain sample chain of custody. Coordinate field repairs.
16.	Field Laboratory Technician	Assist in preparation and recovery of sampling trains and sample inventory.
17.	Process Data Collector (control room)	Record required process parameters at appropriate intervals.

TABLE 9-2. DETAILED TEST SCHEDULE

Crew Member	Activity
<u>Monday, July 29</u>	
1 - 17	Travel to **[City, State]**
1	Contact **[Plant Contact]** EPA Work Assignment Manager, and **[Trade Organization]** representative.
1	Establish communications between the test team, EPA, **[Trade Organization]**, and the plant.
2,3,4	Prepare the inlet sampling location for testing and set-up the equipment. Conduct preliminary measurements.
5,6,7,8,9,10	Prepare the outlet stack sampling location for testing and set-up the equipment. Conduct preliminary measurements.
13,14	Prepare the press vent sampling location for testing and set-up the equipment. Conduct preliminary measurements.
11	Set-up and calibrate the M7E and M10 monitoring equipment at the outlet stack. Warm up and check all monitoring and data acquisition systems for M7E and M10. Coordinate with M25A team leader and manual methods testing team.
12	Set-up and calibrate the monitoring systems for Method 25A at the inlet and outlet stack locations. Coordinate with M7E/M10 team leader and manual methods testing team.
15,16	Set-up the sample recovery areas and inventory all reagents and glassware.
17	Locate points for gathering process data. Establish communications with appropriate plant personnel.
<u>Tuesday, July 30</u>	
SET-UP	
1	Contact **[Plant Contact]** and EPA Work Assignment Manager. Review plant and testing status. Prepare for tests.
2,3,4,5,6,7,8,9, 10,13,14	Perform initial calibrations and daily QC checks. Set-up trains and leak check. Warm-up all equipment and prepare for testing.
11,12	Perform all initial calibrations and QC checks. Check all probe locations, condensers, etc. Verify that the data acquisition system is functioning properly.
15,16	Prepare sampling trains for first run.
17	Prepare to collect process data. Assist others as needed.
TESTING	
2,4	M0011 train - 2 runs at the inlet.
7,9	M0011 train - 2 runs at the outlet.

Table 9-2 (Continued)

13,14	M0011 train - 2 runs at the press vents.
3,4	M202 train - 2 runs at the inlet.
6,9	M202 train - 2 runs at the outlet.
5,10	MM5 train - 2 runs at the outlet.
8,10	VOS train - 2 runs at the outlet.
11,12	Methods 7E, 10, 25A - 2 runs at inlet and outlet.
15,16	Support sampling teams, sample recovery and train preparation. Review paperwork for completeness.
17,1	Collect process data.
1	Coordinate testing effort with plant, EPA, and test personnel. At end of day, secure area and communicate with the plant and the EPA on the testing status.

Wednesday, July 31

Assignments and responsibilities will be the same as for Tuesday, July 30 for the third run. If possible, three additional runs of Method 25 and 25A will be conducted on Wednesday afternoon and Thursday morning. These will involve **[Contractor]** crew members 11,12,17, and 1 and the **[Trade Organization]** staff. The remaining **[Contractor]** staff will pack samples, unneeded equipment, restore the sampling sites, and travel home. If due to testing or plant conditions, the schedule is not completed as planned, Thursday, August 1 will be used as a contingency test day. At the conclusion of the test, there will be a brief informational meeting with the plant and EPA personnel to resolve any questions before the remaining test team members leave the site.

MONDAY July 29, 1991	**TUESDAY** July 30, 1991	**WEDNESDAY** July 31, 1991	**THURSDAY** August 1, 1991
•Travel to site •Establish test team/ Plant communications •Set up test locations •Conduct preliminary measurements •Set up lab for sample recovery	•Complete 2 test runs	•Complete 3rd test run •Pack up all but Methods 25 and 25A equipment •Conduct 2 additional Method 25/25A runs •Collect 2 evacuated cylinder samples •Rest of staff drive home •Afternoon: contingency test day	•Conduct 1 additional Method 25/25A run •Collect 1 evacuated cylinder sample •Restore sites •Remaining staff drive home •Contingency test day

Figure 9-1. Proposed daily test schedule for **[Plant]** test program.

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<< Back to Sampling and Analytical Methods

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These procedures were designed and tested for internal use by OSHA personnel. Mention of any company name or commercial product does not constitute endorsement by OSHA.

Arsenic, Cadmium, Cobalt, Copper, Lead, and Nickel

[236 KB PDF, 24 pages]

Related Information: Chemical Sampling - Arsenic, Cadmium, Cobalt, Copper, Lead, and Nickel

Method number: 1006

Control number: T-1006-FV-01-0502-M

Analyte (isotope)	Target Concn (mg/m^3)	OSHA PEL (mg/m^3)*	ACGIH TLV (mg/m^3)	RQL (μg/m^3)	Standard Error of Estimate (%)
As (75)	0.01	0.01*	0.01	0.34	±5.75
Cd (114)	0.005	0.005*	0.01	0.013	±5.43
Co (59)	0.1	0.1	0.02	0.0064	±5.29
Cu (63)	0.1	0.1	0.2	0.30	±5.27
Ni (60)	1.0	1.0	1.5	0.25	±5.37
Pb (208)	0.05	0.05**	0.05	0.029	±5.26

* PELs are from Table Z-1 & Table Z-2 of 29 CFR , 1910.1000. PELs are time-weighted averages (TWA).

** Arsenic, cadmium and lead have expanded standards requiring biological monitoring and/or medical examinations (29 CFR 1910.1018, 29 CFR 1910.1025, 29 CFR 1910.1027 and 29 CFR 1926.62).

Procedure:	A calibrated personal sampling pump is used to draw a known volume of air through a mixed-cellulose ester (MCE) membrane filter with back-up pad (BUP) contained in a polystyrene cassette. The inside walls of the cassette are wiped with a cellulose nitrate filter. The filter and accompanying cassette wipe are digested in a microwave oven with nitric acid and hydrogen peroxide. The BUP, if visibly contaminated, is analyzed separately following microwave digestion. After cooling, hydrochloric acid is added and the sample is microwaved again. Analysis is done by Inductively-Coupled Plasma/Mass Spectrometry (ICP/MS). Other analytical techniques may be used after compatibility with the digestate of this method is demonstrated for the analytes of interest. These techniques include, but are not limited to, Flame Atomic Absorption Spectrometry (FAAS), Graphite Furnace Atomic Absorption Spectrometry (GFAAS) and Inductively Coupled Plasma-Atomic Emission Spectrometry (ICP-AES). Those using a different analytical technique must consider the detection limit, precision, and sensitivity of the technique as it relates to each particular analyte. Digestates from other methods (e.g. ID-105, ID-121, ID-125G, ID 206) can be analyzed by ICP/MS after compatability with the ICP/MS instrumentation is evaluated and equivalent analytical results are demonstrated.
Recommended sampling time and sampling rate:	240 min at 2.0 L/min (480L) TWA
Special requirement:	The industrial hygienist (IH) must use an MCE filter in conjunction with a sodium carbonate-impregnated BUP when sampling for volatile arsenic compounds.
Status of method:	Evaluated method. This method has been subjected to the established procedures of the Methods Development Team.

January 2005

Phil Giles

Methods Development Team
Industrial Hygiene Chemistry Division
OSHA Salt Lake Technical Center
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1. General Discussion

For assistance with accessibility problems in using figures and illustrations presented in this method, please contact the SLTC at (801) 233-4900. These procedures were designed and tested for internal use by OSHA personnel. Mention of any company name or commercial product does not constitute endorsement by OSHA.

1.1 Background

1.1.1 History

This method describes the collection and subsequent analysis of airborne metal and metalloid particulates by ICP-MS. It provides rapid preparation of samples collected on MCE filters, and simultaneous analysis and data reduction for a wide range of elements, eliminating the necessity of separate analyses by conventional atomic absorption techniques. Air samples should be collected on an MCE filter with included cellulose BUP. This method was not evaluated for its application to surface sampling wipes or bulks collected in the workplace. For samples where volatile arsenic is considered likely to be present (e.g., As_2O_3, $AsCl_3$, AsF_3, AsI_3, AsP, As_2S_3, and H_3AsO_4), use both an MCE filter and a sodium carbonate-impregnated BUP.

Previous to the introduction of Inductively Coupled Plasma-Atomic Emission Spectroscopy (ICP-AES), samples containing metallic particulates were digested in several ways and analyzed by Atomic Absorption Spectroscopy (AAS). While that technique is still used today at the OSHA Salt Lake Technical Center (SLTC), several generations of ICP instruments, with their ability to analyze many elements simultaneously, have tended to shift the analysis of samples toward the ICP. In recent years a new, more sensitive, technique has arisen which combines the generation of a hot plasma, containing many ions (via ICP), with a detector which differentiates those ions based on their mass/charge ratio (using a Mass Spectrometer or MS), rather than their optical emission spectra. One of the primary reasons for choosing ICP-MS is its improved sensitivity for arsenic analysis compared to that found using ICP-AES. The presence of carbon in the matrix enhances the signal of certain elements such as arsenic and selenium. Carbon has this effect because it is better than argon at ionizing atoms such as arsenic and selenium that have ionization potentials between 9-11 electron volts (eV)[1]. To make this enhancement uniform, all standards and samples are prepared in a solution containing 1% ethanol.

A microwave oven is used to digest the samples in disposable centrifuge tubes. The use of such tubes saves time ordinarily spent on cleaning glassware. It also eliminates the possibility of losing sample when transferring between glass containers, because the sample remains in the centrifuge tube, even during analysis. A comparison of the microwave digestion to a hotplate digestion can be found in Section 4.9. The Standard Reference Material (SRM) used was Urban Particulate Matter, SRM 1648. Overall, the results are fairly similar for the elements tested in this method.

Closed-vessel, high pressure microwave digestion has been used for several years for the preparation of various environmental and industrial hygiene samples. Specialized digestion vessels are employed that have a high initial cost and require cleaning between uses. Due to these factors, a lower cost, less labor intensive digestion procedure using open vessels was chosen as having the potential to decrease sample preparation times for routine samples.

This method was fully validated for six elements (As, Cd, Co, Cu, Ni, and Pb). Other elements can be added to the method, depending on their solubility and stability in the acid matrix used in this method, 4% HNO_3 + 1% HCl. Some compounds, such as Cr_2O_3, BeO, Co_3O_4 and certain oxides of iron and nickel, are not very soluble in this acid matrix. To completely solubilize all compounds, more rigorous digestion procedures must be employed. Digestion in a sulfuric acid matrix can improve the solubility for some compounds (Section 4.8.4), but volatile arsenic compounds may be lost in the process.

1.1.2 Toxic effects (This section is for information only and should not be taken as the basis of OSHA policy.)

Ingestion of arsenic can produce fever, anorexia, hepatomegaly, melanosis, cardiac arrhythmia, and death[2]. Neurologic effects include neuropathy, paresthesia, and motor dysfunction. Effects on the liver include jaundice, cirrhosis, and ascites. Cardiovascular problems include acrocyanosis, Raynaud's phenomenon, and gangrene of the lower extremities. The Environmental Protection Agency (EPA) and the International Agency for Research on Cancer (IARC) classify arsenic as a carcinogen of the skin.

Ingestion of cadmium can cause nausea, vomiting, and abdominal pain. Pulmonary effects include pneumonitis, edema, and obstructive pulmonary disease. In the kidneys, it causes tubular dysfunction. Skeletal effects include calcium loss, bone pain, and osteoporosis. The main cardiovascular effect is essential hypertension. IARC classifies cadmium as a human carcinogen based on its relationship to pulmonary tumors.

Ingestion of cobalt can cause vomiting, diarrhea, polycythemia, and goiter. Neurologic effects include tinnitus and deafness due to nerve damage. Cardiovascular effects include giddiness, increased blood pressure, slowed respiration, and cardiomyopathy. Pulmonary effects include respiratory irritation and pneumoconiosis. On the skin, cobalt can cause allergic dermatitis.

Ingestion of copper has been shown to cause vomiting, anemia, hypotension, melena, jaundice, hepatic necrosis, coma, and death.

Ingestion of lead can cause anemia. In the cardiovascular system, it increases blood pressure. Neurologic effects include loss of IQ, neuropathy, convulsions, coma, and death. In the kidneys, it causes tubular necrosis. Reproductive problems involve sterility and neonatal death.

Nickel causes allergic dermatitis. Suspicion of nickel carcinogenicity has focused primarily on respirable particles of nickel subsulfide and nickel oxide[3].

1.1.3 Workplace exposure[4]

Arsenic is a common by-product in ores containing copper, lead, cobalt, and gold. The smelting and refining of these ores can produce arsenic fumes. Arsenic compounds are used in herbicides, insecticides, glassmaking, and wood preservation. The metal is used in alloys in combination with lead and copper in batteries, bearings, electrotype metal, ammunition, automobile body solder, and corrosion resistance. The highly purified metal is useful in semiconductor applications. Arsenicals are still important for the treatment of African trypanosomiasis. Arsenamide is used to kill adult heartworms in dogs.

Cadmium occurs primarily as sulfide minerals in zinc ores, which also may contain lead and copper. In the smelting and refining of these ores, cadmium fumes may be present. The principal uses of cadmium are in batteries, as a coating and plating agent for inhibiting corrosion, in pigments, as a heat stabilizer in plastics and synthetic products, and as a component in brazing and low melting alloys.

Cobalt occurs in minerals associated with ores of nickel, iron, silver, bismuth, copper, manganese, antimony, and zinc. The greatest uses of cobalt are in metallic form in magnetic alloys, cutting and wear-resistant alloys, and high temperature superalloys. Cobalt salts are useful in electroplating, as a catalyst for hardening paints, and as a pigment for glass and ceramics.

Copper fumes are usually present during the smelting and refining of copper ores. The uses of copper metal are very extensive. They include building wiring, plumbing, heating, air conditioning, refrigeration, architectural materials, electrical and electronic products, industrial machinery, valves and fittings, heat exchangers, automobiles, trucks, railroads, aircraft, appliances, ordnance, fasteners, coinage, and utensils and cutlery. Copper compounds are used in fungicides, algicides, insecticides, bactericides, pigments, wood preservatives, electroplating, animal feeds, dietary supplements, antifouling paints, and as heat and light stabilizers in polymers.

Nickel ores come in the form of sulfides, oxides, and silicates, usually in combination with iron. The main uses for the metal are in stainless steels and alloy steels, nonferrous and high temperature alloys, electroplating, magnets, and as a catalyst. Nickel compounds are used in ceramics, thermisters, varistors, electroplating, batteries, colored glass, and in various catalytic reactions.

Lead ranks fifth in the modem industrial world production of metals, behind iron, copper, aluminum, and zinc. Galena is the main lead mineral in ores. Care must be taken during the smelting and refining of the ore to prevent lead inhalation. The principal uses of lead and its compounds are storage batteries, pigments, ammunition, solders, plumbing, cable covering, bearings, and caulking. It is also used to attenuate soundwaves, atomic radiation, and mechanical vibration.

Physical properties of the six metals and their many inorganic compounds can be found in a variety of sources.[5,6]

This method was evaluated according to the OSHA SLTC "Evaluation Guidelines for Air Sampling Methods Utilizing Spectroscopic Analysis"[7]. The Guidelines define analytical parameters, specify required laboratory tests, statistical calculations and acceptance criteria. The analyte air concentrations throughout this method are based on the recommended sampling and analytical parameters.

1.2 Limit defining parameters

1.2.1 Detection limit of the analytical procedure (DLAP)

The DLAP for each of the elements is the response of the reagent blank plus three times the standard deviation (SD) of that reagent blank. It is calculated after doing 10 analyses of the reagent blank. (Sections 1.2.3 and 4.1)

1.2.2 Detection limit of the overall procedure (DLOP)

The DLOP is that amount of analyte spiked on sample media that will give a detector response significantly different from the response of a sampler blank. Eight to twelve spikes in incremental amounts were used to determine the DLOPs. (Sections 1.2.3 and 4.1)

1.2.3 Reliable quantitation limit (RQL)

The RQL is that amount of analyte spiked on a sampler which will give a detector response that is considered to be the lower limit for a precise quantitative measurement. Eight to twelve spikes in incremental amounts were used to determine the RQLs. (Section 4.2)

Table 1.2.3
Detection Limits (DLAPs and DLOPs) and Reliable Quantitation Limits (RQLs)

analyte	*DLAP	*DLOP	*RQL	
(isotope)	(µg)	(µg)	(µg)	(µg/m^3)
As (75)	0.0074	0.049	0.16	0.34
Cd (114)	0.00072	0.0019	0.0063	0.013
Co (59)	0.00041	0.00091	0.0030	0.0064
Cu (63)	0.0044	0.043	0.14	0.30
Ni (60)	0.0034	0.037	0.12	0.25
Pb (208)	0.0024	0.0042	0.014	0.029

*The values above are given as micrograms per 50-mL solution volume.

1.2.4 Instrument calibration

The ICP-MS instrument used in this evaluation, the Perkin-Elmer Elan 6100, employs a single detector with two stages. The lower pulse counting stage is most useful for low intensity signals, while the upper analog stage is most useful for high intensity signals. Both pulse and analog signals are measured simultaneously. A "dual detector calibration" is run routinely to join the two stages together into one straight-line curve, which plots intensity on the same scale from zero to ~ 1 × 10^9 counts per second (cps). This instrument has shown linearity over 7-8 orders of magnitude for most elements, including the six elements in this method.

The standard error of estimate (SEE) from the linear regression of data points was determined from four separate analyses of analytical standards prepared from soluble salts at masses corresponding to 0.1, 0.5, 1, and 2 times the target mass. The standard error of estimate measures the variation or scatter about the line of regression. (An example is shown in Section 3.5.2.)

Table 1.2.4
Standard Error of Estimate for Instrument Calibration

analyte	SEE (µg)	analyte	SEE (µg)	analyte	SEE (µg)	analyte	SEE (µg)	analyte	SEE (µg)	analyte	SEE (µg)
As	0.083	Cd	0.051	Co	1.0	Cu	0.93	Ni	10	Pb	0.78

1.2.5 Precision

The precision of the overall procedure at the 95% confidence level for the six validated elements was obtained from the ambient temperature 17-day storage test done at the target concentrations. This includes an additional 5% error for sampling pump variability. Precision ranged from 10.3 - 11.3%. (Section 4.4)

1.2.6 Recovery

The recovery of arsenic trioxide remained above 95% in the 17-day storage test done at ambient temperature. The recoveries of the other five analytes remained above 98% in the 17-day storage test done at ambient temperature. (Section 4.5)

1.2.7 Reproducibility

Using soluble salts of the analytes, six samples were prepared and submitted to the OSHA Salt Lake Technical Center (SLTC) for analysis. A draft copy of the analytical procedure was given to the analyst. No individual analytical result deviated from the theoretical value by more than the overall precision for the analyte (Section 4.4). Recoveries ranged from 91.9 - 108% (Section 4.6).

2. Sampling procedure

All safety practices that apply to the work area being sampled should be followed. The sampling equipment should be attached to the worker in a manner that will not interfere with work performance or safety.

2.1 Apparatus

2.1.1 MCE filters. Mixed cellulose ester (MCE) membrane filters (0.8 µm pore size) with cellulose backup pads (BUPs), 37 mm diameter, are used to collect air samples. Millipore filters (Cat. no. AAWP03700) were used in this evaluation. These are not to be used for arsenic samples.

2.1.2 Cassettes, 37-mm. Clear, polystyrene cassettes, either 2-section or 3-section can be used for air sampling. SKC cassettes (Cat. no. 225-2 and Cat. no. 225-3) were used in this evaluation.

2.1.3 Pre-assembled 37-mm polystyrene cassettes must be used when arsenic compounds are present. In front is an MCE filter, 0.8 µm pore size, and directly behind it is the sodium carbonate-impregnated BUP. SKC (Cat. no. 225-9001) cassettes were used in this evaluation.

2.1.4 Pre-assembled cassettes, 25-mm. Black, carbon-filled polypropylene cassettes with included MCE filter, 0.8 µm pore size, and BUP can also be used for air sampling. SKC (Cat. no. 225-321) cassettes were used in this evaluation. These are not to be used for arsenic samples.

Air samples are collected using a personal sampling pump attached to the polystyrene cassette and calibrated to within ±5% of the recommended flow rate.

2.2 Reagents

None required

2.3 Technique

Remove the two end plugs from the cassette. Attach the cassette to the sampling pump with plastic tubing and position the components so they do not impede work performance or safety.

After sampling for an appropriate time, turn off the pump, remove the cassette and replace the two end plugs. Seal each sample end-to-end with an Form OSHA-21.

Submit at least one blank sample with each set of samples. Handle the blank sampler in the same manner as the other samples except draw no air through it.

Record sample air volume (liters), sampling time (minutes) and sampling rate (L/min) for each sample, along with any potential interferences known to be present on the Form OSHA-91A. Submit the samples to the laboratory for analysis as soon as possible after sampling.

2.4 Sampler capacity (Section 4.7)

SLTC does not currently have the capability of generating aerosols of metal particulates. For this reason, sampler capacity was tested using retention efficiency tests. Four samplers, each containing an MCE filter in front spiked with soluble salts of the six analytes, separated by a spacer from a sodium carbonate-impregnated BUP in back, had humid air drawn through them for five hours at 2.0 L/min. The MCE filter and the BUP were analyzed separately, both by ICP-MS. No analyte was detected on any BUP. The average recovery was 99.0% for arsenic, 99.6% for cadmium, 97.9% for cobalt, 99.0% for copper, 101% for lead, and 98.9% for nickel (Section 4.7).

2.5 Digestion efficiency (Section 4.8)

Digestion efficiencies for the six analytes were determined at five different concentrations. Four MCE filters were spiked with soluble salts of the analytes at each concentration. The average digestion efficiency was 97.6% for arsenic, 103% for cadmium, 97.4% for cobalt, 99.1% for copper, 104% for lead, and 99.4% for nickel. (Section 4.8.1)

2.6 Recommended sampling time and sampling rate

Sample for a minimum of 240 min at 2.0 L/min (480 L) to collect long-term time weighted average (TWA) samples. If needed, short-term samples can be taken for 15 min at 2.0 L/min (30 L).

2.7 Interferences (sampling)

None are known

3. Analytical Procedure

Adhere to the rules set down in your Chemical Hygiene Plan[8]. Avoid skin contact and inhalation of all chemicals. Review all appropriate MSDSs before beginning work. Follow any SOP or accreditation protocol necessary for proper instrument optimization and analysis.

3.1 Apparatus

3.1.1 Inductively coupled plasma - mass spectrometer (ICP-MS). A Perkin-Elmer Elan 6100 was used in this evaluation. It came with its own accessories, including auto-sampler, peristaltic pump, mass flow controller and water chiller. The Elan software controls the instrument and provides the analytical results.

3.1.2 Laboratory quality microwave. A CEM MARS-5 with accessories, including temperature probe and high throughput accessory set, was used in this evaluation.

3.1.3 Centrifuge. A Thermo IEC Centra CL3 centrifuge with accessories was used in this evaluation.

3.1.4 Plastic graduated centrifuge tubes, 50-mL, accuracy of ±2% or better at the 50-mL mark. Corning polypropylene tubes used in this evaluation had an accuracy of ±2%.[9]

3.1.5 Cellulose nitrate filters. Whatman filters (Cat. no. 7184-004), 0.45 µm pore size, 47 mm diameter, were used in this evaluation to wipe-out the inside of the cassette.

3.2 Reagents

3.2.1 Nitric acid, [CAS no. 7697-37-2], for trace metal analysis. Nitric acid, 'Baker Instra-Analyzed', 69.0-70.0%, (lot V17032) purchased from JT Baker was used in this evaluation.

3.2.2 Hydrochloric acid, [CAS no. 7647-01-0], for trace metal analysis. Hydrochloric acid, 'Baker Instra-Analyzed', 36.5-38.0%, (lot T45036) purchased from JT Baker was used in this evaluation.

3.2.3 Calibration standards

3.2.3.1 Arsenic standard, [CAS no. 7440-38-2], 1000 µg/mL, in 2% HNO_3, (lot 3AD064) purchased from CPI International (CPI) was used in this evaluation.

3.2.3.2 Cadmium standard, [CAS no. 7440-43-9], 1000 µg/mL, in 2% HNO_3, (lot 1LM044) purchased from CPI was used in this evaluation.

3.2.3.3 Cobalt standard, [CAS no. 7440-48-4], 1000 µg/mL, in 2% HNO_3, (lot 2JT116) purchased from CPI was used in this evaluation.

3.2.3.4 Copper standard, [CAS no. 7440-50-8], 1000 µg/mL, in 2% HNO_3, (lot 3AM188) purchased from CPI was used in this evaluation.

3.2.3.5 Lead standard, [CAS no. 7439-92-1], 1000 µg/mL, in 2% HNO_3, (lot 2LF025) purchased from CPI was used in this evaluation.

3.2.3.6 Nickel standard, [CAS no. 7440-02-0], 1000 µg/mL, in 2% HNO_3, (lot PLNI2-2Y) purchased from Spex Certi Prep, Inc. was used in this evaluation.

3.2.4 Internal standards (IS). Internal standards are used to correct for matrix interferences, instrument drift and short-term noise. The following were used for the evaluation of this method.

3.2.4.1 Germanium standard, [CAS no. 7440-56-4], 1000 µg/mL, in 2% HNO_3, (lot 0BF145) purchased from CPI was used in this evaluation. Germanium is used as an internal standard for arsenic, cobalt, copper, and nickel.

3.2.4.2 Indium standard, [CAS no. 7440-74-6], 1000 µg/mL, in 2% HNO_3, (lot 0BF173) purchased from CPI was used in this evaluation. Indium is used as an internal standard for cadmium.

3.2.4.3 Lutetium standard, [CAS no. 7439-94-3], 1000 µg/mL, in 2% HNO_3, (lot 1IF013) purchased from CPI was used in this evaluation. Lutetium is used as an internal standard for lead.

3.2.5 De-ionized water (DIW), 18 megaohm. A Barnstead Model D11901 NANOpure DIamond water purifier was used in this evaluation.

3.2.6 Hydrogen peroxide, [CAS no. 7722-84-1], 30%. Hydrogen peroxide solution, 30%, (lot 5240 T45A05) purchased from Mallinckrodt was used in this evaluation.

3.2.7 Ethanol, [CAS no. 64-17-5], 95%. Ethanol, 95%, (lot 98G23BB) purchased from AAPER Alcohol and Chemical Co. was used in this evaluation.

3.3 Standard preparation

3.3.1 Match the matrix of the standards to the final digested sample matrix of 4% nitric acid, 1% hydrochloric acid, 1% internal standard (IS) mix, and 1% ethanol. For the evaluation of this method, the IS and ethanol were added during preparation of the samples and standards. Alternatively, they may be added at the time of introduction into the instrument (e.g., using a mixing block just prior to the nebulizer).

3.3.2 Bracket sample concentrations with standard concentrations. If, upon analysis, sample concentrations are above the range of prepared standards, dilute the high samples and re-analyze.

3.3.3 Prepare a calibration standard at the target concentrations of the six elements in this method using a 480-L air volume and a final solution volume of 50 mL. This results in the following concentrations: 50 ppb Cd, 100 ppb As, 500 ppb Pb, 1000 ppb Co and Cu, and 10 ppm Ni. The IS mix is prepared at the following concentrations: 2 ppm In, 3 ppm Lu, and 9 ppm Ge.

3.4 Sample preparation

3.4.1 Transfer the MCE filter from the 37 mm cassette to the bottom of the plastic centrifuge tube. Wipe the inside walls of the cassette with a cellulose nitrate filter (Section 3.1.5) moistened with 2-3 drops of DIW. (Table 4.8.3 shows recoveries of spikes on these filters.) Place the wipe at the bottom of the centrifuge tube with the MCE filter. If the BUP is visibly contaminated, digest it (see Section 3.4.2) and analyze it separately (see Table 4.8.2 for recoveries). Add 2 mL of concentrated nitric acid and 0.2 mL of 30% hydrogen peroxide. Cap the tube loosely (no more than ¼ turn), allowing any excess pressure to vent around the cap. Swirl the acid to wet the contents. Place the tube in the fast throughput carousel in the microwave oven. Samples are microwaved using these parameters:

Maximum power = 600 W
Ramp temperature to 104 °C over 9 min
Hold temperature at 104 °C for 3 min

Allow the samples to cool at least 10 min before removing from the microwave. Add 0.5 mL of concentrated hydrochloric acid. Recap the samples and return them to the microwave. Reheat using the following parameters:

Maximum power = 600 W
Ramp temperature to 86 °C over 5 min
Hold temperature at 86 °C for 1 min

Allow the samples at least 10 minutes to cool before removing from the microwave. Add 0.5 mL of IS solution and 0.5 mL of 95% ethanol (see Section 3.3.1). Fill the tube to the 50-mL mark with DIW. If solid particles remain after diluting to volume, filter the sample and digest the filter and particles in the microwave using the same technique. Sample results should be added together after both solutions have been analyzed separately. For this evaluation, the final matrix contains 4% nitric acid, 1% hydrochloric acid, 1% IS, and 1% ethanol.
Note: If volumes other than 50 mL are used, the amounts of acids should be adjusted to keep the matrix approximately the same for samples and standards.

3.4.2 Analyze a contaminated BUP, identified by a discoloration on the white pad, separately using a modification of the above microwave procedure. Instead of using 2 mL of nitric acid, use 4 mL of nitric acid and 0.3 mL of 30% hydrogen peroxide. In the second step, use 1 mL of concentrated hydrochloric acid. In the final step, transfer the contents of the centrifuge tube to a 100-mL volumetric flask, add 1 mL of IS solution and 1 mL of 95% ethanol (see Section 3.3.1), and dilute to volume with DIW. Although the procedure may not completely digest all of the fibers present, a study was done to show that analytes spiked on the BUP do go into solution (Section 4.8.2). If needed, centrifuge tubes for 10 min @ 2000 rpm to compact the fibers.

3.5 Analysis

3.5.1 Follow the manufacturer's standard operating procedures for the particular ICP-MS instrument. Calibrate with the appropriate standards. The parameters that were used in developing this method for the PE Elan 6100 were:

Number of Replicates:	3	Integration Time:	1 sec
Readings/Replicate:	1	Detector Mode:	Dual
Auto Lens:	On	Dwell Time:	20 msec
Sweeps/Reading:	50	Scan Mode:	Peak Hopping

3.5.2 Instrument calibration example

The following calibration curve, using an internal standard, is an example of a curve constructed for arsenic analysis. It is also representative of the calibration curves of the other five analytes. Four spikes of a soluble salt are added to volumetrics at four different concentrations that covers a range 0.1 to 2 times the target concentration for arsenic. The standard error of estimate for this curve is 0.083 µg of arsenic.

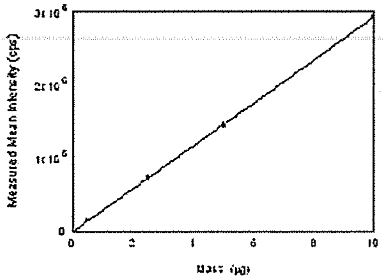

Figure 3.5.2. Plot of calibration curve for arsenic.

3.6 Interferences (analytical)

The following interferences, typically encountered with ICP-MS techniques, were addressed during the evaluation of this method:

Table 3.6
ICP-MS Analytical Interferences

analyte	interference	corrective measures
^{75}As	$^{40}Ar^{35}Cl$	Mathematical correction factor
^{75}As	C	Add ethanol to standards and samples
^{114}Cd	$^{98}Mo^{16}O$	Adjust nebulizer flow to minimize oxides
^{114}Cd	^{114}Sn	Mathematical correction factor
^{63}Cu	$^{31}P^{16}O_2$, $^{47}Ti^{16}O$	Adjust nebulizer flow to minimize oxides
^{115}In	^{115}Sn	Mathematical correction factor
^{60}Ni	$^{44}Ca^{16}O$	Adjust nebulizer flow to minimize oxides
^{208}Pb	^{206}Pb, ^{207}Pb	Mathematically combine all 3 isotopes*

*These three stable isotopes of lead are the endpoint of the radiologic decay of ^{232}Th, ^{235}U, and ^{238}U. The abundance ratio of these lead isotopes to each other may change slightly depending on the source of origin, but together they constitute 98.6% of all stable lead found. Summing the isotopes together cancels out ratio differences.

Although ICP-MS analysis has been found by analysts working in the field to be definitive for most of the elements evaluated in this method. Other analytical techniques can be used if interferences are large and/or additional confirmation is needed. These techniques include, but are not limited to: FAAS, GFAAS, and ICP-AES.

3.7 Calculations

Air sample results are reported in units of mg/m³. For analytes having a PEL listed as a compound, results are reported as mg/m³ of that compound by using gravimetric factors. If it is necessary to analyze the BUP, it is analyzed separately from the combined MCE filter + cellulose nitrate wipe, and the results for each analyte are combined.

The concentration of analyte in the digestate is calculated from the appropriate calibration curve. The concentration (ng/mL) of an analyte in solution multiplied by its volume (mL) results in the mass per sample (ng). The final result, in mg/m³, is calculated using the following formulas:

$$A = G[(C \times D \times H) - (E \times F \times I)]$$

Where
A is combined mass of analytes on sample MCE filter + cellulose nitrate wipe (µg)
C is combined concn of analytes on sample MCE + cellulose nitrate wipe (ng/mL)
D is sample solution volume (mL)
E is concn of analytes on blank MCE filter + blank cellulose nitrate wipe (ng/mL)
F is blank solution volume (mL)
G is 1000 ng/µg conversion factor
H is dilution factor (if any) for sample filters
I is dilution factor (if any) for blank filters

$$B = G[(J \times K \times L) - (M \times N \times O)]$$

Where
B is mass of analyte on sample BUP (µg)
J is concn of analyte on sample BUP (ng/mL)
K is sample BUP solution volume (mL)
L is dilution factor (if any) for sample BUP
M is concn of analyte on blank BUP (ng/mL)
N is blank BUP solution volume (mL)
O is dilution factor (if any) for blank BUP

$$X = \frac{A + B}{\ }$$

Where
X is concn by weight (mg/m³)
V is liters of air sampled

V

4. Backup data

General background information about the determination of detection limits and precision of the overall procedure is found in the "Evaluation Guidelines for Air Sampling Methods Utilizing Spectroscopic Analysis"[10]. The Guidelines define analytical parameters, specific laboratory tests, statistical calculations and acceptance criteria.

This evaluation examined samples collected on MCE filters, cellulose BUPs, and cellulose nitrate filters. Other sample matricies that are digested and/or diluted into the same digestate matrix may be analyzed by this method, but acceptable digestion and instrument performance must be demonstrated.

ICP-MS was the analytical technique used for the evaluation of this method. One of the primary reasons for choosing ICP-MS was its ability to analyze for arsenic, cadmium, and lead simultaneously. Other techniques may be applicable to the analysis of the digestate. Compatibility of the digestate with alternate analytical techniques must be demonstrated for each analyte of interest.

4.1 Detection limit of the analytical procedure (DLAP)

The DLAP is the response of the reagent blank (YBR) plus three times the standard deviation of that reagent blank (S_{BR}), DLAP = $Y_{BR} + 3 \times S_{BR}$. It is calculated after doing 10 analyses of the reagent blank.

Table 4.1
Detection Limit of the Analytical Procedure

analyte	YBR (ppb)	SBR (ppb)	solution volume (mL)	DLAP (µg)
As	0.0003	0.049	50	0.0074
Cd	0.0067	0.0026	50	0.00072
Co	0.0037	0.0015	50	0.00041
Cu	0.0605	0.0092	50	0.0044
Ni	0.0318	0.0121	50	0.0034
Pb	0.0353	0.0042	50	0.0024

4.2 Detection limit of the overall procedure (DLOP) and reliable quantitation limit (RQL)

The DLOP is the amount of analyte spiked on a sampler that will give a detector response significantly different from the response of a sampler blank. The RQL is that amount of analyte spiked on a sampler which will give a detector response that is considered to be the lower limit for a precise quantitative measurement.

The DLOPs and RQLs for the six analytes were determined from the same set of data. The results of the analysis of a blank filter and eleven spiked filters in incremental amounts near these values were plotted to give linear regression lines for each analyte with its own slope and standard error of estimate about the line.

Table 4.2.1
Arsenic Detection Limits
DLOP = 0.049 µg; RQL = 0.16 µg

ng	intensity (cps)	ng	intensity (cps)
0	785.8	150	24886
20	2833	180	41002
40	5466	210	47760
60	7454	240	55743
90	9744	270	62519
120	22662	300	68962

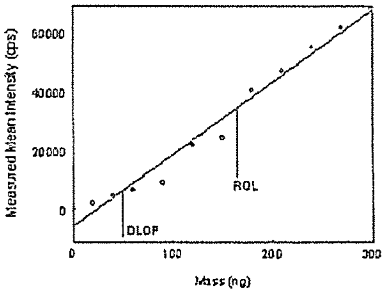

Figure 4.2.1. Plot of data to determine the DLOP/RQL for arsenic ($y = 244.1x - 5020$; SEE = 4024).

Table 4.2.2
Cadmium Detection Limits
DLOP = 0.0019 µg; RQL = 0.0063 µg

ng	intensity (cps)	ng	intensity (cps)
0	39.8	30	3821
4	559.7	36	4809
8	1022	42	5367
12	1531	48	6269
18	2249	54	7126
24	3205	60	7953

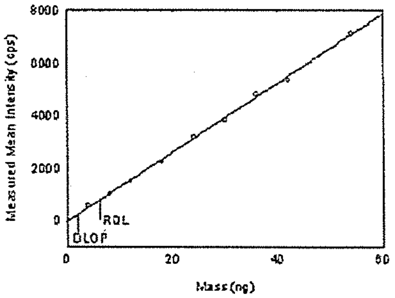

Figure 4.2.2. Plot of data to determine the DLOP/RQL for cadmium ($y = 131.6x - 21.8$; SEE = 83.3).

Table 4.2.3
Cobalt Detection Limits
DLOP = 0.00091 µg; RQL = 0.0030 µg

ng	intensity (cps)	ng	intensity (cps)
0	39.8	30	3821
4	559.7	36	4809
8	1022	42	5367
12	1531	48	6269
18	2249	54	7126
24	3205	60	7953

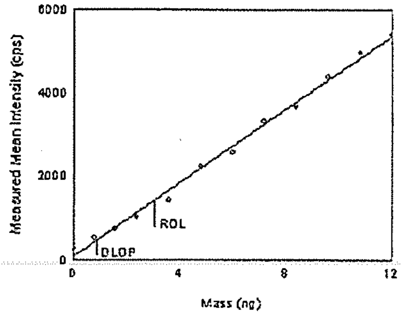

Figure 4.2.3. Plot of data to determine the DLOP/RQL for cobalt (y = 438.7x + 86.1; SEE = 133.8).

Table 4.2.4
Copper Detection Limits
DLOP = 0.043 µg; RQL = 0.14 µg

ng	intensity (cps)	ng	intensity (cps)
0	5945	150	35884
20	11573	180	49825
40	15000	210	52885
60	16628	240	61327
90	21072	270	77093
120	32400	300	76775

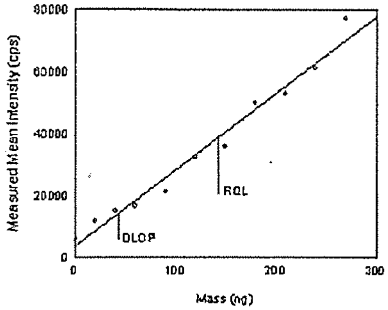

Figure 4.2.4. Plot of data to determine the DLOP/RQL for copper (y = 246.8x + 3483; SEE = 3541).

Table 4.2.5
Nickel Detection Limits
DLOP = 0.037 µg; RQL = 0.12 µg

ng	intensity (cps)	ng	intensity (cps)
0	3252	150	14889
20	4215	180	20023
40	5027	210	21892
60	6162	240	26033
90	7982	270	28898
120	13343	300	31541

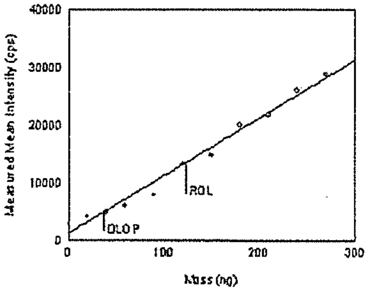

Figure 4.2.5. Plot of data to determine the DLOP/RQL for nickel (y = 100.2x + 1239; SEE = 1225).

Table 4.2.6
Lead Detection Limits
DLOP = 0.0042 µg; RQL = 0.014 µg

ng	intensity (cps)	ng	intensity (cps)
0	2733	15	9664
2	3579	18	13911
4	4091	21	16548
6	5414	24	18536
9	6599	27	20580
12	9474	30	23069

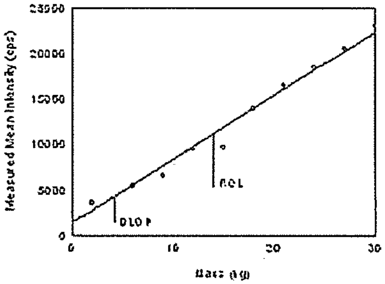

Figure 4.2.6. Plot of data to determine the DLOP/RQL for lead (y = 699.1x + 1396; SEE = 979.4).

4.3 Instrument calibration

The standard error of estimate from the linear regression of data points was determined from four separate analyses of analytical standards at the following levels: 0.1, 0.5, 1, and 2 times the target mass, prepared from soluble salts. The standard error of estimate (SEE) measures the variation or scatter about the line of regression.

Table 4.3

Instrument Calibration, Average Intensity (cps)

analyte	mass (µg)	0.1 × targ. concn (SD)	mass (µg)	0.5 × targ. concn (SD)	mass (µg)	1 × targ. concn (SD)	mass (µg)	2 × targ. concn (SD)	SEE (µg)	upper limit (µg)
As	0.5	1.47×10^5 (2.97×10^3)	2.5	7.33×10^5 (6.98×10^3)	5	1.44×106 ($1.6^2 \times 10^4$)	10	2.94×10^6 (4.07×10^4)	0.083	1000
Cd	0.25	4.50×10^4 (7.54×10^2)	1.25	2.21×10^5 (1.21×10^3)	2.5	4.30×10^5 (6.66×10^3)	5	8.36×10^5 (1.21×10^4)	0.051	500
Co	5	2.80×10^6 (3.66×10^4)	25	1.40×10^7 (7.15×10^4)	50	2.77×10^7 (1.68×10^5)	100	5.54×10^7 (1.23×10^6)	1.0	250
Cu	5	1.50×10^6 (1.94×10^4)	25	7.37×10^6 (4.45×10^4)	50	1.47×10^7 (1.05×10^5)	100	2.91×10^7 (5.62×10^5)	0.93	1000
Ni	50	6.39×10^6 (1.17×10^5)	250	3.21×10^7 (1.52×10^5)	500	6.39×10^7 (3.73×10^5)	1000	1.28×10^8 (2.81×10^6	10	1500
Pb	2.5	1.71×10^6 (2.37×10^4)	12.5	7.81×10^6 (8.89×10^4)	25	1.51×10^7 (3.53×10^5)	50	2.91×10^7 (8.13×10^5)	0.78	1000

4.4 Precision (overall procedure)

The precision at the 95% confidence level is obtained by multiplying the standard error of estimate from the storage test (Section 4.5) by 1.96 (the z-statistic from the standard normal distribution at the 95% confidence level). In Section 4.5, 95% confidence intervals are drawn about their respective regression lines for the six analytes in the ambient storage graph figures. Precisions are summarized below:

Table 4.4
Overall Precision of Analytes

analyte	precision (%)	analyte	precision (%)
As	±11.3	Cu	±10.3
Cd	±10.6	Ni	±10.5
Co	±10.4	Pb	±10.3

4.5 Effects of storage

One of the most common compounds of arsenic is arsenic trioxide, As_2O_3. This compound is known to sublime at 135 °C. To test the storage stability of this compound, 52.34 mg of the pure compound was weighed out and transferred to a 100-mL volumetric flask. The flask was brought to volume with DIW. At room temperature, the As_2O_3 was observed to take 6 days to completely dissolve in solution. Six 50-µL spikes of this solution were pipetted into separate 200-mL volumetric flasks, which were then brought to volume with the standard acid matrix solution. The average recovery of arsenic from the six spikes was 99.8% of the theoretical value (19.82 µg). Eighteen pre-assembled cassettes (Section 2.1.3) were each spiked with 50 µL of the As_2O_3 solution. Humid air containing approximately 15.7 milligrams of water per liter of air (about 80% relative humidity at 22.2 °C) was drawn through the samplers for 4 hours at 2 L/min. Three of these filters were analyzed immediately by ICP-MS. The other 15 were stored at ambient temperature (~23 °C) and analyzed in sets of 3 over the course of 17 days. It was decided to look first at the more rugged ambient test before doing a refrigerated test. A regression curve for arsenic trioxide was obtained by plotting percent recovery versus days of storage. The recovery of arsenic trioxide at ambient temperature remained above 95% at day 17 (Table 4.5.1). The results of this ambient storage test demonstrated that no refrigerated storage test was needed.

Table 4.5.1.
Ambient Storage Test for Arsenic Trioxide

time (days)	recovery (%)		
0	97.7	98.1	101
3	101	96.4	97.3
7	93.6	97.6	97.8
10	104	99.4	102
14	92.9	96.9	96.7
17	96.8	95.2	96.4

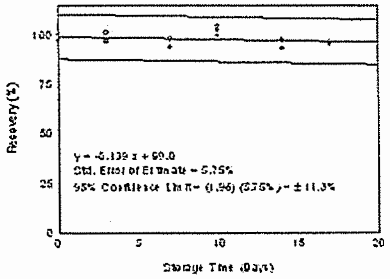

Figure 4.5.1. Ambient storage test for arsenic trioxide on MCE filters.

Eighteen MCE filters placed in 37-mm cassettes (Section 2.1.4) were each spiked with a solution containing soluble salts equivalent to the target concentration of the other five analytes. Humid air containing approximately 15.7 milligrams of water per liter of air (about 80% relative humidity at 22.2 °C) was drawn through the samplers for 4 hours at 2 L/min. Three filters were analyzed immediately by ICP-MS. The other 15 were analyzed in sets of 3 over the course of 17 days. All filters were kept at ambient temperature (~23 °C) in an undisturbed location. A refrigerated storage test was not done. A regression curve measuring the storage stability for each analyte was obtained by plotting percent recovery versus days of storage. All five analytes had recoveries above 95% after 17 days.

Table 4.5.2.
Ambient Storage Test for Cadmium

time (days)	recovery (%)		
0	99.8	100	101
3	102	104	105
6	98.4	99.7	99.1
10	100	101	101
13	98.7	96.6	98.3
17	103	101	98.3

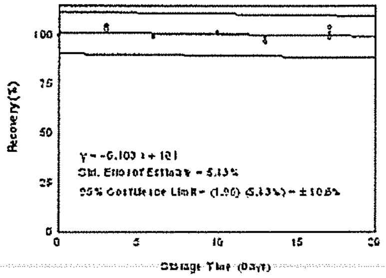

Figure 4.5.2. Ambient storage test for cadmium on MCE filters.

Table 4.5.3.
Ambient Storage Test for Cobalt

time (days)	recovery (%)		
0	97.2	98.6	99.5
3	98.8	97.6	98.5
6	102	103	102
10	103	102	102
13	99.8	101	99.9
17	99.4	100	101

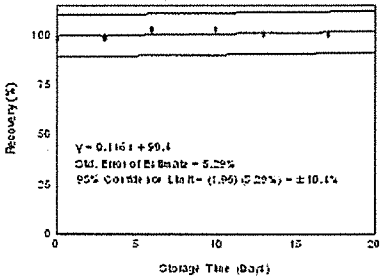

Figure 4.5.3. Ambient storage test for cobalt on MCE filters.

Table 4.5.4.
Ambient Storage Test for Copper

time (days)	recovery (%)		
0	98.5	98.8	99.8
3	99.7	99.0	99.7
6	102	104	102
10	96.8	102	102
13	103	102	101
17	102	101	102

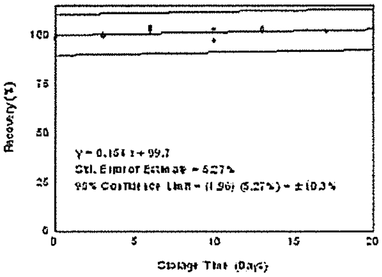

Figure 4.5.4. Ambient storage test for copper on MCE filters.

Table 4.5.5.
Ambient Storage Test for Nickel

time (days)	recovery (%)		
0	98.3	99.1	100
3	99.7	98.0	99.7
6	103	105	103
10	106	102	103
13	101	102	102
17	101	101	102

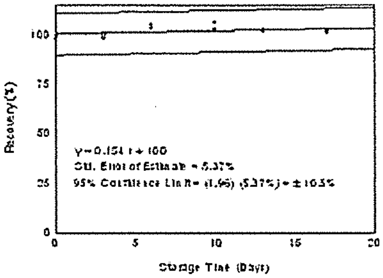

Figure 4.5.5. Ambient storage test for nickel on MCE filters.

Table 4.5.6.
Ambient Storage Test for Lead

time (days)	recovery (%)		
0	97.5	97.5	99.2
3	99.0	99.6	99.6
6	100	102	101
10	104	101	102
13	99.3	98.7	98.6
17	100	99.3	99.3

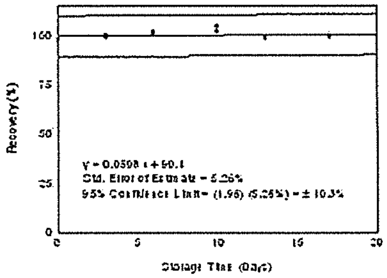

Figure 4.5.6. Ambient storage test for lead on MCE filters.

4.6 Reproducibility

Six filters were spiked with a mixture containing the six elements at the target concentration. This set was submitted to the OSHA SLTC for analysis by ICP-MS. Recoveries for the six analytes ranged from 91.9 - 108% (Tables 4.6.1 - 4.6.6). No spike result for any of the six analytes had a deviation greater than the precision of the overall procedure (see Section 4.4).

Table 4.6.1.
Arsenic Reproducibility

theoretical (µg/sample)	recovered (µg/sample)	recovery (%)	deviation (%)
5.00	4.60	91.9	-8.1
5.00	4.90	97.9	-2.1
5.00	4.85	96.9	-3.1
5.00	4.99	99.9	-0.1
5.00	4.97	99.4	-0.6
5.00	4.69	96.6	-6.2

Table 4.6.2.
Cadmium Reproducibility

theoretical (µg/sample)	recovered (µg/sample)	recovery (%)	deviation (%)
2.50	2.42	96.9	-3.1
2.50	2.56	102	2.4
2.50	2.55	102	2.0
2.50	2.59	104	3.6
2.50	2.57	103	2.8
2.50	2.45	98.0	-2.0

Table 4.6.3.
Cobalt Reproducibility

theoretical (µg/sample)	recovered (µg/sample)	recovery (%)	deviation (%)
50.0	47.2	94.4	-5.6
50.0	49.1	98.2	-1.8
50.0	49.1	98.2	-1.8
50.0	50.6	101	-1.2
50.0	51.0	102	-2.0
50.0	48.0	96.1	-3.9

Table 4.6.4.
Copper Reproducibility

theoretical (µg/sample)	recovered (µg/sample)	recovery (%)	deviation (%)
50.0	49.2	98.3	-1.7
50.0	51.5	103	3.0
50.0	51.0	102	2.0
50.0	52.8	106	5.6
50.0	52.6	105	5.2
50.0	49.3	98.7	-1.3

Table 4.6.5.
Nickel Reproducibility

theoretical (µg/sample)	recovered (µg/sample)	recovery (%)	deviation (%)
500	501	100	0.2
500	524	105	4.8
500	520	104	4.0
500	537	108	7.4
500	540	108	8.0
500	510	102	2.0

Table 4.6.6.
Lead Reproducibility

theoretical (µg/sample)	recovered (µg/sample)	recovery (%)	deviation (%)
25.0	23.5	94.1	-5.9
25.0	24.8	99.2	-0.8
25.0	24.8	99.4	-0.6
25.0	24.9	99.5	-0.5
25.0	25.1	100	0.4
25.0	23.4	93.7	-6.3

4.7 Sampler capacity

Four samplers, each containing a 0.8-µm MCE filter and a sodium carbonate-impregnated back-up pad (BUP) separated from the filter by a spacer, were spiked with an amount of soluble salt of the analyte equivalent to approximately the target concentration based on an air volume of 480 L. Humid air containing approximately 15.7 milligrams of water per liter of air (about 80% relative humidity at 22.2 °C) was drawn through the samplers for five hours at 2 L/min. The MCE filter and the BUP were digested separately, both by microwave digestion. Samples were analyzed by ICP-MS.

Table 4.7
Retention Efficiency

analyte	amount spiked (µg)	average recovery on MCE filter (µg)	SD on MCE filter (µg)	amount found on BUP	% average total recovery
As	5.00	4.95	0.03	ND	99.0
Cd	2.50	2.49	0.02	ND	99.6
Co	50.0	49.0	0.81	ND	97.9
Cu	50.0	49.5	0.13	ND	99.0
Ni	500	494	8.0	ND	98.9
Pb	25.0	25.3	0.72	ND	101

4.8 Digestion efficiency

4.8.1 Recoveries from MCE filters

Digestion efficiencies (DE) for the six analytes were obtained at five different levels (near the RQL and at 0.1, 0.5, 1, and 2 times the target concentration). Six MCE filters were spiked at each mass. The filters were digested in the microwave and diluted to a 50-mL volume. The final matrix was 4% HNO_3, 1% HCl, 1% IS, and 1% ethanol. Average digestion efficiencies range from 97.4% to 104%.

Table 4.8.1.1.
Average % DE for Arsenic on MCE Filters

xtarget	mass	average recovery	SD

Table 4.8.1.2.
Average % DE for Cadmium on MCE Filters

xtarget	mass	average recovery	SD

concn	(μg)	(%)	(%)
RQL	0.150	90.1	1.8
0.1	0.500	101	1.3
0.5	2.50	100	1.6
1.0	5.00	97.9	1.6
2.0	10.0	99.2	1.9
All 5 Levels		97.6	

concn	(μg)	(%)	(%)
RQL	0.02	102	0.74
0.1	0.25	103	1.2
0.5	1.25	104	1.9
1.0	2.50	103	0.90
2.0	5.00	102	1.7
All 5 Levels		103	

Table 4.8.1.3.
Average % DE for Cobalt on MCE Filters

×target concn	mass (μg)	average recovery (%)	SD (%)
RQL	0.0100	104	2.0
0.1	5.00	96.5	0.42
0.5	25.0	95.8	1.7
1.0	50.0	93.8	0.69
2.0	100	96.6	2.2
All 5 Levels		97.4	

Table 4.8.1.4.
Average % DE for Copper on MCE Filters

×target concn	mass (μg)	average recovery (%)	SD (%)
RQL	0.200	98.4	3.0
0.1	5.00	105	1.2
0.5	25.0	97.7	1.5
1.0	50.0	95.4	0.88
2.0	100	98.9	1.9
All 5 Levels		99.4	

Table 4.8.1.5.
Average % DE for Nickel on MCE Filters

×target concn	mass (μg)	average recovery (%)	SD (%)
RQL	0.200	104	3.1
0.1	50.0	99.2	0.88
0.5	250	98.1	1.5
1.0	500	95.7	1.0
2.0	1000	99.4	2.2
All 5 Levels		99.4	

Table 4.8.1.6.
Average % DE for Lead on MCE Filters

×target concn	mass (μg)	average recovery (%)	SD (%)
RQL	0.500	108	1.9
0.1	2.50	103	0.99
0.5	12.5	103	0.85
1.0	25.0	101	1.4
2.0	50.0	106	1.7
All 5 Levels		104	

4.8.2 Recoveries from back-up pads

Six BUPs were spiked with the six analytes at the target concentration. After drying, they were each placed in separate 50-mL centrifuge tubes and taken through a slightly modified version of the microwave digestion procedure described in Section 3.4.2. Four milliliters of concentrated nitric acid and 0.3 mL of 30% hydrogen peroxide were added to each tube. Following the first digestion step, the tubes were cooled and 1 mL of concentrated hydrochloric acid was added to each. After the second digestion step, it could be seen that some fibers remained undigested. Each tube was filled to the 50-mL mark with DIW and centrifuged for 10 minutes @ 2000 rpm. This resulted in the fibers being compacted into the bottom of the tube. The clear solution on top was poured into 100-mL volumetrics. Another 30 mL of DIW were added to each tube and they were centrifuged again. The clear solutions were added to their appropriate volumetric. One milliliter of IS solution and 1 mL of ethanol were added and the volumetrics were brought to volume with DIW. They were analyzed by ICP-MS and the recoveries, which range from 97.6 - 101%, are shown in Table 4.8.2.

Table 4.8.2
Spike Recoveries (%) from Microwaved Back-up Pads

analyte	1	2	3	4	5	6	average recovery	SD
As	102	102	101	98.7	101	99.6	101	1.4
Cd	99.4	100	98.9	97.0	99.3	97.0	98.6	1.3
Co	96.3	97.1	98.9	96.1	99.8	97.4	97.6	1.5
Cu	101	100	102	99.6	103	100	101	1.3
Ni	98.8	99.9	101	98.9	103	100	100	1.5
Pb	102	102	101	99.4	103	101	102	1.2

4.8.3 Recoveries from cellulose nitrate filters (used to wipe out insides of cassettes)

Six cellulose nitrate filters were spiked with the six analytes at the target concentration. They were digested using the normal microwave procedure (Section 3.4.1). They were analyzed by ICP-MS and the recoveries, which range from 99.8 - 103%, are shown in Table 4.8.3.

Table 4.8.3
Spike Recoveries (%) from Cellulose Nitrate Filters

analyte	1	2	3	4	5	6	average recovery	SD
As	103	102	103	104	102	101	103	1.1
Cd	103	100	99.6	99.4	101	99.5	100	1.4
Co	108	97.9	98.2	99.6	97.8	97.1	99.8	4.1
Cu	111	100	100	102	100	99.2	102	4.6
Ni	111	99.7	100	102	100	99.2	102	4.5

Pb	100	101	102	103	102	103	102	1.2

4.8.4 Recoveries from MCE filters digested on the hotplate using sulfuric acid

When MCE filters that have been spiked with solutions containing arsenic are digested on the hotplate using sulfuric acid, most of the arsenic is lost. Six MCE filters were spiked with the six analytes, three at half the target concentration and three at the target concentration. They were digested on the hotplate with four mL of H_2SO_4:H_2O (1:1). Several drops of 30% hydrogen peroxide were added to facilitate the digestion. After cooling, 0.5 mL of concentrated HCl and 0.5 mL of IS solution were added to each. The contents were transferred to 50-mL volumetrics and brought to volume with DIW. They were analyzed by ICP-MS using calibration standards with the same matrix. The recoveries, which range from 11.2 - 101%, are shown in Table 4.8.4.

Table 4.8.4
Spike Recoveries (%) from MCE Filters Digested on the Hotplate using H_2SO_4

analyte	spiked at 0.5 × target concn			spiked at 1 × target concn			average recovery (SD)
As	12.7	9.4	11.1	13.5	9.4	10.9	11.2 (1.7)
Cd	98.3	98.3	98.9	96.0	95.6	96.7	97.3 (1.4)
Co	93.8	92.7	92.1	89.8	87.7	89.2	90.9 (2.3)
Cu	95.3	98.7	98.5	94.2	92.2	93.9	96.2 (3.1)
Ni	111	94.4	93.9	91.8	90.0	91.5	92.8 (2.0)
Pb	100	100	101	101	102	104	101 (1.5)

4.9 Comparison of Microwave Digestion and Hotplate Digestion Using SRM 1648*

In the following microwave digestion, different conditions were used as compared to those in Section 3.4.1. The differences are not judged to constitute a significant change in the procedure. Approximately 100 mg each of SRM 1648 were weighed out on each of six MCE filters and carefully placed into 50-mL centrifuge tubes. Two milliliters of concentrated HNO_3 and 0.2 mL of 30% H_2O_2 were added to each. Samples were then digested in a microwave for 15 min (max T = 110 °C). Samples were cooled for an hour and another 2 mL of concentrated HNO_3 were added, whereupon they were digested for a second time in the microwave under the same conditions. After cooling for an hour, 1 mL of concentrated HCl was added to each and they were re-heated for 6 minutes (max T = 86 °C). Samples were transferred to 100-mL volumetrics, 1 mL of IS solution was added, and they were brought to a final volume with DIW. The final acid matrix was 4% HNO_3 + 1% HCl + 1% IS. Samples were analyzed by ICP-MS.

For the hotplate digestion, approximately 100 mg of SRM 1648 were weighed out on MCE filters and placed in 250-mL Phillips beakers. Eight milliliters of concentrated HNO_3 were added to each. The beakers were heated on the hotplate and drops of 30% H_2O_2 were added until the solution turned clear or no further lightening of color was observed. Samples were heated until approximately half of the HNO_3 had boiled off, leaving about 4 mL of HNO_3. After cooling, 1 mL of concentrated HCl was added and the beakers heated again on the hotplate until boiling began, at which point they were removed and cooled. Samples were transferred to 100-mL volumetrics, 1 mL of IS solution was added, and they were brought to a final volume with DIW. The final matrix was 4% HNO_3 + 1% HCl + 1% IS. Samples were analyzed by ICP-MS.

For the six elements in this method, only cobalt is not included in the results, because it is present at very low levels in the SRM and has a non-certified value. For the other five elements tested, the results are quite comparable, indicating that the two digestion techniques produce similar results.

Table 4.9
Comparison of Microwave Digestion vs. Hotplate Digestion of SRM 1648*

	As						Cd					
	microwave			hotplate			microwave			hotplate		
	expected (µg)	found (µg)	found (%)	expected (µg)	found (µg)	found (%)	expected (µg)	found (µg)	found (%)	expected (µg)	found (µg)	found (%)
	11.75	12.14	103	11.67	12.01	103	7.66	6.91	90.2	7.61	6.92	90.9
	11.65	12.24	105	11.65	11.87	102	7.60	6.96	91.6	7.60	6.82	89.8
	11.82	12.37	105	11.62	12.00	103	7.71	7.06	91.5	7.58	6.86	90.6
	11.67	12.35	105	11.93	11.81	99.0	7.61	7.04	92.5	7.78	6.74	86.7
	11.57	12.47	108	11.75	11.68	99.4	7.55	7.02	93.0	7.66	6.66	86.9
	11.92	12.37	104	11.72	12.32	105	7.78	7.08	91.0	7.64	9.92	90.5
$\bar{x}$	11.73	12.32	105	11.72	11.95	102	7.65	7.01	91.6	7.65	6.82	89.2
SD			1.7			2.3			1.0			1.9

Table 4.9
Comparison of Microwave Digestion vs. Hotplate Digestion of SRM 1648*

	Cu						Ni					
	microwave			hotplate			microwave			hotplate		
	expected (µg)	found (µg)	found (%)	expected (µg)	found (µg)	found (%)	expected (µg)	found (µg)	found (%)	expected (µg)	found (µg)	found (%)
	62.23	56.24	90.4	61.81	61.28	99.1	8.38	6.05	72.2	8.32	6.54	78.6
	61.71	58.86	95.4	61.71	60.81	98.5	8.31	6.20	74.6	8.31	6.49	78.1
	62.60	58.90	94.1	61.51	62.00	101	8.43	6.30	74.7	8.28	6.45	77.9
	61.80	59.18	95.8	63.17	60.66	96.0	8.32	6.30	75.7	8.50	6.34	74.6
	61.27	58.86	96.1	62.21	61.57	99.0	8.25	6.31	76.5	8.38	6.41	76.5
	63.15	59.97	95.0	62.06	64.18	103	8.50	6.50	76.5	8.36	9.75	80.8
$\bar{x}$	62.13	58.67	94.5	62.08	61.75	99.5	8.37	6.28	75.0	8.36	6.50	77.7
SD			2.1			2.4			1.6			2.1

Table 4.9
Comparison of Microwave Digestion vs. Hotplate Digestion of SRM 1648*

	Pb					
	microwave			hotplate		
	expected (µg)	found (µg)	found (%)	expected (µg)	found (µg)	found (%)
	669.3	640.7	95.7	664.8	632.6	95.2
	663.7	636.7	95.9	663.7	626.7	94.4
	673.3	636.5	94.5	661.6	632.1	95.5
	664.7	658.9	99.1	679.4	620.3	91.3
	659.0	647.8	98.3	669.1	622.2	93.0
	679.2	643.8	94.8	667.4	647.4	97.0
$\overline{x}$	668.2	644.1	96.4	667.7	630.2	94.4
SD			1.9			2.0

*Urban Particulate Matter (Standard Reference Material 1648) was purchased from National Institute of Standards & Technology (NIST) in April, 1998. It consists of natural atmospheric particulate material collected in an urban location. Original certification date: 11/16/78. Additional certification update: 5/11/82. This SRM may not be representative of air samples collected for OSHA compliance purposes

4.10 Qualitative analysis

The Elan ICP-MS can also be used to obtain qualitative analysis on a sample. Instead of having the instrument operating in the peak-hopping mode, which looks at specific mass/charge ratios and is used for quantitative analysis, an analyst could operate it in the scanning mode, looking at ranges of the whole spectrum. The mass spectra and expected abundances for all the isotopes of the six analytes and their internal standards are shown in Figures 4.10.1 - 4.10.4. Significant deviations from the expected abundance ratios indicate interferences. It is in the interpretation process (automatically done by the Elan ICP-MS software) where errors may occur concerning the source of interferences. If significant, these errors will result in non-quantitative approximations.

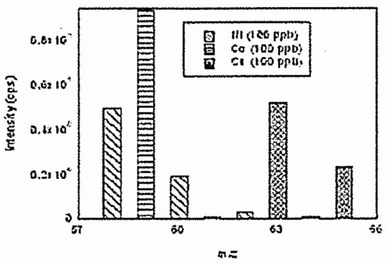

Figure 4.10.1. Mass spectra for nickel, cobalt, and copper.

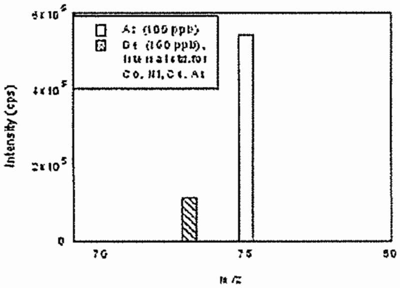

Figure 4.10.2. Mass spectra for arsenic and germanium.

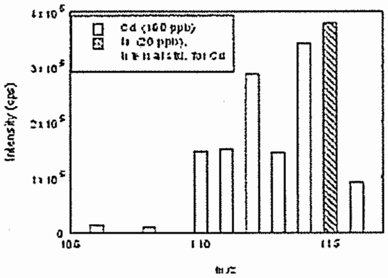

Figure 4.10.3. Mass spectra for cadmium and indium.

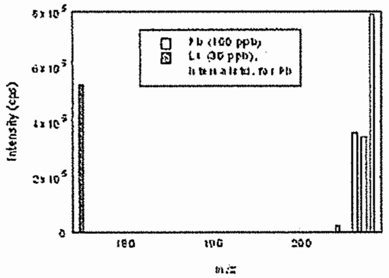

Figure 4.10.4. Mass spectra for lead and lutetium.

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