PB82193111

DCN-77-200-163-05

CONTROL TECHNOLOGY SUMMARY REPORT ON THE PRIMARY NONFERROUS METALS INDUSTRY

Volume IV: Appendix C

Review of the Testimony
Presented at the 1977 OSHA
Public Hearings on Inorganic Lead

J. R. Hoover

Radian Corporation
8500 Shoal Creek Blvd.
Austin, Texas 78758

NIOSH Contract No. 210-77-0008
Radian Contract No. 200-163

U.S. DEPARTMENT OF HEALTH, EDUCATION, AND WELFARE
Public Health Service
Center for Disease Control
National Institute for Occupational Safety and Health
Division of Physical Science and Engineering
Cincinnati, Ohio 45226

15 December 1978

CONTENTS

LIST OF TABLES

SECTION 1
INTRODUCTION

Public hearings on the proposed standard for inorganic lead exposure were held in March, April, and May, 1977. Testimony presented at these hearings reported health effects of lead exposure, the technical feasibility of controlling lead exposure in several industries, costs of compliance, and other related topics. The purpose of this review is to identify and evaluate the testimony presented which related to control technology in the nonferrous metals industry. No evaluation will be made in this document, either of the data relating to other industries or of the actual health effects associated with various levels of exposure to inorganic lead.

Several thousand pages of testimony were presented concerning inorganic lead control technology and personal exposure data in the nonferrous metals industry. The greatest impact of the new standard will be on the secondary lead and battery manufacturing industries, especially the smaller companies. The majority of the testimony presented by these companies was based on reports prepared by several private consultants, most notably Industrial Health Engineering Associates (IHEA) and Charles River Associates (CRA).

Two significant reports dealing with control technology were presented by OSHA. These were the Preliminary Economic Impact Statement prepared by John Short and Associates and the Economic Impact Analysis (EIA) prepared by D.B. Associates, Inc. (DBA). Both of these studies addressed the technological feasibility, cost of compliance and economic impact of the proposed lead standard for several industries, including primary and secondary lead smelting and battery manufacturing.

In the following sections, the major issues and conclusions resulting from the testimony presented are summarized. In addition, reviews of each major exhibit related to control technology or personal exposure data are included. This review of the testimony presented at public hearings on inorganic lead was designed to meet the needs of the "Control Technology Assessment" being performed for the Division of Physical Science and Engineering of NIOSH in Cincinnati. It is not a comprehensive review of all the testimony nor is it intended for use as a health effects document.

SECTION 2
CONCLUSIONS

The testimony presented at the 1977 public hearings on exposure to inorganic lead failed to answer many questions concerning control technology. Most of the smelters affected are not presently equipped to comply with the proposed 100 $\mu g/m^3$ standard on an eight hour, time weighted average (TWA) basis. Few smelters if any, have been able to consistently meet the present 200 $\mu g/m^3$ standard. Also, applicable engineering controls which will meet the proposed standard are not available for many of the problem areas in the primary and secondary lead industries.

From the information presented in the public hearing testimony, it appears that a combination of engineering and administrative controls, personal protective equipment, work practices, maintenance and housekeeping is required to meet the proposed standard for exposure to inorganic lead. In addition, the following conclusions can be drawn:

1) Effectiveness has not been demonstrated for the controls suggested by OSHA to meet the proposed lead standard in several major areas of primary and secondary lead smelters. These controls are listed under ENGINEERING CONTROLS.

2) According to industry spokesman, feasibility greatly depends on the cost of the controls. In many cases, the cost of controls is prohibitive, especially for smaller companies.
   - The costs of administrative controls were not extensively explored by either OSHA or industry studies.

- Housekeeping costs may have been underestimated because they did not include an extensive initial cleanup effort which would be required to meet the proposed standard.

3) A large variety of ventilation, isolation, hooding, or enclosure techniques are possible for controlling and minimizing inorganic lead exposure. However, no data was presented by OSHA which demonstrated that engineering controls could be used to meet the proposed standard in all areas of the nonferrous smelting industry.

These conclusions are discussed in more detail in the following sections.

CONTROL COSTS

A control cannot be judged feasible if its costs is prohibitively high, especially if there is no guarantee of its effectiveness. Cost of compliance estimates for the United States primary smelters are summarized in Table 2-1, while cost estimates for several secondary smelters are given in Table 2-2. None of the cost estimates assume that engineering controls alone will effectively meet the proposed standard.

The control schemes currently in use, such as general ventilation and local exhausting, have not been proven effective for meeting the proposed standard, or, in many cases, the existing standard. The cost of compliance estimates for most smelters presented in the testimony were for installation of the best available control technology. However, there are many areas in both primary and secondary smelters where these controls will not be sufficient to meet the proposed standard. These areas include scrap battery crushing by hand, scrap handling, and slag handling. If new controls must be developed in order to satisfy the proposed standard, the cost of compliance may be much higher than the estimates presented in the hearings. In this case, several of the smaller secondary smelters and one or two of the primary smelters might be forced to shut down.

Table 2-1. Summary of compliance costs estimated for the U.S. primary lead industry (100 μg/m^3 standard).

Source	Hearing Exhibit	Hearing Year	Site	Cost (10^6 $) Capital	Cost (10^6 $) Annual
CRA	127	1977	ASARCO		
			East Helena	5.5	1.4
			El Paso	4.8	1.3
			Omaha	4.2	1.1
			Glover	4.8	1.1
			St. Joe	10.6	3.1
			Bunker Hill	9.2	2.7
			Amax	8.1	2.6
DBA	26	1977	ASARCO		
			East Helena	5.9	1.4
			El Paso	5.2	2.1
			Omaha	4.5	1.2
			Glover	5.2	1.1
			St. Joe	7.5	2.2
			Bunker Hill	18.4	2.7
			Amax	9.5	1.8

One of the few costs which pertained to housekeeping was for vacuum systems. No estimates for an extensive intial clean-up effort were included in the costs of compliance.

Table 2-2. Summary of compliance costs estimated for the U.S. secondary lead industry (100 µg/m^3 standard).

Plant	Capacity (M Short Tons)	Cost (M$) Capital	Cost (M$) Annual	Annual Cost Per Ton of Lead Produced (Cents)
1	16.2	853	512	3.06
2	16.2	2000	246	2.65
3	37	5800	580	3.08
4	10	695	195	2.33
5	75	1822	500	0.80
6	40	701		
7	18	2009	447	3.25
8	18	1454	388	2.63

Source: Exhibit 138-D, 1977 OSHA Hearing on Inorganic Lead

ENGINEERING CONTROLS

The major engineering controls identified in the public hearing testimony were: local exhaust ventilation for major pieces of equipment, general dilution ventilation for fugitive type emissions, enclosure of conveyers for transferring materials and some other major equipment, and vacuum systems for "housekeeping". For some operations, such maintenance of furnaces, few engineering controls were suggested for areas where the present state-of-the-art cannot meet either the existing or porposed standard for airborne lead.

Specific engineering controls which were suggested in the OSHA Economic Impact Analysis (EIA) study include covers, hoods, and exhaust systems for belts and materials handling systems, enclosure and exhaust for the sinter machine area. Local exhaust and dilution ventilation for refinery and reverberatory operations, and filtered air conditioning for operator stations, crane cabs and heavy equipment operator cabs. The EIA admits that the implementation of these engineering controls may not meet the proposed standard.

Engineering controls proposed in studies prepared either by or for the lead industry were similar to the OSHA suggestions. In addition to local and general dilution ventilation both vacuum cleaning and pneumatic dust conveying systems were suggested for secondary lead smelters by the IHEA study.

SECTION 3
DISCUSSION OF SELECTED EXHIBITS

The exhibits discussed in this section relate to engineering controls in the primary and secondary lead industries. A complete listing of the exhibits available from the OSHA Technical Data Center is provided in Section 4 of this document. Copies of particular exhibits may be obtained by writing:

OSHA Technical Data Center
U. S. Department of Labor - OSHA
200 Constitution Avenue, N.W.
Washington, D.C. 20210

EXHIBITS FROM 1977 HEARINGS

No. 22 - "Preliminary Technological Feasibility, Cost of Compliance and Economic Impact Analysis of the Proposed OSHA Standard for Lead." Prepared by John Short & Associates, Inc., under contract to the U. S. Department of Labor, OSHA.

This preliminary Economic Impact Analysis covers 46 target industries including the primary and secondary nonferrous metals industries. This report discusses the emission sources, existing control and manpower, cost of compliance, probability of compliance, and impact on the industry due to the proposed standard. Cost of compliance estimates given are for the entire smelting industry and are not control specific. Additional manpower needs are also estimated. General and local exhaust ventilation, process isolation/enclosure, maintenance, and housekeeping are the major controls considered. No details on these controls are given.

No. 26 - "Technical Feasibility, Cost of Compliance and Economic Impact Assessment of the Proposed Standard for Lead for Selected Industries." Prepared by D.B. Associates, Inc. for the U.S. Department of Labor, OSHA.

This study supplements the preceding study by concentrating on a select group of industries, including the primary and secondary lead smelting industries. In this report, the major operations and locations in the smelting plants, which have a potential for lead exposure, are discussed. In addition, technologically feasible and retrofittable engineering controls for these operations and locations are suggested. The compliance cost estimates for the United States primary lead smelters are borken down by compliance item. These items include air and medical monitoring, engineering controls, work practices, maintenance, and housekeeping. These costs are summarized in Table 3-1. Specific engineering controls for each major emission source include: covering, hooding, and exhausting of belts and materials handling systems, enclosure and exhausting of sinter machines, local exhaust systems and dilution ventilation for reverberatory furnace operations, and filtered air conditioning for operator stations, offices and crane cabs.

No. 65A - Statement of David J. Burton on behalf of OSHA.

In this statement, Mr. Burton describes the history of the OSHA economic impact study for the proposed standard for lead. Mr. Burton describes the approach which he and other members of the DBA staff used to determine the costs of compliance figures for various industries. Included with his statement is an appendix to the OSHA Report which describes the methodology for engineering cost estimates used by DBA. This appendix has been reprinted in Section 5.

Table 3-1. Estimated costs of compliance for U.S. primary smelters.

Compliance Item	EAST HELENA Capital Cost	EAST HELENA Annual Cost	ASARCO-OMAHA Capital Cost	ASARCO-OMAHA Annual Costs	ASARCO-EL PASO Capital Costs	ASARCO-EL PASO Annual Costs	ASARCO-GLOVER Capital Costs	ASARCO-GLOVER Annual Costs	ST. JOE Capital Costs	ST. JOE Annual Costs	AMAX Capital Costs	AMAX Annual Costs	BUNKER HILL Capital Costs	BUNKER HILL Annual Costs
Initial Determination	-	0	-	0	-	0	-	0	-	0	-	3,500	-	-
Air Monitoring	-	-	-	0	-	66,000	-	0	-	30,000	-	52,500	-	60,000
Engineering Controls	5,900,000	300,000	4,500,000		5,250,000		5,180,000		7,500,000		9,540,000	1,120,000	18,400,000	
O & M	-	-	-	470,000	-	415,000	-	520,000	-	596,000	-	-	-	1,470,000
Energy	-	-	-	36,000	-	444,000	-	45,000	-	156,000	-	-	-	266,000
Work Practices	-	480,000	-	210,000	-	0	-	150,000	-	300,000	-	200,000	-	0
General Maintenance	-	480,000	-	290,000	-	700,000	-	300,000		} 900,000	-	244,000	-	452,000
Housekeeping	-	74,000	-	100,000	-	158,000	-	46,500	-		-	95,000	-	90,000
Protective Clothing	-	26,500	-	46,000	-	75,000	-	24,000	-	0	-	0	-	96,000
Biological Monitoring	-	0	-		-	79,000	-	0	-	15,000	-	-	-	60,000
Training, Information	-	1,000	-	} 14,000	-	24,000	-	12,000	-	18,000		27,000	-	19,000
Medical Surveillance	-	48,000	-		-	97,000	-	0	-	66,000	-	38,000	-	70,000
Record keeping	-	31,000	-	38,000	-	2,000	-	20,000	-	60,000	-	34,000	-	66,000
Compliance Program	-	4,000	-	5,000	-	-	-	2,000	-	0	-	-	-	0
TOTALS:	5,900,000	1,444,000	4,500,000	1,209,000	5,250,000	2,060,000	5,180,000	1,119,500	7,500,000	2,311,000	9,540,000	1,814,000	18,400,000	2,649,000

No. 104 - Statement of Melvin W. First on behalf of OSHA.

In his statement, Dr. First supports the proposed new lead standard. He feels that conventional engineering controls such as vacuum sweeping systems, pneumatic or mechanical materials conveying, exhaust ventilation, and isolation/enclosure can be effective in meeting the standard and that the reliance on personal, protective equipment and workers' rotation should be reserved for certain maintenance operations and emergency situations. He also believes strongly in the reliance on lead-in-air monitoring as opposed to blood lead monitoring for determination of worker exposure. Dr. First emphasizes the critical importance of worker-management cooperation for effective health protection.

No. 127 - "Economic Impact of Proposed OSHA Lead Standards." Prepared by Charles River Associates for the Lead Industries Association.

In this report, the economic impacts of the proposed regulation on the primary and secondary lead industries and the battery industry are addressed. This study presents an in-depth analysis of the primary industry by smelter. Included in this analysis are descriptions of the technology used in smelting and refining lead, production figures for all the smelters and associated mines, a discussion of the integration of the producers, employment, and the financial position of the companies. In addition, detailed costs of compliance are given and are divided into these major components: capital costs, annual charge to capital reflecting interest and depreciation, operating costs including power and labor, air monitoring and medical monitoring costs, and administrative costs including record keeping, respirator program, and lost production time. Tables 3-2 and 3-3 summarize the important costs, both short run and long run associated with compliance.

The capital and operating costs were provided by the companies themselves. It is emphasized that these costs represent "best attainable" control technology which will not meet the proposed standard in some areas of the plants. If technology must be developed to control these areas to the proposed, 100 $\mu g/m^3$ air-lead standard, the actual costs may be greater than those shown in Tables 3-2 and 3-3. No details of these engineering controls are given in this report.

The secondary lead smelting industry is given a rather cursory treatment in this report. Cost of compliance estimates were obtained from conversations with plant operators, studies performed by Industrial Health Engineering Associates and db Associates, and from the OSHA Economic Impact Statement: Inorganic Lead. Very little background information is included on the secondary industry. The final part of this report covers the battery industry. A detailed analysis of this industry, cost of compliance, and economic impacts of compliance are addressed.

No. 138-D - "Final Report; Engineering Cost and Feasibility Study, Proposed OSHA Lead Standard, Secondary Smelters, for Lead Industries Association." Prepared by Industrial Health Engineering Associates.

This report investigates the technical feasibility and costs required to achieve the proposed lead-in-air standard of 100 $\mu g/m^3$ in secondary lead smelters. The study includes the operating and maintenance costs of the engineering controls, but does not address the cost of record keeping, medical examinations, etc.

Table 3-2. Long-Run Incremental Annual Costs for Primary Lead Producers in Complying with the Proposed OSHA Air-Lead Standards

	Exposed Employment	Refinery Capacity (Short Tons)	Total Capital Costs (Millions of January 1976 Dollars)	Annual Charge to Capital (Millions of January 1976 Dollars)	Operating Costs (Millions of January 1976 Dollars)	Air Monitoring Costs (Millions of January 1976 Dollars)	Medical Costs (Millions of January 1976 Dollars)	Administration Costs (Millions of January 1976 Dollars)	Total Annual Costs (Millions of January 1976 Dollars)	Increase in Cost of Production of Lead* (Costs Per Pound)	Increased Cost Per Employee (Dollars)
ASARCO	(837)	290,000	19.247	2.999	.746	.049	.080	.948	4.822	.83	5761
E. Helena	(225)	Smelter	5.499	.857	.221	.013	.021	.272	1.348	---	6151
El Paso	(225)	Smelter	4.828	.752	.184	.013	.021	.280	1.250	---	5556
Omaha	(242)	180,000	4.153	.647	.142	.014	.024	.245	1.072	1.03	4430
Glover	(145)	110,000	4.767	.743	.199	.009	.014	.151	1.116	.51	7697
St. Joe	(629)	225,000	10.627	1.656	1.063	.036	.034	.282	3.071	.68	4882
Bunker Hill	(450)	140,000	9.236	1.439	1.118	.018	.033	.064	2.672	.95	5938
Amax	(300)	140,000	8.144	1.269	1.123	.012	.020	.210	2.634	.94	8780
Total	(2216)	795,000	47.254	7.363	4.050	.115	.167	1.504	13.199	.83	5956

Note: Incremental costs are the costs of achieving 100 μg/m^3 standard (or best practicable air quality) from present levels.

*Assumes 100 percent capacity utilization.

Table 3-3. Short Run (to 1980) Incremental Annual Costs for Primary Lead Producers in Complying with the Proposed OSHA Air-Lead Standards

	Exposed Employment	Refinery Capacity (Short Tons)	Total Capital Costs (Millions of January 1976 Dollars)	Annual Charge to Capital (Millions of January 1976 Dollars)	Operating Costs (Millions of January 1976 Dollars)	Air Monitoring Costs (Millions of January 1976 Dollars)	Medical Costs (Millions of January 1976 Dollars)	Administration Costs (Millions of January 1976 Dollars)	Total Annual Costs (Millions of January 1976 Dollars)	Increase in Cost of Production of Lead * (Costs Per Pound)	Increased Cost Per Employee (Dollars)
ASARCO	(837)	290,000	19.247	2.999	.746	.155	.261	2.182	6.343	1.09	7538
E. Helena	(225)	Smelter	5.499	.857	.221	.045	.088	.633	1.844	---	8196
El Paso	(225)	Smelter	4.828	.752	.184	.033	.081	.666	1.716	---	7627
Omaha	(242)	180,000	4.153	.647	.142	.042	.049	.581	1.461	1.39	6037
Glover	(145)	110,000	4.767	.743	.199	.035	.043	.302	1.322	0.60	9117
St. Joe	(629)	225,000	10.627	1.656	1.063	.095	.055	.524	3.395	0.75	5394
Bunker Hill	(450)	40,000	9.236	1.439	1.118	.053	.110	.140	2.860	1.02	6356
Amax	(300)	140,000	8.144	1.269	1.123	.037	.097	.500	3.026	1.08	10087
Total	(2216)	795,000	47.254	7.363	4.050	.340	.523	3.346	15.622	0.98	7050

Note: Incremental costs are the costs of achieving 100 μg/m^3 standard (or best practicable air quality) from present levels (not necessarily 200 μg/m^3).

*Assumes 100 percent capacity utilization.

A typical secondary smelter using lead and battery scrap is described on a process-by-process basis. The engineering controls required for each process are addressed and a cost estimate for these controls is reported. Controls suggested include local and general exhaust ventilation, isolation and/or enclosure, vacuum cleaning systems and pneumatic dust conveying.

A summary of the cost estimate is given in Table 3-4.

Table 3-4. Cost of compliance estimate for secondary lead smelter.

Nominal Capacity	60 tons/day
Capital Installed Cost	$2,000,000
Power Required	1,792,000 kwH/year
Maintenance (incl. labor)	$164,000 per year
Incremental Labor	12,875 hours/year
Capital cost per unit capacity (tons/day)	33000

This report also concludes that it will not be technically feasible to meet the proposed standard in certain areas of the secondary lead smelter. These areas are the breaking of batteries by hand, the scrap handling operation, and the handling of slag.

In addition, this report discusses the ban on recirculation of cleaned air which is part of the proposed standard. It is concluded that this requirement should be deleted due to the energy situation and the removal efficiency which can be obtained with available technology. A reprint of this exhibit is included in Section 6.

No. 142D - "Variations in Personal Air Sampling Results for Individual Employees Over a Period of About Ten Successive Work Days." Prepared by ASARCO.

This exhibit presents the range and variance in daily exposure to lead over a ten day period for several employees in ASARCO's El Paso smelter. These data do not specify the departments or job/operations where they were taken. This exhibit is reprinted in Section 7.

No. 142E - "Updated Summary of Lead Air Sampling Data for East Helena, El Paso, Glover, Newark, Omaha, and Whiting Plants for 1975 and 1976." Presented by ASARCO.

This exhibit summarizes lead air sampling data for all of ASARCO's lead smelters. These data are broken down by sample date, type of sample, department, and job or operation. For each smelter, a range and mean is reported. This exhibit is reprinted in Section 7.

No. 144 - List of Employee Exposure Data Concerning ASARCO's Omaha Refinery.

This list reports blood lead levels taken at various times in 1976-1977 by different departments for the Omaha Refinery. This list is reprinted in Section 7.

No. 196 - Statement of Knowlton J. Caplan (on behalf of AMAX Lead Company).

Mr. Caplan discusses the types of engineering controls which AMAX would have to install at the Buick smelter to meet the proposed lead standard. He emphasizes that engineering controls alone are not the answer. Several areas within the smelters will be impossible to control to 100 $\mu g/m^3$ using engineering controls. A combination of engineering controls, administrative controls, and personal protective equipment in addition to an industrial hygiene medical program will be necessary to assure worker protection.

Some of the difficult to control operations of the smelter are described, along with possible engineering controls for each operation. Most of these controls have not been proven effective in lead smelter applications. These engineering controls include a mechanized drossing machine to skim the dross from the refinery kettles and pneumatically convey it to a fabric filter, and the use of the Hawley Trav-L-Vent system for control of dross ladle emissions and the dross furnace skimming and charging operations. The Trav-L-Vent consists of a wind box that moves along a straight rectangular duct, picking up and laying down a strip of conveyer belting which forms the top side of the duct by means of a set of rollers.

No. 216 - Statement of Michael O. Varner on
Behalf of ASARCO.

In his statement, Mr. Varner presents ASARCO's estimates of cost of compliance for their primary lead smelters. He addresses not only engineering controls but also costs of increased medical monitoring and record keeping.

Mr. Varner's statement emphasizes ASARCO's opposition to the air and blood monitoring requirements of the proposed standard. ASARCO feels that repetitive air sampling adds no useful information unless a change in the process or controls has been made.

In addition, it is very expensive. The cost to ASARCO of the proposed air monitoring program is approximately $500,000 per year. ASARCO recommends that air sampling and air standards be used primarily as a guide and that the enforced standard should be based on biological monitoring. Mr. Varner estimates the additional biological sampling program will cost approximately $220,300 per year. The costs of record keeping are estimated to be at least $303,500.

Finally, a summary of the costs of improvements made at ASARCO facilities since 1971 to reduce airborne lead concentrations is attached. The cost of completed improvements is approximately 4 million dollars with more than 2.25 million dollars worth of related projects ongoing. The engineering controls listed in this summary include ventilation improvements, process enclosure, increased hooding for some processes and air-conditioning of crane cabs.

No. 217 - Statement of E. S. Godsey on Behalf of ASARCO.

In this statement, Mr. Godsey, Chief Fume and Dust Recovery Engineer for ASARCO Incorporated, describes the basis and methodology used to calculate the cost of compliance estimates for the ASARCO smelting plants. In addition, some of the problems involved in designing ventilation systems to meet lead-in-air requirements are addressed.

No. 296 - Letter dated 3 June 1977 to Docket Officer, OSHA, from Robert Denham, ASARCO, Inc., enclosing cost calculations requested of Mr. Godsey at the San Francisco Hearing.

This exhibit contains the detailed calculations carried out by Mr. Godsey in arriving at the total cost to attempt to meet the proposed OSHA standard. Included in this statement are summaries of the cost estimates and specification sheets with cost estimates for each project.

SECTION 4

INORGANIC LEAD HEARING EXHIBIT LIST

U.S. DEPARTMENT OF LABOR
Occupational Safety and Health Administration
WASHINGTON, D.C. 20210

INORGANIC LEAD
H-004
EXHIBIT LIST

HEARING DATES:
March 15-April 14, 1977 (Wash.)
April 26-April 28, 1977 (St. Louis)
May 3-May 6, 1977 (San Francisco)

DOCUMENTS AVAILABLE IN :
OSHA Technical Data
Center - Docket Office
Room S-6212
200 Constitution Ave., N.W.
Washington, D.C. 20210
(202) 523-7894

1. "Criteria for a Recommended Standard: Occupational Exposure to Inorganic Lead," U.S. Department of Health, Education, and Welfare, National Institute for Occupational Safety and Health, 1972.

2. "Occupational Exposure to Lead: Proposed Rulemaking," U.S. Department of Labor (OSHA), Federal Register, Vol. 40, No. 193, October 3, 1975 at p. 45933.

2.A. "Occupational Exposure to Lead: Extension of Time to File Comments on Proposed Rule; Corrections," U.S. Department of Labor (OSHA), Federal Register, Vol. 40, No. 232, December 2, 1975 at p. 55866.

3. Comments received in response to proposal, Federal Register, October 3, 1975 and December 2, 1975. See attachment I.

4. Additional comments received after the close of proposal comment period. See attachment II.

5. References to proposal. See attachment III.

6. Additional references. See attachment IV and IV (A).

7. Calandra, J.C., "Review of EPA's Position on the Health Implications of Airborne Lead Dated November 28, 1973 and The Final Lead Additive Regulations of the Environmental Protection Agency Published in the Federal Register December 6, 1973, Vol. 38, No. 234, pp. 33734-33741," Houston Chemical Co., May 2, 1974.

8. Sixty-nine (69) Congressional letters on proposed standard.

9. Lead samples for the dates August 10 through July 10, 1975 by Region.

10.A. Lead test samples from January 1973.

10.B. Explanation of how to read computer summary of inspections.

11.A. National Detailed Test/Sample Inspection Analysis, August 7, 1974 (p. 14), July 22, 1974 (p. 11), and August 22, 1975 (p. 5).

11.B. Explanation of how to read computer summary of inspections.

12.A. OSHA Inspections Related to the Smelting and Refining of Lead, July 1972 thru March 1975.

12.B. Department of Labor, OSHA Inspection Test/Sample Report.

12.C. Explanation of how to read computer summary of inspections.

13. Letter dated April 14, 1975 form Chloride Inc.

14.A. Executive Order 11821, "Inflation Impact Statements," November 27, 1974.

14.B. Executive Order 11949, "Economic Impact Statements," December 3, 1976.

15. Office of Management and Budget Circular No. A-107, January 28, 1975.

16. Secretary's Order 15-75 on Inflationary Impact Statements.

17. Letter dated January 19, 1976 to Docket Officer, OSHA from Standish F. Medina, Debevoise, Plimpton, Lyons, and Gates.

18. Letter dated February 11, 1976 to Docket Officer, OSHA from Standish Medina, Debevoise, Plimplton, Lyons, and Gates. Reply dated March 9, 1976.

19. Letter dated January 10, 1977 to Grover Wrenn, OSHA from Standish F. Medina, Debevoise, Plimpton, Lyons, and Gates.

20. Letter dated February 2, 1977 to David J. Kuchenbecker, SOL (OSHA) from James H. Heacock, State of California Department of Health.

21. "Proposed Standard for Exposure to Lead: Informal Public Hearing; Availability of Preliminary Technological Feasibility and Inflationary Impact Study; and Receipt of Additional Studies," U.S. Department of Labor (OSHA), Federal Register, Vol. 42, No. 2, January 4, 1977 at p. 808.

22. "Preliminary Technological Feasibility, Cost of Compliance and Economic Imapct Analysis of the Proposed OSHA Standard for Lead," Prepared by John Short & Associates for U.S. Department of Labor, OSHA.

23. Sixty-nine (69) references as listed in 42 FR 810, January 4, 1977. See attachment V.

24. Papers presented at Second International Workshop on Occupational Lead Exposure, Re-evaluation of Permissible Limits on Lead Exposure, Permanent Commission and International Association on Occupational Health (Amsterdam, September 1976). See attachment VI.

25. "Proposed Standard for Exposure to Lead: Availibility of Technological Feasibility and Economic Impact Study; Certification of Economic Impact; and Identification of Additional Studies," U.S. Department of Labor (OSHA), Federal Register, Vol. 42, No. 31, February 15, 1977 at p. 9190.

26. "Economic Impact Statement, Inorganic Lead," U.S. Department of Labor, OSHA, February 1977.

27. Sixteen (16) references as listed in 42 FR 9191, 15 February 1977. See attachment VII.

28. Comments received in response to 42 FR 808, 4 January 1977 and 42 FR 9190, 15 February 1977. See attachment VIII.

29. Notices of Intention to Appear at 15 March 1977 Informal Hearing on Proposed Standard for Occupational Exposure to Inorganic Lead. See attachment IX.

30. "Environmental Impact Statements: Statements Received February 14 Through February 18, 1977," Council on Environmental Quality, Federal Register, Vol. 42, No. 38, 25 February 1977 at p. 11034 /contains draft statement on inorganic lead/.

31. Draft Environmental Impact Statement: Inorganic Lead; U.S. Department of Labor, Occupational Safety and Health Administration, February 1977.

32. Seventy (70) references to the draft Environmental Impact Statement. See attachment X.

33. Comments received in response to the draft Environmental Impact Statement. See attachment XI.

34.A. Letter to William Lee from Richard P. Wedeen

34.B. Letter to William Lee from Badi M. Boulos

34.C. Letter to William Lee from G. M. Baker

34.D. Letter to William Lee from Kezaburo Tsuchiya

34.E. Letter to William Lee from Ellen K. Silbergeld

34.F. Letter to William Lee from Robert A. Kehoe

35.A. Letter from William Lee to Herbert L. Needleman

35.B. Letter from William Lee to Henrietta Sachs

35.C. Letter from William Lee to Louis Kopita

35.D. Letter from William Lee to Paul Hammond

35.E. Letter from William Lee to Ellen Silbergail

35.F. Letter from William Lee to Robert Baloh

35.G. Letter from William Lee to John Finklea

35.H. Letter from William Lee to Jerome F. Cole

35.I. Letter from William Lee to Ruth Lilis

35.J. Letter from William Lee to K. Tsuchiya

35.K. Letter from William Lee to Charles Peterson

35.L. Letter from William Lee to Jules Kann

35.M. Letter from William Lee to R. L. Zielhuis

35.N. Letter from William Lee to John Repko

35.O. Letter from William Lee to Ken Nelson

35.P. Letter from William Lee to Gene Baker

35.Q. Letter from William Lee to Sven Hernberg

35.R. Letter from William Lee to Stephan Krop

35.S. Letter from William Lee to Bruce A. Fowler

35.T. Letter from William Lee to Badi Boulos

35.U. Letter from William Lee to Theodore R. Robinson

35.V. Letter from William Lee to D. Barltrop

35.W. Letter from William Lee to Robert Kehoe

35.X. Letter from William Lee to Clement Richer

35.Y. Letter from William Lee to Anna Maria Seppalainen

35.Z. Letter from William Lee to Richard Wedeen

36. Letter to K. W. Nelson from R. E. G. Rendall

37. Severities of Lead Samples Taken, and Related Citations, National, by Area (July 1972 - December 1975).

38.A. National Institute for Occupational Safety and Health, Health Hazard Evaluation Determination, Report No. 75-177-343, Hersey Products Company, Inc., November 1976.

38.B. National Institute for Occupational Safety and Health, Health Hazard Evaluation Determination, Report No. 76-75-340, Rocky Mountain Bank Note, November 1976.

38.C. National Institute for Occupational Safety and Health, Health Hazard Evaluation Determination, Report No. 76-36-339, Eagle Picher Industries, Inc., November 1976.

39. Program Directive #200-45: Lead and Its Inorganic Compounds

40. Program Directive #300-7: Issuance of Citiations Under the Genral Duty Clause for the Administration of Chelating Agents

41. Written statement of East Penn Manufacturing Co., Inc.

42. Written statement of Acme Battery Manufacturing Company.

43. Written statement of National Electrical Manufacturers Association.

44. Written statement of Bethlehem Steel Corporation.

45. "Guidelines for Controlling Occupational Exposure to Lead", OSHA, n.d.

46. Charter of Standards Advisory Committee on Rate Retention. (DRAFT)

47. Statement of Grover Wrenn, OSHA.

48. See Exhibit 46.

49. "Report on the Action Level Concept", NACOSH Subgroup on Standards, June 24, 1976.

50. Transcript of National Advisory Committee on Occupational Safety and Health, Subgroup on Standards, April 14, 1976.

51. Statement of Anna Maria Seppalainen (on behalf of OSHA), "The Nervous System and Lead with Special Reference to Occupational Lead Exposure".

51.A. Appendix I to Seppalainen statement.

51.B. Appendix II to Seppalainen statement (bibliography).

51.C. Appendix III to Seppalainen statement.

52. Statement of John D. Repko (on behalf of OSHA), "Testimony in Regard to the Evaluation of Behavioral Functions of Workers Exposed to Inorganic Lead".

53. Statement of Hector P. Blejer (on behalf of OSHA).

54. Statement of Paul B. Hammond (on behalf of OSHA).

55.A. Statement of M.A. El Batawi (on behalf of OSHA), "Primary Reliance on Air Lead Determinations for the Protection of Workers' Health".

55.B. World Health Organization, "Environmental and Health Monitoring in Occupational Exposure to Health Hazards", Technical Report Series No. 535, Geneva: World Health Organization, 1973.

55.C. World Health Organization, "Early Detection of Health Impairment in Occupational Exposure to Health Hazards", Technical Report Series No. 571, Geneva: World Health Organization, 1975.

55.D. World Health Organization, "Methods Used in Establishing Permissible Levels in Occupational Exposure to Harmful Agents", Technical Report Series, unnumbered, Geneva: World Health Organization, 1976.

56. Statement of Daniel T. Teitelbaum (on behalf of OSHA).

56.A. Six (6) transparencies used to illustrate presentation of Daniel T. Teitelbaum.

57. Statement of S. Piomelli (on behalf of OSHA).

58. Statement of Iona Lancranjan; list of pathologic conditions able to influence spermatogenesis. (on behalf of OSHA).

58.A. "Diagnosis of Inorganic Lead Poisoning: A Statment", Ronald E. Lane and Others, British Medical Journal, 23 November 1968, p. 501.

58.B. Silbergell, Ellen K. and J. Julian Chisholm, "Lead Poisoning Altered Urinary Catecholamine Metabolitis as Indicators of Intoxication in Mice and Children", Science, 192 (4235), 1976, pp. 153-155.

58.C. Kober, Thomas E. and Gary P. Cooper, "Lead Competitively Inhibits Calcuim-Dependent Synoptic Transmission in the Bullfrog Sympathetic. Ganglion", Nature, Vol. 262 (19 August 1976), pp. 704-705.

59. Statement of Vilma R. Hunt with bibliography.

60.a.i. Curriculum Vitae, Andrea M. Hricko.

60.a.ii. "Testimony on Reproductive Effects of Lead Exposure: Scientific Evidence and Policy Issues", Andrea M. Hricko. (on behalf of OSHA)

60.B. Letter dated February 28, 1977 to Andrea M. Hricko. Labor Occupational Health Program, Univeristy of California from Peter Westerholm, National Board of Occupational Safety and Health, Sweden.

60.c.i. "One Week Pregnancy Test", Parade Magazine.

60.c.ii. Lanesman, Robert and Birg B. Saxena, "Results of the First 1000 Radioreceptoransorp for the Determination of Human Chorionie Gonoclotropin: A New, Rapid, Reliable, and Sensitive Pregnancy Test", Fertility and Sterility, Vol. 27, no. 4 (April 1976), pp. 257-368.

61. Letter dated November 18, 1976 to William Usery, Secretary of Labor from James D. English, United Steelworkers of America.

62. Letter dated December 9, 1976 to James D. English, United Steelworkers of America from Grover Wrenn.

63. Letter dated February 24, 1976 to Morton Corn, OSHA from George Becker, United Steelworkers of America.

64. Letter dated April 2, 1976 to George Becker, United Steelworkers of America from Morton Corn, OSHA.

65.A. Statement of David J. Burton (on behalf of OSHA).

65.B. "Addenda to Economic Impact Statement", March 11, 1977.

66. Statement of Arvil V. Adams (on behalf of OSHA).

67. "CRA Data Given to DBA by Ken Wise Approximately January 27, 1977".

68. Statement of Samuel S. Epstein (AFL-CIO).

69. Statement of Herbert Z. Needleman (AFL-CIO).

70. Statement of Donald E. Johnson (AFL-CIO).

71. Statement of Olga M. Madar (Coalition of Labor Union Women - CLUW).

71.A. Letter dated March 9, 1977 to Coalition of Labor Union Women from Patricia Schroeder, U.S. Congress.

72. Statement of Jeanne M. Stellman (CLUW).

73. Statement of Florence Simons (CLUW).

74. Pamphlet of Apsee, Inc.

74.A. Video presentation of Apsee, Inc.

75. Statement of Peter J. Schultz (J.I. Case Co.)

76. Statement of Dan A. Noe, (Independent Battery Manufacturers Association, Inc., IBMA).

77. Written statement of the Council on Wage and Price Stability.

78. Department of Health, Education and Welfare, National Institute for Occupational Safety and Health (NIOSH), Reprint for Proposal no. 210-77-0117-0000, February 16, 1977, Cross-sectional medical survey of workers exposed to lead.

79. National Institute for Occupational Safety and Health, Health Hazard Evaluation 76-36-369, Supplemental Report (Follow up Medical Study to HHE 76-36-339), Eagle Pitcher Industries, Inc., March 1977. (see ex. 38.C.)

80. Statement of Bernard R. Roy (AMAX, Inc.)

81.A. "Comments Regarding Effectiveness of ALA for Screening of Plumbism and the Impracticality of the Proposed 1975 Federal Standard for ALA", Robert F. Bell (on behalf of AMAX, Inc.)

81.B. Twenty (21) slides used in presentation of Robert F. Bell.

81.C. Bell, Robert F., "Comparison of Blood Lead, Urinary Delta-Aminolevulinic Acid, and Hemoglobin as Screening Tests in a Primary Lead Smelter", Pre-Publication Draft.

82.A. Curriculum Vitae and Statement of Richard P. Wedeen (on behalf of OSHA).

82.B. Two hand-drawn charts used in presentation of Richard P. Wedeen.

83. Index of NIOSH Exhibits presented with testimony (Exhibits 84-91).

84. Statement of Edward J. Baier (National Institute for Occupational Safety and Health, NIOSH).

85. National Institute for Occupational Safety and Health, "Environmental and Morbidity Phase: Bunker Hill Study, Interim Report".

86.A. Letter dated 4 August 1975 to Marshall Miller, OSHA from John F. Finklea, NIOSH. (See also 325)

86.B. "A Report of Recent Medical Studies of Five U.S. Lead Plants," Bureau of Epidiomology and NIOSH, Center for Disease Control, March 1977.

86.C. Lilis, Ruth, and Alf Fischbein, "Health Effects of Lead in Secondary Smelter Workers: Results of an Investigation of Employees of a Secondary Lead Smelter in Vernon, California, November 1976: Initial Report of a Clinical Field Survey," Mt. Sinai School of Medicine, 31 January 1977.

86.D. "Analysis of Blood and Air Lead Data from General Motors, Delco Battery Plant, Muncie, Indiana: Interim Report," NIOSH, nd.

86.E. Bridbord, Kenneth, "Relationship Between Air Lead Exposure and Blood Lead Levels in Occupational Situations," NIOSH, 4 March 1977.

86.F. "Proficiency Testing Summary Analysis: Toxicology, Blood Lead 1976, Parts I, II, III & IV," Center for Disease Control; "Summary Report on Proficiency Testing of Blood Lead 1976," Center for Disease Control.

86.G. Purdy, Alan H. and Kenneth Bridbord, "A Review of the Recent Literature Concerning the Relationship of Free Erythrocyte Protorphyrin, Zinc Protorphyrin and Blood Lead Level," NIOSH, nd.

86.H. Bridbord, Kenneth and Hector Blejer, "Prophylactic Chelation Therapy in Occupational Lead Poisoning: A Review," NIOSH, 15 December 1976, Pre-Publication Draft.

86.I. "Lead and Inorganic Lead Respirator Selection Recommendations," NIOSH, 15 March 1977.

86.J. "Supplemental Information: Sampling and Analytic Procedures Engineering Control Technology," NIOSH, March 1977.

86.K. Tola, Sakari, Sven Hernberg, and Ritva Vesanto, "Occupational Lead Exposure in Finland, VI. Final Report," Scand. j. work environ & health, 2 (1976) 115-127.

86.L. Committee to Coordinate Toxicology and Related Programs, DHEW, (Hans L. Falk, Chairman), "Human Health Consequences Due to Lead Exposure from Automotive Emissions," 8 June 1976.

86.M. National Academy of Sciences, Committee on Toxicology, "Recommendations for the Prevention of Lead Poisoning in Children," July 1976; for the Consumer Product Safety Commission.

87. NIOSH Certified Equipment, 15 December 1975; Cumulative Supplement, June 1976.

88. NIOSH/OSHA Standards Completion Program, "Draft Technical Standard and Supporting Documentation for Lead and Inorganic Compunds," nd.

89. Joint NIOSH/OSHA Standards Completion Program, "Respirator Decision Logic," 2 August 1976.

90. Blair, Austin (Boeing Aerospace Co.), "Abrasive Blasting Respiratory Protective Practices," April 1974; contract for NIOSH.

91. Pritchard, John A. (Los Alamos Scientific Laboratory), " A Guide to Industrial Respiratory Protection," June 1976; for NIOSH.

92. Statement of Catherine East (on behalf of OSHA).

93. Statement of M. K. Williams (on behalf of Lead Industries Association).

94. Chisholm, J. Julian, Jr., E. David Mellits, and Maureen B. Barrett, "Interrelationships Among Blood Lead Concentration, Quantitative Daily ALA-U and Urinary Lead Output Following Calcium EDTA," from Effects and Dose-Response Relationships of Toxic Metals, Amsterdam: Elsevier, 1976, pp. 416-433.

95. National Academy of Sciences, Lead: Airborne Lead in Perspective, Washington, NAS, 1972, p. 132.

96. Selander, Stig and Kim Cramèr, "Interrelationships Between Lead in Blood, Lead in Urine, and ALA in Urine During Lead Work," British Journal of Industrial Medicine, 1970, 27, 28-39.

97. "London, G.M. and others, "Free Erythrocyte Protoporphyrin Level and Nerve Conduction Velocity in End-stage Renal Disease," British Medical Journal, 1975, 4, 324-325.

98. Conradi, Sebastain, Lars-Olof Ronnevi, and Olof Vesterberg, "Abnormal Tissue Distribution of Lead in Amyotrophic Lateral Sclerosis," Journal of the Neurological Sciences, 1976, 29: 259-265.

99.A. Petkau, A. and others, "Lead Content of Neuromuscular Tissue in Amyotrophic Lateral Sclerosis: Case Report and Other Considerations," British Journal of Industrial Medicine, 1974, 31, 275-287.

99.B. Chisholm, J. Julian, Jr., Maureen B. Barrett, and Harvey V. Harrison, "Indicators of Internal Dose of Lead in Relations to Derangement in Heme Synthesis," The Johns Hopkins Medical Journal, 137, 6-12 (1975).

99.C. Barry, P. S. I., "A Comparison of Concentrations of Lead in Human Tissues," British Journal of Industrial Medicine, 1975, 32, 119-139.

99.D. Ahlgren, Lars and others, "X-Ray Flourescence Analysis of Lead in Human Skeleton in Vivo," Scand. j. work environ. & Health, 2 (1976) 82-86.

100. Statement of Dennis Malcolm (Chloride Inc.)

100.A. Taylor, J. F., " A Comparitive Study of Blood Leads and Lead-in-Airs to Test the Validity of the Current TLV for Lead," unpublished, 10 March 1977.

101. Curriculum vitae, Meier Schneider (Teamsters)

101.A. Thomas, Paul A. B., "Airborne Lead Concentrations and Their Control in the Lead Storage Battery Industry," (Master's Thesis, California State University, North-Ridge, 1976).

102. "Smelter Workers May Live Longer," The Cominco Orbit, Vol. 7, No. 2, 11 February 11, 1977.

103. Statement of Edward N. Doyle (Cominco, Ltd.).

104. Statement of Melvin W. First (on behalf of OSHA). See Ex. 270.

105.A. Statement of W. E. Blumberg, J. Eisenger, and A.A. Lamola (Bell Laboratories).

105.B. Lamola, A. A. and T. Yamane, "Zinc Protoporphyrin in the Erythrocytes of Patients with Lead Intoxication and Iron Deficiency Anemia," Science, Vol. 186 (6 December 1974), pp. 936-938.

105.C.i. Piomelli, Sergio and others, "Erythropoietic Protorphyria and Lead Intoxication: The Molecular Basis for Difference in Cutaneous Photosensitivity; I. Different Rates of Disappearance of Protoporphyrin from the Erythrocytes, Both in Vivo and in Vitro," The Journal of Clinical Investigation, vol. 56 (December 1975) pp. 1519-1527.

105C.ii. Lamola, Angelo A. and others, "Erythropoietic Protoporhyria and Lead Intoxication: The Molecular Basis for Difference in Cutaneous Photosensitivity; II. Different Binding of Erythrocyte Protoporphyrin to Hemoglobin," The Journal of Clinical Investigation, Vol. 56 (December 1975) pp. 1528-1535.

105.D. Fischbein, Alf, Josef Eisinger, and William E. Blumberg, "Zinc Protoporphyrin Determination: A Rapid Screening Test for the Detection of Lead Poisoning," The Mount Sinai Journal of Medicine, Vol. 43, No. 3 (June 1976), pp. 294-299.

105.E. Fischbein, Alf and others, "Flourometric Zinc Protoporphyrin Determination in Blood - A Practical Method for the Dectection of Chronic Lead Poisoning," unpublished, nd.

105.F. "Lead Disease Among Workers in Secondary Lead Smelters," see Exhibit 23, Lilis and Fischbein.

105.G. Blumberg, W. E., and others, "Zinc Protoporphyrin Level in Blood Determined by a Portable Hematoflourometer: A Screening Device for Lead Poisoning," Bell Laboratories, nd.

105.H. Lamola, A.A. and others, "Quantitative Determination of Erythrocyte Zinc Protoporphyrin," unpublished, nd.

105.I. Addendum to Exhibit 105.A.

106. United States Patent, Blumberg, et.al., 3,973,129, August 3, 1976.

107. Sixteen (16) slides and transparencies used in presentation of A.A. Lamola (Bell Laboratories).

108. Eisenger, Josef, "Lead and Man: Historical Survey and Recent Biochemistry," unpublished, nd.

109. Statement of Sara Nelson (National Organization for Women).

110. Statement of Camille Kozlowski (Women & Health Committee, New York Chapter, National Organization for Women).

111. "Lead Danger Found in Two Workplaces," United Rubber Worker, May 1976, p. 6; errata, United Rubber Worker, June 1976, p. 4.

112. Citation (amended), No. S-8492, Eagle-Pitcher Industries, Region 7, Area 4120.

113. Hemological Studies conducted by Ferguson Medical Laboratory, Joplin, Missouri; Blood Lead and Urinary Lead Evaluations conducted by Falzone Medical Laboratories, Lincoln Park, Michigan [see TR. p. 2533].

114. Comments of R. L. Bockstahler at meeting with employees and NIOSH on Friday, June 18, 1976.

115.A. Memorandum dated 6 July 1976 to URW Local 812 Members Employed at the Eagle-Picher Chemical and Fibers Division in Joplin, Missouri from URW International President Peter Bommarito and URW Director of Industrial Hygiene Louis S. Beliczky.

115.B. Special Report to the International President from Louis S. Beliczky dated 22 June 1976.

116. Statement A. E. Stewart; 37 color photographs (on behalf of Industrial Union Department).

117.A. Statement of Alf Fischbein (on behalf of Industrial Union Department).

117.B. Fischbein, Alf, "Zinc Protoporphyrin and Blood Lead Levels in a Group of Swedish Lead Storage Battery Workers," unpublished, nd.

118.A. Curriculum Vitae, Ruth Lilis (on behalf of Industrial Union Department).

118.B. Twenty-four (24) slides presented by Ruth Lilis.

118.C. Lilis, Ruth, "Health Effects of Lead in Secondary Smelter Workers," unpublished, nd.

118.D. Lilis, Ruth and Alf Fischbein, "Chelation Therapy in Workers Exposed to Lead: A Critical Review," Journal of the American Medical Association, Vol. 235, No. 26 (June 28, 1976) pp. 2823-2824.

118.E. Lilis, Ruth and others, "Nephropathy in Chronic Lead Poisoning," British Journal of Industrial Medicine, Vol. 25 (1968) pp. 196-202.

118.F. Lilis, Ruth and others, "Renal Function in Chronic Lead Poisoning," La Medicina del Lavoro, Vol. 58 - N. 8-9 - 1967, pp. 506-512.

118.G. Complete Bibliography, Ruth Lilis.

119. Biographical Sketch and Selected Publications List, Jose A. Valciukas (on behalf of Industrial Union Department).

119.A. Valciukas, Jose A. and others, "Behavioral Testing in Lead Exposed Workers: Results of a Clinical Survey," unpublished, nd.

120. Rice, Carol, "Lead Contamination in the Homes of Secondary Lead Smelter Workers," unpublished, nd. (on behalf of I.U.D.)

120.A. Curriculum Vitae, Carol Rice.

121. Statement of Gary E. Mosher (American Foundrymen's Society).

122. Notice of Intention to Appear at OSHA hearing on proposed lead standard, Washington, 15 March 1977, James W. Lorio.

122.A. Chart of employees, job, blood lead samples, air lead samples.

122.B. Natelson, Ethan A. and Herbert L. Fred, "Lead Poisoning From Cocktail Glasses: Observations on Two Patients," Journal of the American Medical Association, Vol. 236, No. 22 (29 November 1976) p. 2527.

122.C. Description of Calcium Disodium Versenate (calcium disodium edetate injection, U.S.P.)

122.D. "A Special Problem of Lead in Women Workers," Abstract for the National Conference on Lead and Arsenic, February 24-25, 1975.

122.E. Members in Attendance, Fall Meeting, Miami, Florida, September 17 and 18, 1976, Independent Association of Secondary Lead Smelters.

122.F. Memorandum dated 26 November 1975 on Defense Supply Agency letterhead [subject, addressee, addressor deleted].

123. Outline of statement and four (4) supporting exhibits of Lawrence Scheinbaum (Estee Battery Co.).

124. Statement of Lloyd McBride (United Steelworkers of America).

124.A. Additional Contractual Provisions Relating to Safety and Health

124.B. Examination Information

124.C. Appointment Cards: Union Record and Member's Record

125. Statement of Jerome F. Cole (Lead Industries Association).

125.A. Letter dated 8 March 1977 to Dr. Jerry Cole, ILZRO from James Pierce, University of Missouri Environmental Trace Substances Research Center.

125.B. Letter dated 18 January 1974 to Max Allen, Canadian Broadcasting Company from Jerome F. Cole, ILZRO.

126. Statement of James C. Burrows (on behalf of Lead Industries Association).

127. Charles River Associates, Inc., "Economic Impact of Proposed OSHA Lead Standards," Prepared for Debevoise, Plimpton, Lyons and Gates (Lead Industries Association), March 1977.
*Executive Summary
*Appendix 1: Lead Consumption and Production: An Overview
*Appendix 2: Primary Lead Mining, Smelting and Refining
*Appendix 3: The Storage Battery Industry

128. Block, Frank E., "A Leach-Electrolysis Method for Producing Lead," March 1977 (on behalf of Bureau of Mines, U.S. Department of Interior).

129. Statement of Stuart Manix (Lancaster Battery Co.).

130. Statement of Laher Battery Production Co.

131. Statement of Ardell Miller (Bell City Battery Manufacturing Co.).

132. Statement of Roger Winslow (Voltmaster Co., Inc.).

133. Statement of Phillip Hamilton (Voltmaster Co.).

134. Statement of John Bode (on behalf of Voltmaster Co.).

135. Statement of Dr. K. A. Garber (on behalf of Voltmaster).

136. Statement of Robert Smith (on behalf of Voltmaster Co.).

137. Statement of Charles W. Hockenberry (Battery Council International).

138.A. Statement of Knowlton J. Caplan (on behalf of Battery Council International).

138.B. Resumé of Knowlton J. Caplan.

138.C. Study of capital costs for compliance with a 200 microgram per cu. m. lead-in-air standard for three battery plants.

138.D. Caplan, Knowlton J., and Gerhard W. Knutsen, "Final Report: Engineering Cost and Feasibility Study, Proposed OSHA Lead Standard, Secondary Smelters, for Lead Industries Association," n.d.

139. Statement of Lee Koenig (Crown Battery Co.).

140. Statement of Charles Herbert Allen (on behalf of Red Diamond Battery Co.).

141. Statement of Kelley McCann (Continental Battery Manufacturing Co.).

142.A. Statement of Kenneth W. Nelson (ASARCO, Inc.).

142.B. Curriculum Vitae, Kenneth W. Nelson.

142.C. Comments of ASARCO, Inc. on proposed OSHA lead standard, dated 16 January 1976.

142.D. Appendix 3A: "Variations in Personal Air Sampling Results for Individual Employees Over a Period of about Ten Successive Work Days"

142.E. Appendix 4A: "Updated Summary of Lead Air Sampling Data for East Helena, El Paso, Glover, Newark, Omaha, and Whiting Plants for 1975 and 1976"

142.F. Appendix 6A: Nackowski, S.B. and others, "Trace Metal Contamination of Evacuated Blood Collection Tubes," ASARCO Department of Environmental Sciences, n.d.

142.G. Appendix 12A: Hine, C.W. and others, "Assessment of Health of Employees with Different Body Burdens of Lead," ASARCO Department of Environmental Sciences, January 1977.

142.H. Appendix 13: "Specific Objections to, and Requested Revisions of, the Regulations Proposed by OSHA as 1910..025, Occupational Exposure to Lead, in Federal Register 40: 45933-48, October 3, 1975."

142.I. "El Paso Lead Study," ASARCO Department of Environmental Sciences, November 2, 1976.

143. Statement of Simon D. Strauss (ASARCO, Inc.).

144. List of Employee Exposure Data Concerning ASARCO Omaha Refinery. (Submitted by George Becker, USWA).

145. Statement of Constance Dupré (Equal Employment Opportunity Commission).

146. Statement of Sidney M. Wolfe, Peter Greene, and Kenneth Rosenman (Public Citizen's Health Research Group.

146.B. Hunter, Donald, <u>The Diseases of Occupations</u>, London: The English Universities Press Ltd., 1969, pp. 234-239.

147. Statement of Marcia E. Fine (Environmental Defense Fund).

148. Statement of Judy Lichtman (Women's Legal Defense Fund).

149. Statement of Sheldon Samuels (on behalf of Peter Bommarito, United Rubber Workers, I.U.D. Health and Safety Committee). (see exhibit 331).

150.A. Statement of Marjorie Lundquist (Globe Union, Inc.).

150.B. Statement of Charles W. Fishburn (Globe Union, Inc.).

151. Statement of Marjorie Lundquist (on her own behalf).

152. Statement of Ralph G. Smith (on behalf of General Battery Corporation).

153. Statement of David W. Nelson and Frederick Mabry (United Steelworkers of America).

154.A. Statement of J. William Lloyd (United Steelworkers of America).

154.B. Curriculum Vitae, J. William Lloyd.

155.A. Statement of Claudia Miller (United Steelworkers of America).

155.B. Curriculum Vitae, Claudia Miller.

156. Black and white photograph of Mr. Mossell Starkey (United Steelworkers of America).

157. Contract agreement between General Battery Corporation, Hamburg, Pa. and Local 4425, United Steelworkers of America, April 9, 1974 to April 9, 1977.

158. Agreement between General Battery Corporation, Reading, Pa., and Local 5227, United Steelworkers of America, April 30, 1976 to April 30, 1979.

159. Arbitration Report between United Steelworkers of America, Local 5227 and General Battery Corporation, Reading Pa., October 21, 1976.

160. "International Conducts Safety Tour," <u>The 5227 USWA Battery Cable</u>, Vol. II, No. 4, May-June 1976, p. 3.

161. Statement of George Becker (United Steelworkers of America).

162. Report of the Advisory Committee on Lead Absorption to the Industrial Commission of the State of Illinois.

163. Safety and Health Rules, National Lead Co., Hoyt Plant, Granite City, Illinois.

164. Letter dated 25 June 1974 to R. J. Sabatino, N-L Industries from George A. Everding, Defense Contract Administration.

165. Becker, George, "Lead Contamination as Viewed by the Worker," National conference on Health Effects of Occupational Lead and Arsenic Exposure, Chicago, February 24 and 25, 1975.

166. Black and white photograph of prescription for cuprimine and capsuls of cuprimine.

167. Statement of George Becker at International Conference on Heavy Metals in the Environment, Toronto, October 27-31, 1975.

168. Decision, U.S. Court of Appeals for the Eight Circuit, No. 73-1721, American Smelting and Refining Company v. Occupational Safety and Helath Review Commission et al.

169. Letter dated 8 August 1975 to Walter Ruch, NIOSH (Region X) from James A. Bax, State of Idaho Department of Health and Welfare.

170. Industrial Health Protection in Lead Exposure Areas, The Bunker Hill Co.

171. Statement of Leonard Woodcock (United Auto Workers).

172. Statement of Paul Bergsoe (Paul Begsoe & Son A/S).

173. Mackey, Thomas S. and Svend Bergsoe, "Smelting of Unbroken Batteries," Lead-Zinc-Tin Session, American Institute of Mining, Metallurgical and Petroleum Engineers, Atlanta, Georgia, March 9, 1977.

174. Mackey, Thomas S. and Svend Bergsoe, "Flash Agglommeration of Flue Dust," Pyrometallurgy Session, American Institute of Mining, Metallurgical and Petroleum Engineers, Atlanta, Georgia, March 9, 1977.

175. Nine (9) black and white photgraphs.

175.A. Fifteen (15) color prints corresponding to slides shown by Thomas Mackey.

175.B. SB Furnace Cost and Energy Data.

176. Statement of Kenneth C. Kerman (Kermatrol).

177. Slide and promotional material, Kermatrol.

178. Statement of Frank Nix (United Auto Workers).

179. Statement of Richard Cardinal (United Auto Workers).

179.A. Williams notice.

179.B. Periodic examination program for lead workers.

179.C. Survey results.

179.D. Mondano report.

179.E. Correspondence re: M. Mondano.

179.F. Compensation reports, 1966-76.

179.G. Citiations.

179.H. Comparison of air sampling results.

179.I. Local demands, 1976.

179.J. Watson report.

179.K. Article in Bennington (Vt.) Banner, 7 April 1977.

180. Statement of Franklin Mirer (United Auto Workers).

Exhibits submitted at St. Louis Regional Hearing.

181. Statement of Flo Ryer (OSHA).

182. Letter dated 17 March 1977 to Nathan Ferry, United Steelworkers of America Local 1010 from Dr. Herbert Rubindtein, Loyola University Stritch School of Medicine.

183. Employee seniority list annotated to show chelation at Cook County Hospital and Elsewhere.

184. "New Employee Orientation," ASARCO.

185. Mailgram dated 20 February 1976 to Turner Chandler from Dr. Alf Fischbein, Mount Sinai School of Medicine.

186. Letter dated 26 March 1976 To Who It May Concern from E. Paul Thomas, M.D.

187. Medical claim forms and supporting documentation, Allen D. Wright.

188. Affidavit of Halvin Gregory, 21 April 1977.

189. Affidavit of Leroy Barnes, 21 April 1977.

190. Affidavit of Allen Wright, 21 April 1977.

191. Affidavit of Woodrow Claiborn, 21 April 1977.

192. Affidavit of Wilbur Morris, 22 April 1977.

193. Affidavit (not signed) of Jesse Spencer, 22 April 1977.

194. "Lead Poisoning Investigation-1977", N-L Industries Plant, McCook, Illinois, prepared by R.L. Pace.

195. A.-195.X. Twenty-Four (24) affidavits of employees of McCook, Illinois N-L Industries plant.

196. Statement of Knowlton J. Caplan (on behalf of AMAX Lead Co.).

197. Statement of Knowlton J. Caplan (on his own behalf).

198. Request of Ronald Herrington dated 1 April 1977 for lead level of blood as of last blood test.

199.A. Record of employee discipline, E.L. Compton, 11 April 1977.

199.B. Record of employee discipline, M.L. Johnson, 11 April 1977.

200. Letter dated 31 October 1975 to David Bell, OSHA from Ardell and Jeanith Miller, Bell City Battery Manufacturing Co.).

201. Instruction Manual, Series 95 Double Cartridge Respirator.

202. Statement of Ardell Miller (Bell City Battery Manufacturing Co.).

203. Statement of Mary Anne Rosen (Coalition of Labor Union Women).

204. Statement of F.J. Grigsby, Jr. (KW Battery Division, Westinghouse Electric Corporation).

205. Outline of testimony and promotional material (Racal Airstream Inc.).

206. Certificate of Death, Mack Neal Letterman, 11 May 1972. (See Exhibit 33

Exhibits submitted at San Francisco Regional Hearing.

207. Norarized statement of Kathy I. Kriedeman (United Steelworkers of America).

208. Twelve (12) copies of Bunker Hill Company written warnings to Employees on blood lead levels.

209. Five (5) copies of Bunker Hill Company Clinic blood lead tests.

210. United Steelworkers of America memorandum dated 18 March 1977 to Frank Valenta and Fred Mabry from James English and George Becker regarding employee panels.

211. California Department of Health, Occupational Health Section, Medical Bulletin, "Women Workers and Occupational Exposure to Lead," February 1977.

212. Statement of S. William Meehan (Meehan Battery Company).

213. Crockford, G.W., "Personal Protection-The Last Report?," Annals of Occupational Hygiene, Vol. 19 (1976), pp.345-350.

214. Thompson, Jill, D.D. Jones, and Willi Beasley, "The Effect of Metal Ions on the Activity of delta-aminolevulinic Acid Dehydratase," British Journal of Industrial Medicine, 34 (1977), pp.32-36.

215. Milburn, Hemther, Elena Mitran, and G.W. Crockford, "An Investigation of Lead Workers for Subclinical Effects of Lead Using Three Performance Tests," Annals of Occupational Hygiene, Vol. 19 (1976), pp.239-249.

216. Statement of Michael Varner (ASARCO, Inc.).

217. Statement of E.S. Godsey (ASARCO, Inc.).

218.A. Statement of Charles Hine (ASARCO, Inc.).

218.B. Curriculum vitae, Charles H. Hine.

218.C. Publications list, Charles H. Hine.

219. Letter dated 20 May 1975 to William F. Thompson, United Steelworkers of America from Art Lennon, Bunker Hill Company.

220. Statement of Raymond Godber (Trojan Battery Company).

221.A. Statement of Ira H. Monosson (State of California Department of Health).

221.B. Curriculum vitae, Ira H. Monosson.

221.C. Curriculum vitae, Paul Thomas.

222. California Department of Health, Occupational Health Section, Medical Bulletin, "Guidelines for Physicians in the Use fo Chelating Agents for Treatment of Occupational Poisoning from Inorganic Lead," n.d.

223. See Exhibit 211.

Materials Identified for the Record After the
San Francisco Regional Hearing

224. Statement of Council on Wage and Price Stability.

225. Statement of R.G. Wiencek (General Motors Corporation).

226. Statement of Jane Culbreth (National Federation of Business and Professional Women's Clubs).

227. Statement of Health Right.

228. Statement of American Iron and Steel Institute.

228.A. Arthur D. Little, "Steel and the Environment: A Cost Impact Analysis; A Report to The American Iron and Steel Institute," May 1975.

228.B. Temple, Barker and Sloane, "Economic Analysis of Proposed and Interim Final Effluent Guidelines: Integrated Iron and Steel Industry," for Environmental Protection Agency, March 1976.

228.C. Marshall, Paul, Synthesis of discussion symposium by Council on Wage and Price Stability on Steel, 26 April 1976.

228.D. Council on Wage and Price Stability, "Catalog of Federal Regulations Affecting the Iron and Steel Industry," December 1976.

229. Statement of Republic Steel Corporation.

230. Statement of Frank Kesterman (Shipbuilders Council of America).

231. Statement of Resource Consultants.

232. Supporting Materials for Testimony (United Auto Workers).

233. Statement of William Rom (on behalf of Industrial Union Department, AFL-CIO).

234. Supporting Documents submitted by Lead Industries Association, See Attachment XI.

235. Supporting documents submitted by Globe Union, Inc.

236. Supporting documents submitted by Marjorie Lundquist (on her own behalf).

237. Statement of Bethlehem Steel Corporation.

238. Letter dated 1 April 1977 to Clarence Page, OSHA from Lawrence Hodges, J.I. Case enclosing Safety Information Sheets.

239. One (1) black and white photograph, submitted by Arthur Phillips.

240. Letter dated 11 April 1977 to Clàrence Page, OSHA from Donald Vial, State of California Department of Industrial Relations.

241. Letter dated 30 March 1977 to Docket Officer, OSHA from Gary Mosher, American Foundrymen's Society enclosing a copy of American Foundrymen's Society Foundry Health and Safety Guide Number 23, lead.

242. Letter dated 7 April 1977 to Clarence Page, OSHA from Charles Peterson, Deere & Company.

243. Letter dated 25 April 1977 to Clarence Page, OSHA from W.E. Blumberg, J. Eisenger, and A.A. Lamola, Bell Laboratories.

244. Letter dated 2 May 1977 to Clarence Page, OSHA from Knowlton Caplan, Industrial Health Engineering Associates enclosing Clarifying Comments on testimony given in St. Louis.

245. Letter dated 21 April 1977 to William Lee. OSHA from Donald Lynam, International Lead Zinc Research Organization enclosing data from Study of King et al.

246.A. Letter dated 9 February 1976 to Melvin Glasser, United Auto Workers from John Finklea, NIOSH (submitted by George Becker, United Steelworkers of America).

246.B. Letter dated 28 September 1975 to Mr. Keppler from Mr. Carey, (submitted by George Becker, United Steelworkers of America).

247.A. Letter dated 12 May 1977 to Clarence Page, OSHA from Bernard Roy, AMAX, Inc. enclosing tables with supportive data for testimony of 21 March 1977.

247.B. Errata in written statement of Bernard Roy (AMAX,Inc.); see exhibit 80.

248. Letter dated 9 March 1977 to OSHA Committee Management Office from N.J. Masington, Jr. on behalf of ESB Inc.

249. Elias, R., Y. Hirao, and C. Patterson, "Impact of Present Levels of Aerosol Pb Concentrations on Both Natural Ecosystems and Humans,"

250. Letter dated 5 May 1977 to OSHA Committee Management Office from J.B. Neilands, University of California Berkeley enclosing written statement.

251. Letter dated 26 April to Clarence Page, OSHA from Clair Patterson, California Institute of Technology enclosing Patterson, D., D. Settle, B. Schaule, and M. Burnett, "Transport of Pollutant Lead to the Oceans and Within Ocean Ecosystems," in H.L. Windom and R.A. Duce (ed.), Marine Pollutant Transfer, Lexington, Mass.: D.C. Heath and Company.

252. Statement of Richard Bergen (United Rubber Workers, Local 812).

253. Statement of Mike Sappington (Resource Consultants, Inc.).

254. Statement of Coalition for the Medical Rights of Women.

255.A. Leaflet, "Get the Lead Out!" prepared by Coalition for Workers' Rights.

255.B. Leaflet, "Lead Poisoning: Sweeping It Under the Rug?," prepared by Coalition for Workers' Rights.

256. Letter dated 29 April 1977 to David Kuchenbecker, SOL from Paul Bergsoe & Son A/S.

256.A. Bergsoe, Annual Report, 1975-1976.

256.B. United States Patent 4,013, 456, Bergsoe, Method for Treating Flue Dust Containing Lead, 22 March 1977.

256.C. Plastic envelope of flue dust.

256.D. Sample of agglomerate.

257. Letter dated 18 May 1977 to OSHA from Richard Wedeen.

258. Letter dated 13 May 1977 to Clarence Page, OSHA from John Fernandex, Medical Legal Research enclosing statement.

259. Mine Safety Appliances Data Sheet 10-01-09, "Powered Air Purifying Respirator".

260. Two (2) tables showing concentrations of various substances in blood samples (submitted by Charles Hine, ASARCO, San Francisco Hearing; see exhibit 218.A.).

261. "Agreement Between NL Industries, Cleveland Plant and Employees Represented by United Steelworkers of America, Local 735," 14 May 1976 to 11 April 197

262. "Second International Workshop, Permissible Levels for Occupational Exposure to Inorganic Lead: Report of an International Meeting," Amsterda The Netherlands, 21-23 September 1976. Final Report.

263. Prieve, Claudia, "Lead and Women, A Unique Problem?", Job Placement in the Lead Trades, Society for Occupational and Environmental Health, Washington, D.C. 17-19 June 1976.

264. Letter dated 18 February 1976 to Arthur Carter, California Department of Industrial Relations from Clark Deichler on behalf of Prestolite Battery Division.

265. Statement of Chicago Area Committee on Occupational Safety and Health.

266. Dr. Paul Hammond, "Calculation of the Resulting Blood Lead Level from an Air Lead Level of 50 ug/m^3."

267. Postcard postmarked 11 March 1977 to Clarence Page, OSHA from Dorothy Harte.

268. Letter dated 17 March 1977 to Clarence Page, OSHA from Les AuCoin, Member of Congress enclosing two (2) constituent letters.

269. Letter dated 27 April 1977 to D. Kuchenbecker, SOL from M.A. El Batawi, World Health Organization.

270. Statement (revised) of Melvin First (on behalf of OSHA). See Exhibit 104.

271. Bingham, Eula, "Trace Amounts of Lead in the Lung," Proceedings of the University of Missouri Third Annual Conference on Trace Substances in Environmental Health, D.D. Hemphill (Ed.), 24-26 June 1969, pp.83-90.

272. Letter dated 11 March 1977 to Grover Wrenn,OSHA from Esther Baginsky State of California Department of Health Enclosing table, "Report of Selected Occupational Disease Attributed to Lead and Chelation Treatment, California, 1975."

273. Letter dated 16 March 1977 to William Lee, OSHA from Phillipe Grandjean, Institute of Hygiene, Copenhagen enclosing lead exposure data.

274. Letter dated 24 March 1977 to Ray Marshall, Secretary of Labor Michael Cookman, Nibco Inc.

275. Letter dated 18 April 1977 to William Lee, OSHA from Morris Joselow, College of Medicine and Dentistry of New Jersey enclosing: Joselow, Morris M. and Jorge Flores, "Application of the Zinc Protoporphyrin (ZP) Test as a Monitor of Occupational Exposure to Lead," American Industrial Hygiene Association Journal, (38), February 1977, pp.63-66.

276. Letter dated 23 February 1976 to William Lee, OSHA from Ellen Silbergeld, National Institute of Neurological and Communicative Disorders and Stroke.

277. Letter dated 27 November 1975 to Jerome Cole, Lead Industries Association from Kenzaburo Tsuchiya.

278. Letter dated 6 April 1977 to David Kuchenbecker, SOL from John Hall, on behalf of Lead Industries Association enclosing a portion of a questionnaire distributed by Charles River Associates and requested for the record.

279. Letter dated 2 May 1977 to David Kuchenbecker, SOL from Stanley Jaspan, on behalf of Globe-Union Inc. enclosing four (4) documents requested for the record on 14 April 1977.

280. Letter dated 25 March 1977 to David Kuchenbecker, SOL from David Burton DB Associates enclosing supplemental material requested for the record.

281. Letter dated 6 April 1977 to Clarence Page, OSHA from Louis Beliczky, United Rubber Workers enclosing notice of intention to appear at St. Louis Regional Hearing and additional comments for the record.

282. Letter dated 26 April 1977 to David Kuchenbecker, SOL from Anna Maria Seppalainen, Institute of Occupational Health enclosing additional comments and data for the record. (See Exhibit 51).

283. Letter dated 27 April 1977 to J.R. Broadway, OSHA Jacksonville, Florida from G.W. Wilson, Southway Battery Manufacturing Corporation.

284. Letter dated 8 March 1977 to David Kuchenbecker, SOL from James Johnson General Motors Corp.

284.A. Lerner, Sidney, "Health Maintenance of Workers Exposed to Inorganic Lead: A Guide for Physicians," February 1977.

285. Buncher, C.R., P.S. Gartside, and S.I. Lerner, "Analysis of Delco-Remy Air Lead and Blood Lead Data," University of Cincinnati College of Medicine, cover letter dated 23 May 1977.

286. Thirty (30) slides used in presentation of Sergio Piomelli (see exhibit 57).

287. Letter dated 24 March 1977 to David Kukenbeck (<u>sic</u>), SOL from Amanda Hawes, Legal Aid Society of Alameda County (See Exhibit 148).

288. Caplan, Knowlton, "Engineering Cost and Feasibility Study: Proposed OSHA Lead Standard," for Battery Council International, July 1976. (See also Exhibit 29, item 29-A).

289. Letter dated 25 May 1977 to David Kuchenberker (<u>sic</u>), SOL from D. Malcom (See Exhibits 100, 100.A).

290. Letter dated 26 May 1977 to Clarence Page, OSHA from Charles Allen, Allen Battery Consultants. (see exhibit 140).

290.A. "Working With Lead in Industry," RSR Corp.

290.B. "Your Family and Lead Exposure," ESB Inc.

290.C. National Institute for Occupational Safety and Health, "A Prescription for Battery Workers," March 1976.

291. Letter dated 19 February 1976 to William Lee, OSHA from Paul Toth, Ford Motor Company.

291.A. Information on respirators used by Ford Motor employees when grinding lead.

291.B. Ford Motor Company Lead Control Program.

292. Submission dated 7 August 1972 to National Institute for Occupational Safety and Health from J.J. Ahern, Motor Vehicle Manufacturers Association in response to request for information, Federal Register, Vol.37 No.79, 22 April 1972.

293. Letter dated 26 May 1977 to Clarence Page, OSHA from Roger Winslow, Voltmaster Battery Company, Inc. enclosing blood lead reports on current employees.

294. Letter dated 26 May 1977 to Clarence Page, OSHA from Jerome Cole, Lead Industries Association.

294.A. See Exhibit 255.A.

294.B. Kehoe, Robert, "Pharmocology and Toxicology of Heavy Metals: Lead," Pharmac. Ther.A., Vol.1, 1976, pp.161-188.

294.C. Tola, Sakari and Claes-Henrik Nordman, "Serum Creatinine Concentrations S-GOT and S-GPT Activities and Lead Exposure," Int. Arch. Occup. Environ. Hlth. 39 (1977), pp. 37-44.

294.D. Tola, S.and C.H. Nordman, "Smoking and Blood Lead Concentration in Lead Exposed Workers and an Unexposed Population," Environmental Research, 13 (1977), pp.250-255.

294.E. Zeilhuis, R.L., "Dose Response Relationship for Inorganic Lead," n.d.

294.F.

295. Letter dated 27 May 1977 to Clarence Page, OSHA from Franklin Mirer, United Auto Workers Enclosing "Lead: A Worker's Cuide to Checking Exposure to Lead," U.A.W. Occupational Health & Safety, Vol. VI, No.1. January-February 1977. (See exhibit 180).

296. Letter dated 3 June 1977 to Docket Officer, OSHA from Robert Denham, ASARCO Inc. enclosing cost calculations requested of Mr. Godsey at San Francisco Hearing. (See exhibit 217).

297. Letter dated 25 May 1977 to Clarence Page, OSHA from Ira Monosson, California Department of Health. (see exhibit 221.A).

297.A. Data summary and analysis of Prestolite Battery Division prepared by Rodney Beard. Stanford University School of Medicine, March 1977.

297.B. "Lead Exposures in the California Battery Industry," from CAL/OSHA inspections.

297.C. Ten (10) sets of results of biological monitoring at several battery plants by CAL/OSHA.

298. Statement of General Motors Corporation with six (6) appendices. (see exhibit 225, 284, 284.A., 285).

299. Letter dated 1 June 1977 to David Kuchenbecker, SOL from Jan Handke, NIOSH enclosing five (5) additions to "Interim Bunker Hill Report." (see exhibit 85).

300. National Institute of Occupational Safety and Health, "Final Report: Environmental Phase: Bunker Hill Study," n.d.

301. Baker, Edward L. and others, "Lead Poisoning in children of Lead Workers: Home Contamination with Industrial Dust," The New England Journal of Medicine, Vol.296, No.5 (3 February 1977). pp. 260-261.

302. Abed, D. and others, "Clinical Report: Fatal Lead Encephalopathy Concerning an Anatomo-Clinical Case," Arch. Maladies Profess. 34(10-11): 599-608 (1973). Original in French.

303. Letter dated 6 June 1977 to David Kuchenbecker, SOL from Peter Kahn on behalf of General Battery Corporation enclosing statement of Ralph Smith and "Production of Burning Teams in Reading, PA. Burning Department," 13 January 1976.

304. Letter dated 27 May 1977 to Clarence Page, OSHA from James English, United Steelworkers of America enclosing a memorandum dated 4 January, 1977 to Jerome Cole on probable format for OSHA lead hearings.

305. Letter dated 23 May 1977 to David Kuchenbecker, SOL from Svend Bergsøe, Paul Bergsøe & Son A/G. (See exhibits 172-175).

306.A. Letter dated 23 May 1977 to David Kuchenbecker, SOL from Svend Bergsøe, Paul Bergsøe & Son A/G. (See exhibit 172-175).

306.B. Two (2) black and white photographs with accompanying captions.

306.C. Corrections to testimony of Svend Bergsøe, 13 May 1977.

306.D. Transcript pages 5142-5204 as corrected according to exhibit 306.C.

307. Bergsoe, Svend and Sidney Pearle, "The Story About the SB Furnace."

308. Letter dated 30 May 1977 to David Kuchenbecker, SOL from Peter Greene, Health Research Group. (see exhibit 146A)

309. Alessio. L. and others. "Free Erythrocyte Protoporphyrin as an Indicator of the Biological Effect of Lead in Adult Males: III. Behavior of Free Erythrocyte Protoporphyrin in Workers with Past Lead Exposure," International Archives of Occupational and Environmental Health, 38 (1976), pp.77-86.

310. Letter dated 27 May 1977 to Docket Officer, OSHA from Arthur Schulert, Environmental Science and Engineering Corp.

311.A. Letter dated 1 June 1977 to Clarence Page, OSHA from Bernard Roy, AMAX submitting corrections and clarifications to transcript of AMAX presentation.

311.B. Dr. R.F. Bell's Slide Presentation, OSHA Lead Hearings, 23 March 1977 TR. 1642-1649 (on behalf of AMAX). (see exhibit 81.B.).

312. Letter dated 1 June 1977 to Clarence Page, OSHA from Jeanith Miller, Bell City Battery Co.

313. Letter dated 4 June 1977 to Clarence Page, OSHA from J. Scott McAllister enclosing "Statement of Reasons."

314. Supplementary Testimony of Globe-Union, Inc. (see exhibits 150A, 150B, 235).

315.A. Letter dated 31 May 1977 to Clarence Page, OSHA from David Krack, Estee Battery Co. (see exhibit 123).

315.B. Six (6) blood lead analyses, Estee Battery Co.

315.C. Eight (8) groups of employee blood lead data, Estee Battery Co.

316. Promotional material and data on Apsee, Inc. equipment. (see exhibits 74, 74A).

317. Snee, R.D. "Evaluation of Studies of the Relationship Between Blood Lead and Air Lead, Petroleum Laboratory, E.I. du Pont de Nemours & Co., 7 April 1977.

318. Letter, no date, from Ioana Lancranjan. (see exhibits 58, 58A, 58B).

319. Letter dated 18 March 1977 to David Kuchenbecker from Anna Maria Seppalainen. (see exhibits 51, 51A-C).

320. Letter dated 5 June 1977 to Clarence Page, OSHA from Stanley Rodman, National Automotive Radiator Service Association.

321. Letter dated 4 June 1977 to Clarence Page, OSHA from F.J. Grigsby, KW Battery Division, Westinghouse Electric Corporation enclosing results of split sample blood lead determinations, January 1977. (see exhibit 204).

322. Schwarz, K. "Potential Essentiality of Lead," Arh. Hig. Rada. Toksikol., 26 (1975), pp. 13-28.

323. Letter dated 8 June 1977 to Clarence Page, OSHA from Stuart Manix, Lancaster Battery Company. (see exhibit 129).

324.A. Battery Council International, "The Storage Battery Manufacturing Industry, 1976-1977 Year Book," 1976.

324.B. Battery Council International, "The Storage Battery Manufacturing Industry, 1973-1974 Year Book," 1974.

324.C. Burkarl, R.A. "Market Analysis 1977-1981," Globe Battery, April 1977.

325. Letter dated 4 August 1975 to Marshall Miller, OSHA from John Finklea NIOSH. (Also Exhibit 86.A).

326. Notices of Intention to Appear at St. Louis Regional Hearing commencing 26 April 1977. See attachment VI.

327. Notices of Intention to Appear at San Francisco Regional Hearing commencing 3 May 1977. See attachment VII.

328. Supplemental Statement of St. Joe Minerals Corporation, 13 June 1977.

329. Curriculum Vitae of persons appearing on behalf of OSHA.

330. "Comparison of Proposals by OSHA and L.I.A. with Respect to Health Standards For Occupational Exposure to Lead," 2 February 1977 (Submitted by Lead Industries Association). (see exhibit 125,234).

331. Attachments: Testimony of Sheldon W. Samuels (see exhibit 149).

332. Eller, Peter M. and Janet C. Haartz, "A Study of Methods for the Determination of Lead and Cadmium "American Industrial Hygiene Association Journal, Vol. 38 (March 1977), pp.116-124.

333. National Institute for Occupatioanl Safety and Health, "Reproductive History Questionnaire." (see exhibit 146.A.).

334. Memorandum dated 11 June 1977 to Clarence Page, OSHA from Kenneth Bridbord, NIOSH enclosing NIOSH Interim Report TA 77-26 "Analysis of Blood Lead and Air Lead Data from Chloride Inc., Tampa, Florida," and "Analysis of Blood and Air Lead Data from General Motors, Delco-Remy Battery Plants, Muncie, Indiana and Fitzgerald Georgia."

335. Post-Hearing Comments by the Lead Industries Association, Inc. Concerning the Proposed Standard for Exposure to Lead, 16 June 1977.

336. Eighty-six (86) pieces of correspondence concerning proposed lead standard.

337. Letter dated 15 June 1977 to Docket Officer, OSHA from K.W. Nelson, ASARCO, Inc.

338. Letter dated 15 June 1977 to Clarence Page, OSHA from Richard Bergen, United Rubber Workers Local 812 enclosing Death Certificate of Mark Letterman.

339. Grunder, F.I. and A.E. Moffitt, Jr., "Evaluation of Zinc Protoporhyrin in an Occupational Environment," n.d. (submitted by Bethlehem Steel Corp.)

340. "Summary Discussion by Globe-Union Inc. of the Hearing Record on the Proposed Standard for Occupational Exposure to Lead," 20 June 1977.

341. "Post-Hearing Comments by General Battery Corporation, Reading, Pennsylvania, Concerning the Proposed Standard for Exposure to Lead," 20 June 1977.

342. "Post-Hearing Brief of The Battery Council International," 20 June 1977.

343. "Post Hearing Brief of United Steelworkers of America, AFL-CIO-CLC on Standard for Inorganic Lead," 20 June 1977.

344. Repko, John D., "Supplemental Report of Behavioral and Neurological Deficits of Workers in the Storage Battery Manufacturing Industry," 15 June 1977.

345. Letter dated 9 May 1977 to William Lee, OSHA from F. Irene Williamson, American Public Health Association.

345.A. Announcement of 3 May 1977 Enviromental Health Hazard Project Meeting; Angenda for 3 May meeting, "Nerve Conduction and Neurotoxicity Arsenic Exposure."

345.B. Four (4) 60-minute cassette tapes of 3 May 1977 meeting, "Nerve Conduction and Neurotoxicity Arsenic Exposure."

345.C. Transcription of exhibit 345.B.

346. Letter dated 20 June 1977 to Docket Officer, OSHA from K.W. Nelson, ASARCO enclosing "Erythrocyte Values at Altitude," in Environmental Biology, Philip L. Altman and Dorothory S. Dittmer, Editors, Bethesda, Maryland: Federation of American Societies for Experimental Biology, 1966, pp. 351-361.

347. Letter dated 20 June 1977 to Clarence Page, OSHA from Bernard Roy, AMAX Inc.

348. Letter dated 20 June 1977 to Docket Officer, OSHA from Marjorie Lundquis enclosing summary discussion of hearing record. (on her own behalf)

349. Post-Hearing Comments of United Auto Workers.

350. Letter dated 23 June 1977 to William Lee, OSHA from Donald Lynam, Lead Industries Assoc. (see exhibit 234, item 21)

351. Letter dated 4 June 1977 to Clarence Page, OSHA from Joan Samuelson enclosing "Employment Rights of Women in the Toxic Workplace," California Law Review, July 1977, in press.

352. Letter dated 28 June 1977 to David Kuchenbecker, SOL from E.N. Doyle, Cominco Ltd.

SECTION 5

REPRINT OF INORGANIC LEAD HEARING EXHIBIT NO. 65A

APPENDIX A

Methodology for Engineering Cost Estimates

In this section we describe the method used to estimate the cost to individual firms and the whole industry of installing the engineering controls needed to meet the proposed OSHA standard.

A number of battery plants considered to be representative of the various sectors of the industry were visited by an industrial hygiene consultant retained by the Battery Council International. For each operation in these sample plants which generates lead dust estimates were made of the cost of controls which would be needed to bring the operation into compliance with the proposed OSHA standard. The costs for each operation include the capital cost of purchasing and installing the necessary equipment, the cost of operating the equipment, which includes power and maintenance, and the cost of decreased labor productivity resulting from installation of the equipment. In addition the down-time for each operation was estimated based on the amount of time needed for installation of the engineering controls. Table I presents the results of this effort on a generalized basis for each operation which will have to be brought into compliance with the standard.

In order to gather the data needed to estimate the costs on a plant by plant basis, CRA sent out a questionnaire to as many battery producers as could be contacted. The type of information requested included the number of batteries produced per shift and the number of shifts per day for each operation; the number of grid and parts casting machines, stacking machines, pasting stations, group drop stations, etc.; and the amount of the plant area exposed to lead dust. "With the responses received from battery producers plant-level costs were estimated for 83 SLI battery plants, including almost all of the plants of the major firms and large independent firms." The 14 industrial battery plants for which data were available are not considered in this section.

In order to estimate a total engineering compliance cost for the whole industry it was necessary to project costs for the remaining firms in the industry based on the results obtained in the analysis of firms which responded to the questionnaire. This was done in the following manner.

Several directories were used to compile a list of the firms which did not reply to the questionnaire. The directories included the Dun and Bradstreet Metalworking Directory, the Battery Council International membership directory, and the Independent Battery Manufacturers Association directory. Industry services provided help in determining the employment of each of these plants. They were then matched with similar sized plants from the group which did respond to the questionnaire and the compliance costs and capacity were estimated for each plant based on its "model" from the sample. The costs for these plants were then added to the costs of the plants in the sample to obtain estimated costs to the entire SLI battery industry.

The 1972 Census of Manufacturers lists a total of 208 plants producing lead-acid storage batteries in the United States. Of the 111 plants for which data were unavailable, 82 were located through the directories. The remaining 29 plants were all assumed to employ fewer than 20 workers, since in theory the Dun and Bradstreet Metalworking Directory covers all plants with more than 20 employees. Of the 82 plants located through the directories 66 employ less than 20 workers, so a total of 95 plants not in the CRA sample were determined to e employ fewer than 20 workers. The remaining 16 plants ranged in employment from 20 up to 150 workers. For the purpose of determining employment impacts, the firms employing fewer than 20 workers were assumed to employ an average of 10 workers each, for a total of 950 employees for the 95 plants in this category. The other 16 firms have a total employment of 812.

Table 1

ADDITIONAL LABOR, POWER, AND COSTS INCURRED TO COMPLY WITH PROPOSED OSHA STANDARDS UNDER NORMAL OPERATING CONDITIONS[1]

	Sample	Industry	Five Largest Producers	Smaller Companies
Estimated Capacity (000 units)	68,865	75,459	58,916	1,610
Total Capital Cost (Millions of Dollars)	237.667	345.669	166.532	26.143
Labor per year (Manhours)	2,876,638	3,316,360	2,094,081	139,803
Kilowatt Hours per Year	206,052 000	247,184,139	155,596,482	11,684,422
Capital Cost Per Year[2] (Millions of Dollars)	29,545	41.971	20.659	3.008
Maintenance Cost Per Year (Millions of Dollars)	9.389	14.094	6.567	1.071
Labor Cost Per Year[4] (Millions of Dollars)	16.113	18.870	11.915	.795
Power Cost Per Year (Millions of Dollars)	4.100	4.919	3.096	.233
Total Operating Cost Per Year[3] (Millions)	29.603	37.883	21.578	2.099
Total Cost Per Year (Millions)	59.148	79.854	42.238	5.107

(Table continued on following page)

Table 1 (continued)

Footnotes

[1]Normal Operating Capacity is assumed to be 85% capacity utilization.

[2]Capital cost is amortized over 15 years at an interest rate of 9% for large producers and 7.75% for small producers (Small Business Administration rate)

[3]Operating cost is the sum of maintenance, labor, and power costs and is assumed to vary proportionately with capacity utilization.

[4]Labor cost is due to lower productivity caused by the inconvenience etc. of the ventilating equipment.

SOURCE: Data supplied by the Battery Industry and by Industrial Health Engineering Associates.

Table 2

COMPLIANCE COST PER BATTERY AT 85 PERCENT AND
65 PERCENT CAPACITY UTILIZATION

Scenario I[1]

	Sample (cents)	Industry (cents)	Five Largest Companies) (cents)	Smaller Companies[2] (cents)
Operating Cost/Unit	50.6	59.1	43.1	153.3
Capital Cost/Unit (at 85% of capacity)	50.4	65.4	41.3	219.7
Capital Cost/Unit (at 65% of capacity)	66.0	85.6	53.9	287.3
Total Cost/Unit (at 85% of capacity)	101.0	124.5	84.4	373.0
Total Cost/Unit (at 65% of capacity)	116.6	144.7	97.0	440.6

Table 3

ANNUAL COST BY PLANT TO COMPLY WITH PROPOSED OSHA STANDARDS UNDER NORMAL OPERATING CONDITIONS: SCENARIO I[1]

Plant Number	Capital Costs per Battery (units)	Operating Cost per Battery (units)	Total Cost per Battery (units)	Estimated A Plant Capa (000 Batter
1	.60	.47	1.07	700
2	2.99	5.57	8.56	150
3	.38	.60	.98	1,617
4	.53	.40	1.03	490
5	.35	.53	.88	1,690
6	.51	.60	1.11	1,090
7	.36	.56	.92	1,400
8	.40	.66	1.06	1,150
9	.34	.51	.85	1,290
10	3.06	2.34	4.40	122
11	3.78	2.24	6.02	32
12	.65	.56	1.21	354
13	.68	.64	1.32	623
14	.67	.65	1.32	1,187
15	1.44	1.22	2.66	115
16	2.18	1.28	3.46	103
17	.40	.34	.74	1,600
18	.59	.49	1.08	600
19	.47	.44	.91	450
20	.42	.42	.84	700
21	.55	.47	1.02	650
22	.61	.63	1.24	475
23	.60	.47	1.07	725
24	.40	.35	.75	1,425
25	.58	.49	1.07	800
26	.59	.48	1.07	600
27	.77	.67	1.44	425

Table (continued)

ANNUAL COST BY PLANT TO COMPLY WITH PROPOSED OSHA STANDARDS UNDER NORMAL OPERATING CONDITIONS: SCENARIO I

lant umber	Capital Cost per Battery[2]	Operating Cost per Battery[3]	Total Cost per Battery	(000 Batterie Estimated Ann Plant Capaci
28	.67	.60	1.27	400
29	.60	.53	1.13	350
30	.54	.49	1.03	450
31	.77	.66	1.43	312
32	.60	.81	1.41	1,000
33	.72	.65	1.36	1,193
34	.65	.57	1.22	750
35	.54	.47	1.01	600
36	.58	.49	1.07	850
37	.68	.59	1.27	700
38	.73	.63	1.36	400
39	.54	.69	1.23	793
40	.33	.34	.67	1,725
41	.53	.49	1.02	875
42	1.72	.99	2.71	64
43	1.21	.73	1.94	237
44	2.25	1.25	3.50	75
45	7.49	4.67	12.16	16
46	2.31	1.57	3.88	54
47	2.05	1.35	3.40	60
48	2.58	1.46	4.04	150
49	2.20	1.50	3.70	65
50	8.12	5.97	14.09	17.5
51	6.99	4.43	11.42	15.8
52	1.54	.93	2.47	125
53	1.44	.95	2.39	155
54	.88	.86	1.74	700

Table (continued)

ANNUAL COST BY PLANT TO COMPLY WITH PROPOSED OSHA
STANDARDS UNDER NORMAL OPERATING CONDITIONS: SCENARIO I

Plant Number	Capital Cost per Battery[2]	Operating Cost per Battery[3]	Total Cost per Battery	(000 Batte Estimated Plant Cap
55	.79	.83	1.62	625
56	1.01	.99	2.00	450
57	.65	.68	1.33	1,075
58	.80	.78	1.58	1,000
59	.93	.91	1.84	500
60	.36	.31	.67	2,000
61	.35	.29	.64	2,500
62	.28	.26	.54	4,500
63	.34	.29	.63	3,000
64	.38	.33	.71	2,000
65	.92	1.13	2.05	519
66	.84	1.01	1.85	671
67	2.25	2.30	4.55	136
68	.79	.83	1.62	635
69	3.45	2.13	5.58	35
70	9.09	5.95	5.04	12
71	5.45	3.20	3.65	20
72	.29	.35	.64	1,446
73	.33	.37	.70	1,349
74	.32	.36	.68	1,446
75	.25	.34	.59	1,250
76	.32	.40	.72	1,000
77	.23	.32	.55	1,375
78	.28	.36	.64	1,250
79	.27	.35	.82	1,750
80	.21	.38	.59	3,000
81	.34	.42	.76	750
82	.33	.42	.75	1,000
83	.31	.38	.69	875

Table (continued)

ANNUAL COST BY PLANT TO COMPLY WITH PROPOSED OSHA STANDARDS UNDER NORMAL OPERATING CONDITIONS: SCENARIO I

[1]Scenario I assumes that companies attempt to bring their current plant and equipment into compliance without changing plant configuration or purchasing new equipment.

[2]Assuming a normal operating rate of 85 percent of capacity.

[3]Operating costs include the cost of power, maintenance, and lost labor productivity necessary to comply with the proposed standards.

FIGURE

TOTAL ANNUAL ENGINEERING COSTS PER UNIT OF CAPACITY
BY PLANT CAPACITY ASSUMING AN 85% OPERATING RATE: SCENARIO 1

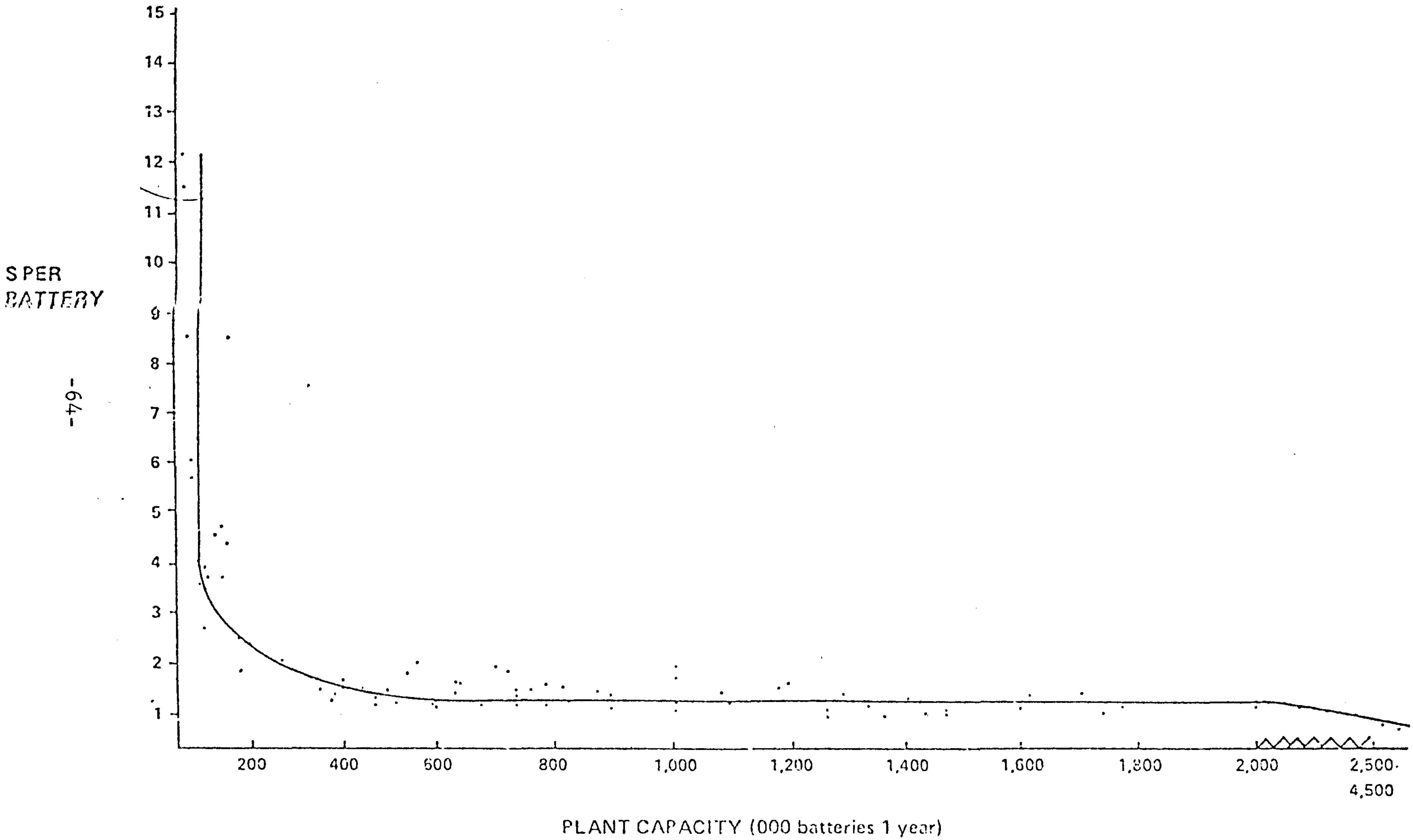

Table 4

COMPLIANCE COSTS FOR MACHINE STACKERS, HAND STACKING STATIONS, CAST ON STRAP MACHINES, AND GROUP DROPPING AND BURNING STATIONS[1]

	Capital Cost (000 dollars)	Capital Cost Per Year (dollars)	Maintenance Per Year (dollars)	Labor Cost Per Year (dollars)	Power Cost Per Year (dollars)	Total Annual Cost (dollars)
Stacking Machine	158.4	19651	6800	5690	2981	35122
Hand Stacking Station	84.0	10421	3700	4324	1620	20065
Cast on Strap Machine	202.4	25110	8700	4324	3829	41963
Group Dropping and Burning Station	98.0	12158	4200	4324	1855	22537

[1]Based on Industrial Health Engineering Associates estimates and assuming 2 shift production

[2]Assumes 9 percent interest rate and 15 year life.

[3]Average cost wage is $5.69 per hour.

[4]1.99 cents per kilowatt hour.

Table 5

ADDITIONAL LABOR, POWER, AND COSTS INCURRED TO COMPLY WITH PROPOSED OSHA STANDARDS UNDER NORMAL OPERATING CONDITIONS[1] WHEN PRODUCERS OPTIMALLY SUBSTITUTE MECHANIZATION FOR LABOR.

	Sample	Industry	Five Largest Producers	Smaller Companies
Estimated Capacity (000 units)	68,865	75,459	58,916	1,610
Total Capital Cost (Millions of Dollars)	202.092	307.677	144, 268	23.332
Labor per year (Manhours)	2,864,050	3,281,459	1,591,028	119,914
Kilowatt Hours per Year	207,691,940	247,065,104	136,022,111	10,088,945
Capital Cost Per Year[2] (Millions of Dollars)	24.845	36.993	17.897	2.684
Maintenance Cost Per Year (Millions of Dollars)	8.066	13.335	5.710	.968
Labor Cost Per Year[4] (Millions of Dollars)	13.852	18.672	9.052	.682
Power Cost Per Year (Millions of Dollars)	3.513	4.917	2.707	.201
Total Operating Cost Per Year[3] (Millions)	25.431	36.923	18.953	1.851
Total Cost Per Year (Millions)	50.276	73.916	36.850	4.536

(Table continued on following page)

Table 5 (continued)

Footnotes

[1]Normal Operating Capacity is assumed to be 85% capacity utilization.

[2]Capital cost is amortized over 15 years at an interest rate of 9% for large producers and 7.75% for small producers (Small Business Administration rate)

[3]Operating cost is the sum of maintenance, labor, and power costs and is assumed to vary proportionately with capacity utilization.

[4]Labor cost is due to lower productivity caused by the inconvenience etc. of the ventilating equipment.

SOURCE: Data supplied by the Battery Industry and by Industrial Health Engineering Associates.

Table 7

ANNUAL COST BY PLANT TO COMPLY WITH PROPOSED OSHA STANDARD UNDER NORMAL OPERATING CONDITIONS: SCENARIO 2

Plant Number	Capital Costs per Battery (units)	Operating Cost per Battery (units)	Total Cost per Battery (units)	Estimated Annual Plant Capacity (000 Batteries)
1	.55	.43	.98	700
2	2.55	5.16	7.71	150
3	.30	.53	.83	1,617
4	.45	.35	.80	590
5	.27	.46	.73	1,690
6	.36	.46	.82	1,090
7	.29	.49	.78	1,400
8	.30	.60	.95	1,150
9	.28	.45	.73	1.290
10	1.65	1.94	3.59	122
11	3.77	2.25	6.02	32
12	.64	.56	1.20	354
13	.60	.56	1.17	623
14	.48	.48	.96	1,187
15	1.21	.98	2.18	115
16	1.69	.98	2.67	102
17	.34	.29	.63	1,600
18	.55	.44	.99	600
19	.41	.39	.80	450
20	.38	.39	.77	700
21	.47	.39	.86	650
22	.49	.52	1.01	475
23	.55	.41	.96	725
24	.33	.28	.60	1,425
25	.46	.38	.84	800
26	.50	.40	.90	600
27	.57	.49	1.06	425

Table 7 (continued)
ANNUAL COST BY PLANT TO COMPLY WITH PROPOSED
OSHA STANDARD UNDER NORMAL OPERATING CONDITIONS: SCENARIO 2

lant lumber	Capital Costs per Battery (units)	Operating Cost per Battery (units)	Total Cost per Battery (units)	Estimated Annual Plant Capacity (000 Batteries)
28	.47	.42	.89	400
29	.53	.46	.98	350
30	.42	.39	.80	450
31	.58	.50	1.08	312
32	.42	.57	.99	1,000
33	.49	.46	.95	1,193
34	.47	.40	.88	750
35	.45	.39	.84	600
36	.40	.33	.73	850
37	.59	.42	.91	700
38	.54	.45	.99	400
39	.41	.53	.93	793
40	.33	.34	.68	1,725
41	.38	.35	.72	875
42	1.72	.99	2.71	64.
43	1.00	.59	1.59	237
44	2.24	1.25	3.49	75
45	7.49	4.68	12.17	16.
46	2.30	1.57	3.88	54.
47	2.05	1.35	3.39	60
48	2.24	1.25	3.49	150
49	2.20	1.50	3.70	65
50	7.40	4.82	12.22	17.
51	6.99	4.43	11.42	15.
52	1.44	.86	2.30	125
53	1.11	.75	1.86	155
54	.65	.65	1.30	700

Table 7

ANNUAL COST BY PLANT TO COMPLY WITH PROPOSED
OSHA STANDARD UNDER NORMAL OPERATING CONDITIONS: SCENARIO 2

Plant Number	Capital Costs per Battery (units)	Operating Cost per Battery (units)	Total Cost per Battery (units)	Estimated Annual Plant Capacity (000 Batteries)
55	.59	.65	1.24	625
56	.72	.72	1.44	450
57	.49	.54	1.04	1,075
58	.59	.60	1.19	1,000
59	.71	.71	1.42	500
60	.34	.28	.62	2,000
61	.31	.26	.58	2,500
62	.25	.23	.48	4,500
63	.30	.25	.56	3,000
64	.35	.31	.66	2,000
65	.77	.99	1.76	519
66	.68	.87	1.56	671
67	1.66	1.78	3.44	136
68	.75	.80	1.55	635
69	3.44	2.13	5.57	35
70	9.09	5.95	15.04	12
71	5.45	3.20	8.65	20
72	.30	.35	.64	1,446
73	.33	.37	.70	1,349
74	.31	.36	.68	1,446
75	.30	.33	.63	1,250
76	.37	.39	.77	1,000
77	.27	.32	.59	1,375
78	.33	.36	.69	1,250
79	.32	.35	.67	1.750
80	.24	.29	.43	3,000
81	.40	.42	.82	750
82	.39	.41	.80	1,000
83	.35	.38	.73	875

TOTAL ANNUAL ENGINEERING COSTS PER UNIT OF CAPACITY
BY PLANT SIZE ASSUMING AN 85% OPERATING RATE: SCENARIO 2

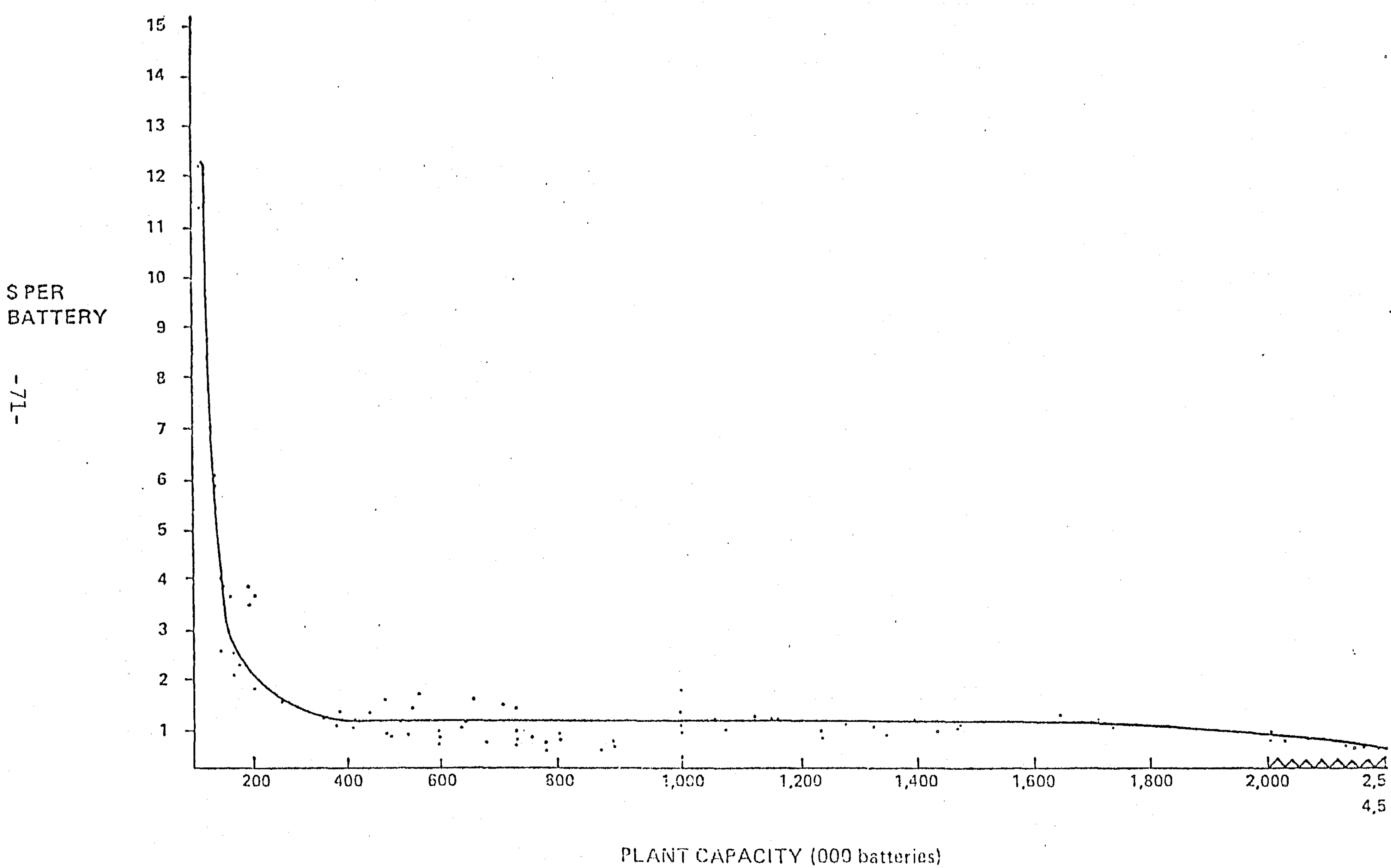

Table 6

COMPLIANCE COST PER BATTERY AT 85 PERCENT AND 65 PERCENT CAPACITY UTILIZATION AFTER REPLACING LABOR WITH MECHANIZATION

Scenario II[1]

	Sample (cents)	Industry (cents)	Five Largest Companies (cents)	Smaller Companies[2] (cents)
Operating Cost/Unit	43.4	57.6	37.8	135.3
Capital Cost/Unit (at 85% of capacity)	42.4	57.7	35.7	196.1
Capital Cost/Unit (at 65% of capacity)	55.5	75.4	46.7	256.5
Total Cost/Unit (at 85% of capacity)	85.8	115.3	73.5	331.4
Total Cost/Unit (at 65% of capacity)	98.9	133.0	84.5	391.8

Table 7

BATTERY INDUSTRY MONITORING COSTS

	First Year	Long Run
Number of:		
blood lead samples	79,446	23,981
air lead samples	123,269	47,963
medical examinations	34,129	11,991
Cost of:		
blood lead samples	\$ 794,460	\$ 239,810
air lead samples	\$1,232,690	\$ 479,630
medical examinations	\$1,365,141	\$ 479,630
Total Cost	\$3,392,291	\$1,199,070

DATA SOURCE: Data supplied by battery producers

DERIVATION: The number of samples and medical examinations and costs were derived from the specifications published by OSHA in the *Federal Register*, Volume 40, Number 193, Friday, October 3, 1975, pp. 45934-45948 as follows:

First Year

blood lead: 12/year for employees with blood lead level > 60 µg/100 g, until the level drops below 60 µg/100 g;
6/year for employees exposed to > 100 µg/m³ air lead, but with blood levels below 60 µg/100 g;
2/year for employees exposed to > 50 µg/m³ but less than 100 µg/m³ air lead and less than 60 µg/100 g blood lead level;

air lead: 1 initial sample for all employees;
4/year for employees exposed to between 50 to 100 µg/m³;
12/year for employees exposed to > 100 µg/m³

medical exams: 6/year for employees with blood lead level > 60 µg/100 g until the blood lead level falls below 60 µg/100 g;
1/year for employees exposed to >50 µg/m³ air lead level

Long Run

blood lead: 2/year for all exposed employees (assumes that air lead exposure for all employees is brought below 100 µg/m³, but is still > 50 µg/m³

air lead: 4/year for all exposed employees based on same assumption as for blood lead

medical exams: 1/year for all exposed employees based on above assumption also

Table 7 (continued)

BATTERY INDUSTRY MONITORING COSTS

Costs

Blood and air lead samples are assumed to cost $10 each, and medical examinations $40 each, including the value of lost productivity.

Table 8

MONITORING COSTS PER BATTERY BY COMPANY

CENTS/BATTERY[1]

Company Number	Estimated Annual Company Capacity (000 Batteries)	First Year				Long Run				Current Expenditures		
		Blood Lead	Air Lead	Medical Exam	Total	Blood Lead	Air Lead	Medical Exam	Total	Blood Lead	Air Lead	Medical Exam
1	9,577	1.8	2.6	3.1	7.5	0.4	0.8	0.8	2.0	NA	0.6	NA
2	32	4.7	5.3	9.4	19.4	0.9	1.9	1.9	4.7	NA	NA	NA
3	354	0.75	1.2	1.0	2.95	0.2	0.4	0.4	1.0	0.3	NA	NA
4	1,187	0.35	0.6	0.7	1.65	0.2	0.3	0.4	0.9	0.5	0.2	NA
5	103	0.9	1.4	1.6	4.0	0.7	0.7	0.7	1.7	1.5	NA	NA
6	9,962	0.9	1.3	1.7	3.9	0.4	0.8	0.8	2.0	0.6	3.0	NA
7	8,886	1.2	1.5	2.25	5.0	0.2	0.5	0.5	1.2	0.9	0.1	NA
8	237	1.8	2.8	3.0	7.6	0.4	0.8	0.8	2.0	0.6	0.1	1.0
9	54.5	3.9	5.0	7.3	16.3	0.7	1.5	1.5	2.7	9.2	3.7	NA
10	150	2.1	3.2	2.8	8.1	0.5	0.9	0.9	2.3	1.3	6.7	NA
11	17.5	7.7	12.6	10.3	30.5	2.3	4.6	4.6	11.5	1.1	2.9	NA
12	225	3.4	5.6	4.7	13.7	0.9	1.7	1.7	4.3	NA	NA	NA
13	155	1.5	1.5	2.8	5.5	0.2	0.4	0.4	1.0	0.8	0.5	NA
14	4,350	1.7	2.9	2.9	7.5	0.5	1.0	1.0	2.5	0.9	0.2	NA
15	16,491	0.4	1.0	0.6	2.0	0.2	0.4	0.4	1.0	0.5	NA	NA

[1]These figures assume capacity operation. An average battery industry operating rate of 85 percent capacity utilization could be used to determine costs under normal operating conditions.

NOTE: Totals may not add due to rounding.

SOURCE: Data supplied by battery producers.
For assumptions underlying calculations see note to Table

CHARLES RIVER ASSOCIATES CRA

Table 10

PROFIT INFORMATION FOR PLANTS PRODUCING LESS THAN 1000 BATTERIES PER DAY

Capacity (batteries per day)	Annual Avg. profit over period provided[1] ($/battery)	Highest Annual Profit in period provided ($/battery)	Absorbed Cost (Compliance Cost -$1.04) ($/battery)	Post Compliance Average Loss ($/battery)
240	1.12	1.40	2.35	1.23
260	.44	.77	2.66	2.22
70	.54	.54	11.18	10.64
500	1.44	2.16	1.26	-.18
620	.46	0.63	.84	.38

[1]Period cover 1973 to 1975 in all cases except the third plant where information only available for 1975. Income figures are pre-federal taxes.

SECTION 6

REPRINT OF INORGANIC LEAD HEARING EXHIBIT NO. 138D

INDUSTRIAL HEALTH ENGINEERING ASSOCIATES, INC.

INDUSTRIAL HYGIENE
AIR POLLUTION

7340 WASHINGTON AVENUE SOUTH
HOPKINS, MINNESOTA 55343
(612) 941-8410

April 6, 1977

Mr. Clarence Page
OSHA Office of Committee Management
Docket No. H-004
Room N-3633
U. S. Department of Labor
3rd and Constitution Avenue NW
Washington, D.C. 20210

Dear Mr. Page:

Enclosed are four copies of the "Engineering Cost and Feasibility Study-Proposed OSHA Lead Standard-Secondary Lead Smelters" For Lead Industries Association" which I promised to submit for the record on the occasion of my recent appearance at the lead hearings.

Very truly yours,

Knowlton J. Caplan

Knowlton J. Caplan, P.E.

KJC/pp

Enclosures

cc: S. Medina

CONSULTING • EVALUATION • DESIGN • MONITORING SERVICE

INDUSTRIAL HEALTH ENGINEERING ASSOCIATES, INC.

INDUSTRIAL HYGIENE
AIR POLLUTION

7340 WASHINGTON AVENUE SOUTH
HOPKINS, MINNESOTA 55343
(612) 941-8410

FINAL REPORT

ENGINEERING COST AND FEASIBILITY STUDY
PROPOSED OSHA LEAD STANDARD
SECONDARY SMELTERS
FOR
LEAD INDUSTRIES ASSOCIATION

Knowlton J. Caplan, P.E.

Gerhard W. Knutson, Ph.D.

TABLE OF CONTENTS

SUMMARY

1. It is judged technically not feasible to control lead-in-air concentrations to 100 $\mu g/m^3$ in several areas of the secondary lead smelter, such as:

   a) Breaking of industrial and side-terminal batteries.

   b) Handling of scrap, due to excessive maintenance problems; and handling of miscellaneous, non-uniform scrap.

   c) Handling of slag.

   Cost estimates were based on a study of one secondary lead smelter. The summary of the results are as follows:

   Capacity: 60 tons lead produced per day.
   Capital cost: $2,000,000
   Power Consumption: 1,792,000 KWH per year
   Maintenance: $164,000 per year
   Incremental labor: 12,875 man-hours per year
   Capital cost per unit capacity (tons per day): $33,300

INDUSTRIAL HEALTH ENGINEERING ASSOCIATES, INC.

INDUSTRIAL HYGIENE
AIR POLLUTION

7340 WASHINGTON AVENUE SOUTH
HOPKINS, MINNESOTA 55343
(612) 941-8410

FINAL REPORT

ENGINEERING COST AND FEASIBILITY STUDY PROPOSED OSHA LEAD STANDARD SECONDARY SMELTERS FOR LEAD INDUSTRIES ASSOCIATION

INTRODUCTION

In October of 1975, the Occupational Safety and Health Administration of the U. S. Department of Labor proposed a new Occupational Lead Standard. Following that proposal, the Lead Industries Association engaged Industrial Health Engineering Associates to provide a cost and feasibility study of the engineering controls necessary to achieve the lead-in-air concentrations of 100 $\mu g/m^3$ proposed by the OSHA standard. The cost study includes the operating and maintenance costs of the engineering facilities that would be required, including maintenance labor. It does not include record keeping, medical examinations, etc.

NATURE OF THE INDUSTRY AND APPROACH TO THE PROBLEM

The secondary lead smelter industry is poorly defined. Published information about the industry is poor, no doubt partly because of the poor definition; for example, the number of plants is variously estimated from 40 to 140. Some secondary smelters process a number of non-ferrous scrap materials, lead being just one of several metals recovered. Another general type handles only lead; the primary source being old lead-acid batteries. (These plants are known as "battery breakers"). The industry serves a very useful function in recovering lead, and in eliminating what would be a serious waste disposal problem, the disposal of used batteries.

Most secondary lead smelters are quite small and do not meet current OSHA standards of 200 µg lead per cu. m. air. The plant surveyed by IHE had two blast furnaces and no reverberatory furnace. The plant produced 60 tons lead per day.

PROCESS DESCRIPTION AND REQUIRED ENGINEERING MODIFICATIONS

Battery Breaking

Lead-acid batteries, shipped in by truck or railroad car, are placed on a conveyor to an enclosed saw. The saw separates the tops from the battery case. The separated battery is then conveyed to the dumping station where the battery case is inverted and the battery tops, plates and remaining sulfuric acid are collected in a pile below the battery dumping platform, where the acid drains off. The case itself is discarded.

To reduce airborne lead and sulfuric acid mist, the saw enclosure would be provided with exhaust ventilation, and local exhaust at the dumping station would be required.

Another process for cutting tops off batteries is a hydraulic guillotin knife. A side draft exhaust hood would be required for control.

Still another manual operation, breaking the cases with an axe, is required for side terminal batteries and large industrial batteries. Here again local exhaust ventilation would be required.

The cost of control facilities is $70,000 (see Cost Estimate Item 1).

Scrap Material Handling

The pile of plates and lids is saturated with sulfuric acid and must be dried before it can be fed to a furnace. Consequently, the pile below the dumping station is constantly being moved to other locations to dry. Typically, front end loaders moved these piles from battery breaking to locations outside. In some plants, the storage is in an open shed. The handling by payloader, with the attendant spillage, wheeled traffic over floors which cannot be kept clean, etc., represents an operation which is impossible to control, even to 200 $\mu g/m^3$. (Workers wear respirators in current operations).

To control the lead dust, the entire material handling system would require revision and mechanization. One such system would be as follows:

(a) From the dumping station, the scrap would fall through a chute to a belt conveyor, and be conveyed to a washer (to remove residual acid). The belt conveyor and washer would be enclosed and exhausted to a wet collector. The wash water would require neutralization of acid and recovery of lead.

(b) From the washer, scrap would be conveyed by enclosed belt conveyor to a drier, so that it could be charged to a furnace without danger of explosion. Dust control would be required on the equipment.

(c) From the drier, the scrap would be handled in enclosed, exhausted belts and bucket elevators to storage bins.

(d) From the storage bins, the scrap would move by weigh feeders and belts to the blast furnace skip hoists.

The cost of such facilities would be $724,000 (Item 2, Cost Estimate).

It is anticipated that the equipment described above would not be suitable for handling all kinds of scrap received; and that it would be marginal, anyway, in achieving a 100 μg standard. Scrap handling is the most troublesome area in all secondary smelters. The equipment described would need to be housed for weather protection. The building would require complete enclosure and exhaust to segregate the area and minimize contamination of adjacent operations. The cost of such a building is estimated at $191,000 (Item 2A, Cost Estimate).

Blast Furnace Charging

The charge for the blast furnace is complex and variable. The major source of lead is battery plates. Other significant sources are scrap from lead-acid battery plants, scrap from oxide plants, dross from the refinery, dust from the baghouse and miscellaneous scrap containing lead. To complete the charge rerun slag, scrap cast iron, limestone and coke are added. The proportion of additives is determined by the type of lead scrap and conditions of the blast furnace.

The problems of variability in the lead charge require variability in other components of the charge. It is not deemed feasible to automate the charge preparation. A compromise solution is to charge the lead by the automatic material handling described above, and to charge the additives by skip hoist.

To reduce the airborne lead levels in the breathing zone below 100 $\mu g/m^3$, it will be necessary to enclose the charging operation and control the direction of air flow so as to carry airborne dust away from the employee's breathing zone. This would be accomplished by proper distribution of make-up air. The make-up air would be supplied from a perforated plate plenum which provides a relatively uniform 100 feet per minute side draft. Air direction would be so designed that all significant sources would be downwind of the operator. The air would then be discharged to atmosphere through a tall stack. The cost would be $45,200 (Item 3, Cost Estimate).

Blast Furnace Fume Control

Local exhaust and enclosure would be required on the blast furnace skip hoist. The slag tap and lead tap are currently provided with hoods which would require improvement and larger exhaust rates. The fume and dust-laden exhaust would require a fabric filter. The existing blast furnace flue gas exhaust is adequate. The cost would be $208,000 (Item 4, Cost Estimate).

Slag Handling

The slag cools and solidifies. Once solid, the slag mold is dumped on the floor and the slag separated from the matte. Both by-products are handled by payloader. To obtain control, the slag handling area would be enclosed and provided with exhaust ventilation at a cost of $10,500 (Item 5, Cost Estimate).

It is not known whether handling slag is a major or minor lead-in-air source. IHE has conducted tests in the smoke and fume rising from molten slag, and although the fume contains lead, the concentrations are less than would be expected. If the slag handling is a greater source than anticipated here, the proposed correction will not be adequate to reach the 100 μg goal, and workers will require respirators.

Isolation of Blast Furnace From Refinery

The blast furnace operations are a greater source of lead-in-air and more difficult to control, than is the lead refinery. Many more workers are in the refinery than are required to tend the blast furnace. Therefore, the two areas would be segregated by a wall. Ventilation airflows required for other purposes can be designed so the flow is from the refinery to the blast furnace area through any necessary doorways. The cost is $9,300 (Item 6, Cost Estimate).

Refinery

In the refinery, the lead blocks from the blast furnace are melted in open-top hemispherical kettles. The melt is subjected to various treatments to remove impurities as a dross which floats on top of the molten lead. In other refinery processes, chemicals are added to produce the desired lead alloy. The purified or alloyed lead is pumped to small molds ("pigs") where it solidifies and is removed to inventory.

The refinery kettles are equipped with hoods. To achieve a 100 μg standard, the hoods would require improvement and a greater volume of exhaust ventilation, at a cost of $33,500 (Item 7, Cost Estimate).

Casting Station

The purified or alloyed lead is cast into small ingots or pigs at the casting machine. The machine rotates a series of molds past a fixed pouring station, cools the metal with water and dumps the solidified ingot on an idler conveyor. From there the ingot goes to inventory.

Lead can become airborne at the pouring ladel and the return runner carrying overflow lead back to the kettle. To prevent escape of airborne lead, the pouring station and return lead runner would be hooded and ventilated. The hoods would be connected by flexible duct to a distribution header. When the casting station is moved to another kettle, the hoods would be reconnected to the header at another inlet and the previous inlet sealed. The exhaust air must pass through a dust collector before discharge to atmosphere. The cost of the system would be $40,000 (Item 16, Cost Estimate).

Vacuum Cleaning System

To achieve a 100 μg standard, the floors must be kept clean by a powerful "house" vacuum cleaning system. Floors must be cleaned once per shift, and immediately after any spills. Cost is $53,400 (Item 8, Cost Estimate).

Pneumatic Conveying of Flue Dust

Dust and fumes collected in the hoppers of the fabric filters and cooling towers are charged into the blast furnace. The new blast furnace feeds the material by screw conveyors and bucket elevators. The old blast furnace flue dust is collected in hoppers, transferred to the base of the blast furnace, and shoveled into the skip hoist. The handling of collected dust from these collectors, and from those to be added, would be by pneumatic conveyor system. Cost would be $27,400 (Item 9, Cost Estimate).

Crucible Cleaning

The lower part of the blast furnace, the "crucible", is removed weekly for cleaning and rebuilding. (The slag is extremely corrosive and attacks the lining of the crucible). The cleaning and rebuilding, using hammer and chisel, is excessively dusty. A special side draft hood would be required to capture the dust generated. The operator will require a respirator. The blast furnace would not be in operation during such cleaning, so the capacity of the blower and fabric filter could be used for this purpose. A special hood, and ductwork and dampers, would be required at a cost of $5,000 (Item 10, Cost Estimate).

Lunch Room Ventilation

The lunch room requires ventilation to meet the 100 µg standard while occupied by personnel in contaminated work clothing. A special down-draft piston flow system would be required, at a cost of $75,000 without air conditioning (Item 11, Cost Estimate). In addition, it may be necessary to require shoe covers and clothes change for some workers to achieve the rules of the proposed standard (50 µg).

Locker Room Ventilation

The plant has change room-locker room with limited capacity. Provisions have been made to provide each employee with double lockers and shower facilities. Additional ventilation would be required, however, to keep the dust concentrations below 100 µg. The system would be similar to that described for the lunch room. The cost would be $42,500 (Item 12, Cost Estimate).

New Substation

A total of 600 HP would be added to operate the required engineering controls; the plant is currently at the limit of electrical capacity, so a new substation would be required at a cost of $21,000 (Item 13, Cost Estimate). (Cost of distribution and controls to loads is included in their specific estimates).

Water Treatment Facilities

The contaminated waste water generated in the plant by the scrap washer (and from other sources) would require neutralizing the waste water and settling and filtration of the precipitated lead. Facilities similar to those required by a battery plant would be used, at a capacity of 100 gpm and cost of $250,000 (Item 14, Cost Estimate).

Drum Opening Station

Various lead-containing recycle scrap materials are received in metal drums. A ventilated station for opening drums and dumping into the skip hoist would be required. Hoods and an exhaust capacity of 20,000 cfm would be required, with fabric filter, at a cost of $160,000. The empty drums must be washed, otherwise handling the empties would create excessive dust. Thus a drum washing station would be needed, at a cost of $34,000. Total cost of the facility would be \$194,000 (Item 15, Cost Estimate).

INDUSTRIAL HYGIENE CONSIDERATIONS

There are many hazardous materials used in industry which have permissible exposure levels, under OSHA standards, below the proposed 100 $\mu g/m^3$ standard for lead. A great many of these are used in very much smaller quantities than lead, and therefore, bench top and laboratory type facilities are used in their processing and handling. This in itself is an important comparison, in that operations on an industrial production scale cannot be conducted manually in total glove box type enclosures and in small containers except at many multiples of the cost of typical industrial manufacturing processes.

There is also a significant difference between the industrial hygiene problem created by hazardous materials present in trace amounts in what is otherwise the mainstream of production, and the situation where the hazardous material itself is the mainstream of production, as in a secondary smelter.

There exists at least one historical example of a somewhat comparable situation to that required by the proposed OSHA lead standard. At one time the TLV for natural uranium was 50 $\mu g/m^3$. In a new plant, designed and constructed with this TLV in mind, and of a production capacity comparable to many secondary smelters in terms of annual tonnage, the capital cost of achieving the 50 $\mu g/m^3$ level was \$3,850,000 (1955 dollars). In that process, however, there were no "scrap" operations, the feed material was reasonably uniform and was all received in standard 30-gallon clamp-top drums. Furthermore, much of the process was a wet chemistry process in which the uranium bearing materials were completely enclosed in pipelines, pressure vessels, etc.

An interesting comparison can be made with vinyl chloride. Vinyl chloride is a hazardous material of recent notoriety, a proven human carcinogen. The OSHA standard was set a 1 part per million part of air by volume (ppm). It is common practice to use ppm units for gases and vapors, and milligrams or micrograms per cubic meter for particulate material such as dust and fumes. If the molecular weight of the gas or vapor is known, the ppm style of unit can be converted to micrograms per cubic meter. If this is done for vinyl chloride, 1 ppm is equal to 2,550 micrograms per cubic meter of vinyl chloride. Thus when expressed in the same units as the proposed 100 $\mu g/m^3$ standard for lead, the vinyl chloride standard is 25 times as liberal. The vinyl chloride standard is in general much easier to achieve. As is generally well known, vinyl chloride is produced in a closed, tightly sealed wet chemistry process at pressures of about 50 pounds per square inch and temperatures below 1,000°F. For normal operations, leakage from piping, packing glands of pumps, etc., is the major source of air contamination and can be controlled by improved maintenance, selected application of local exhaust ventilation, and copious general ventilation. Cleaning the inside of reactors and other pressure vessels is a major hygiene problem, for which adequate personal protective equipment is required. The well-known commercial PVC plastic is polymerized vinyl chloride (a different chemical) and can be manufactured to contain such small trace amounts of unpolymerized vinyl chloride that meeting the 1 ppm (2,550 µg) standard is usually not much of a problem.

TECHNICAL FEASIBILITY

It will not be technically feasible, in our opinion, to meet the proposed 100 µg/m³ lead-in-air standard by engineering controls in several major areas of the second smelter.

1) Breaking of batteries by hand, using an axe, will probably not meet the standard. Development of a machine to perform this function would be necessary to assure success.

2) The scrap-handling operation will be of dubious success for two reasons. First, there are significant amounts of highly variable scraps that cannot be handled by a mechanized system. Second, even handling of battery scrap presents a difficult corrosion and abrasion problem, so that maintenance activities will be frequent. Such activities result in spills on the floor, and (without respirators) high exposure for the workers performing the maintenance.

3) Handling of slag may be an unsolved problem. Process changes may be necessary, such as granulating the slag with water, not generally used in secondary smelters. Other possible process changes are only "proposed" and are proprietary.

RECIRCULATION OF CLEANED AIR

The proposed OSHA standard (1910.1025 (f)(3)) requires that "air from any exhaust ventilation system for lead shall not be recirculated into the workroom." It would be most unfortunate, in our opinion, if this provision were to be promulgated as part of the standard.

Most exhaust systems in secondary smelters would not be amenable to recirculation, but some, notably the high-volume systems for the lunch rooms and locker rooms, would be. Considerable energy and cost savings would be available if recirculation were used on those system.

An extensive history and background exists on this topic which should be briefly reviewed. It has been a rather uniform policy on the part of almost all official agencies and almost all professional industrial hygienists to recommend, up until recently, that recirculation of air cleaned of toxic contaminants should not be done. It was recognized that the air cleaning devices, even though basically capable of cleaning the air to a safe degree, were not completely reliable and all too frequently received inadequate maintenance. Therefore, with recirculation, there was a finite risk that the workroom air would be dosed with toxic materials by the ventilation system itself. In the days of cheap energy, it was a good decision and correct policy to require that recirculation be prohibited and the air exhausted from the building be replaced with outside air suitably heated or otherwise conditioned. It should also be remembered that most proposals for such recirculation were based on the use of a single air cleaning device without any "back-up" or redundancy to insure that the recirculated air would be safe. Recirculation proposals were made on that basis because (in the days of cheap energy) the savings by recirculation would be negated if additional safeguards and monitoring devices were required for the recirculated air.

Now, however, the cost of energy is such that it becomes economically wise to spend the extra capital and maintenance cost to provide for recirculation of cleaned air <u>if</u> such a system can be designed and monitored so that it is reliable and safe. For dry particulate dusts such as the lead oxide dust, the technology has been in existence for some time to permit such safe recirculation. The typical system would consist of a self-cleaning fabric filter as the first air cleaning device; if well maintained, the cleaned air from such a filter in a battery plant service would be fit to breathe. However, for safety and reliability the first filter would be followed by a second or back-up filter which would consist of a high efficiency filter of the HEPA type. This second filter would not be self-cleaning but would require replacement if sufficient dust leaked through the first filter and built up resistance on the second filter. Filters of the class proposed for second or back-up filter can be tested in place to insure that their efficiency is reliably high; there are no moving parts or other phenomena which would destroy the efficiency of such a filter bank, once it is properly installed. Various other controls and devices can easily be installed to monitor the concentration of lead or total dust in the cleaned air to automatically bypass the system in the event of failure, etc.

Such a recirculation system properly designed can recover essentially 100% of the heat in the air exhausted from the workroom and, in addition, can recover essentially 100% of the energy used in moving the air, forcing the air through filter resistances; and can even recapture essentially 100% of the wasted electrical energy represented by the inefficiency of the electric motors involved.

In typical recirculation situations, only a slightly greater capital investment is required to permit such recirculation than is required to provide make-up air. With today's fuel costs, the cost is recovered in less than one year. In view of the reasonable projection that energy costs will increase faster than other costs, such economic benefits can only become more attractive. It is obvious, of course, that proper recirculation of cleaned air in a safe manner is consistent with national energy policies; and that forbidding such provisions on the basis of "tradition" would be neither wise nor economic.

It can even be reasonably argued that a well-designed recirculation system will provide a better working environment than would a conventional exhaust and make-up air system. Lead oxide dust can be removed from the air so that the lead-in-air concentration is as low or lower than the outside air concentration in the vicinity of the plant. Furthermore, requirements that recirculation cannot be practiced would, due to economic pressures, result in attempts to use minimal exhaust air volumes on dust control hoods in order to minimize the volume of make-up air required and the heating cost thereof. In that event, better control of the lead dust at the capture points would be achieved if the more generous air volumes permitted by recirculation were used.

It should be recognized that, for the small establishment, the mere price of fuel is not the whole picutre. The only fuels suitable for small installations for make-up air duty are natural gas, propane or LPG, or fuel oil. For these fuels, price is not the only consideration because they are at times (and may increasingly so become in the future) literally unavailable. The next step up, for the small establishment, would be to purchase electricity for heating, which is typically two to three times as expensive as the fuels described above; or to provide a small steam plant fired by coal. The capital cost of the small coal-fired steam plant would be as large or larger than the typical small plant.

In recognition of the oncoming "fuel crisis" the Committee on Industrial Ventilation of the American Conference of Government Industrial Hygienists, in its publication "Industrial Ventilation ---A Manual of Recommended Practices", 13th and 14th Editions (1974 and 1976) devoted several pages to a description of ways in which such recirculation of air, cleaned of toxic contaminants, could be achieved; and included a list of pertinent considerations to insure that the recirculation was safe. Further, The National Institute of Occupational Safety and Health, Engineering Branch, recognizing the same factors, has conducted and is conducting studies on the same subject.

Consideration of the above factors indicates clearly to us that the referenced requirement in the OSHA standard should be deleted.

COST ESTIMATES

For the plant estimated by IHE, the following summary applies (see Appendix-Cost Estimate for details).

Nominal capacity:	60 tons per day lead produced
Capital installed cost:	$2,000,000
Power, KWH/year:	1,792,000
Maintenance (incl. labor):	$164,000 per year
Incremental labor (for operating new facilities):	12,875 hours per year

Capital cost per unit capacity (tons per day)

$$\frac{\$2,000,000}{60} = \$33,000$$

Several similar secondary smelters have been studied by IHE regarding cost of compliance to meet the current 200 $\mu g/m^3$ standard. Those capital costs range from about $400,000 to $600,000 and would not be adequate to meet the standard in the scrap handling area. The operator of the front end loader would still require a respirator. Alternatively, the cab of the loader could be enclosed, pressurized by filtered air, and air conditioned; the operator would require a respirator when outside the cab.

APPENDIX A
COST ESTIMATE

ITEM NO.	DESCRIPTION & COST BASIS	INSTALLED CAPITAL COST THOUSANDS	ANNUAL OP. COST		
			POWER KWH/ SHIFT-YEAR	MAIN. INCL. LABOR	△ LABOR HR/SHIFT YEAR
1	Local exhaust applied at saw house (750 cfm, 2 required), dump station (5,300 cfm, 2 required), hydrakeever (5,400 cfm) and axe breaking station (5,000 cfm). Use damper to activate either hydrakeever or axe breaking station. 17,500 cfm N.R. through a wet scrubber.	70.0	118,000	3,500	-0-
2	Material Handling				
	Replace payloader movement of plates with enclosed conveyor system. Including two bins for handling scrap from other sources, e.g., battery plant, refinery, dross, etc.				
	Installed material handling equipment	374.0	90,000*	18,700	-0-
	Ventilation	350.0	568,000	29,300	-0-
	21,000 cfm through scrubber				
	28,000 cfm through fabric filter				

* Plus 390,000 gallons #2 oil

APPENDIX A
COST ESTIMATE

ITEM NO.	DESCRIPTION & COST BASIS	INSTALLED CAPITAL COST THOUSANDS	ANNUAL OP. COST POWER KWH/ SHIFT-YEAR	MAIN. INCL. LABOR	△ LABOR HR/SHIFT YEAR
2A	Scrap Material Handling Building				
	Enclose scrap handling and exhaust 20,000				
	cfm for dust control	191.0	23,500	9,000	-0-
3	Blast Furnace Charging				
	Piston flow dust control in skip hoist				
	loading area 12,000 cfm of filtered air				
	flashing the area (2 required) exhausted				
	through a tall stack.	45.2	82,000	2,000	-0-
4	Blast Furnace Fume Control				
	Provide local exhaust of blast furnace				
	lead. tap, slag tap and charge hopper				
	all to fabric filter (25,000 cfm)	208.0	425,000	27,300	-0-
5	Slag Handling				
	Construct an enclosure around slag hand-				
	ling (15x20x10 ft. high), exhaust enclo-				
	sure and discharge through a tall stack				
	(12,800 cfm)	10.5	20,000	530	0

APPENDIX A
COST ESTIMATE

ITEM NO.	DESCRIPTION & COST BASIS	INSTALLED CAPITAL COST THOUSANDS	ANNUAL OP. COST POWER KWH/ SHIFT-YEAR	MAIN. INCL. LABOR	△ LABOR HR/SHIFT YEAR
6	BF & Refinery Isolation				
	Construct wall separating BF from refinery 70 ft. wide, 35 feet high framing and sheet metal.	9.3	-0-	-0-	-0-
7	Refinery				
	Improve hoods on kettles by making pump access door. Extend burner stack though roof, increase exhaust to capacity 18,000 cfm	33.5	-0-	-0-	-0-
8	Vacuum Cleaning System				
	(previous detailed estimates)	53.4	230,000	5,300	12,700
9	Pneumatic Handling of Flue Dust				
	(from previous detailed estimates)	27.4	38,800	1,400	-0-
10	Special Hood for Crucible Cleaning				
	Uses BF hood baghouse since BF not operating during crucible cleaning	5.0	-0-	200	-0-

APPENDIX A
COST ESTIMATE

ITEM NO.	DESCRIPTION & COST BASIS	INSTALLED CAPITAL COST THOUSANDS	ANNUAL OP. COST		
			POWER KWH/ SHIFT-YEAR	MAIN. INCL. LABOR	△ LABOR HR/SHIFT YEAR
11	Lunch Room Ventilation				
	30,000 cfm down draft no A/C	75.0	21,000	8,200	-0-
12	Locker Room Ventilation				
	17,000 cfm down draft no A/C	42.5	12,000	3,400	-0-
13	New Substation				
	For additional 600 HP capacity	21.0	-0-	-0-	-0-
14	Water Treatment				
	At 100 gpm (from costs of similar system)	250.0	---- 35,000/year ---		
15	Drum Handling Station				
	Ventilated drum opening station and skip				
	hoist hood. Drum washing station.	194.0	96,000	18,300	175

APPENDIX A
COST ESTIMATE

ITEM NO.	DESCRIPTION & COST BASIS	INSTALLED CAPITAL COST THOUSANDS	ANNUAL OP. COST POWER KWH/ SHIFT-YEAR	MAIN. INCL. LABOR	△ LABOR HR/SHIFT YEAR
16	Exhaust on Casting				
	Enclose lead pouring station and return				
	runner. Exhaust 5,000 cfm	40.0	67,600	2,000	-0-
	TOTAL	1,999.8	1,791,900	164,100	12,875

SECTION 7

REPRINT OF INORGANIC LEAD HEARING
EXHIBIT NUMBERS 142D, 142E, 144

APPENDIX 3A

VARIATIONS IN PERSONAL AIR SAMPLING RESULTS FOR INDIVIDUAL EMPLOYEES OVER A PERIOD OF ABOUT TEN SUCCESSIVE WORK DAYS

EL PASO LEAD STUDY

Variations in Personal Air Sampling Results for Individual Employees over a Period of About Ten Successive Work Days

Employee	Variation in Daily Exposure: Range mg Pb/m^3	Variation in Daily Exposure: Variance $(mg/m^3)^2 \times 10^{-4}$
A	0.026-0.189	23.5
B	0.005-0.019	0.54
C	0.004-0.026	0.64
D	0.018-0.119	9.4
E	0.050-0.102	5.6
F	0.013-0.092	5.9
G	0.025-0.116	10.4
H	0.015-0.100	5.7
I	0.022-0.089	4.3
J	0.038-0.180	27.1
K	0.018-0.111	8.5
L	0.013-0.241	55.0
M	0.012-0.042	1.2
N	0.013-0.143	18.0
O	0.077-0.428	104.0
P	0.019-0.105	8.1
Q	0.022-0.074	3.8
R	0.021-0.149	16.0
S	0.030-0.125	9.6
T	0.010-0.065	2.7
U	0.029-0.110	7.0
V	0.036-0.231	42.8
W	0.011-0.092	7.3
X	0.014-0.102	6.6
Y	0.009-0.214	33.2
Z	0.007-0.166	26.4
AA	0.012-0.099	10.5
BB	0.026-0.147	19.4
CC	0.044-0.147	7.8
DD	0.034-0.090	6.0
EE	0.038-0.158	14.8
FF	0.027-0.493	205.8
GG	0.012-0.059	3.0
HH	0.006-0.032	0.6
II	0.014-0.069	3.4
JJ	0.027-0.087	6.1
KK	0.017-0.045	1.0
LL	0.024-0.094	5.7
MM	0.006-0.022	0.3
NN	0.026-0.239	39.0
OO	0.019-0.139	22.9
PP	0.012-0.312	69.0

A P P E N D I X 4

UPDATED SUMMARY OF LEAD AIR SAMPLING DATA FOR EAST HELENA, EL PASO, GLOVER, NEWARK, OMAHA, AND WHITING PLANTS FOR 1975 and 1976.

E A S T   H E L E N A

Report Month	Report Year	Sampler Description	No. of Samples by Department	No. of Samples by Job or Operation	Lead Conc'n. (mg/m^3)
April-May	1976	Personal Monitor	(8) Sinter Plant	(4) Cleanup Man	0.54
					0.55
					0.48
					0.20
				(2) Moisture Tester	0.26
					0.44
				(2) Machine Man	0.16
					0.55
			(11) Zinc Fuming Furnace	(1) Lunch Room	0.01
				(2) Furnaceman	0.08
					0.18
				(2) Furnaceman Helper	0.11
					0.16
				(2) Cranechaser	0.07
					0.33
				(2) Craneman	0.03
					0.08
				(2) Coal Feederman	0.07
					0.03
			(4) Zinc Fuming Holding Furnace	(2) Furnaceman	0.02
					0.03
				(2) Helper	0.10
					0.14
			(17) Yard	(2) Front End Loader Cab	0.19
					0.07
				(2) Adobeman	0.17
					0.13
				(7) Loader Operator	0.34
					0.08
					0.04
					0.11
					0.09
					0.25
					0.11

E A S T   H E L E N A

Report Month Year	Sampler Description	No. of Samples by Department	No. of Samples by Job or Operation	Lead Conc'n. (mg/m^3)
April- May 1976 (con't)	Personal Monitor	(17) Yard	(2) Breaking Floor Helper	0.17
				0.11
			(2) Breaking Floor Craneman	0.12
				0.17
			(2) Lead Baghouse Operator	0.12
				0.04
		(2) New Deal	(2) Mix Bins Craneman	0.51
				0.40
		(4) Cottrell	(2) Head Operator	0.13
				0.17
			(2) Operator	0.08
				0.11
		(14) Zinc Fume Loading	(2) Baghouse Man	0.29
				0.18
			(2) Fluecleaner	0.05
				0.07
			(10) Fume Loader	0.28
				0.16
				0.26
				0.30
				0.28
				0.19
				0.31
				0.11
				2.9
				0.36
		(4) Machine Shop	(4) Welder	0.23
				0.11
				0.07
				0.07
		(26) Blast Furnace	(4) Jackhammerman	0.10
				0.08
				0.85
				0.15
			(3) Feed Floor Hoist Man	1.38
				0.42
				0.29

E A S T   H E L E N A

Report Month	Year	Sampler Description	No. of Samples by Department	No. of Samples by Job or Operation	Lead Conc'n. (mg/m^3)
April-May (con't)	1976	Personal Monitor	(26) Blast Furnace	(4) Slag Motorman	0.09
					0.13
					0.17
					0.24
				(2) Furnaceman	0.11
					0.53
				(2) Dross Furnaceman	0.48
					0.30
				(2) Bullion Man	0.29
					0.77
				(2) Reverb Helper	0.63
					0.78
				(4) Feed Floor Hoist Room	0.23
					0.36
					0.91
					0.24
				(1) Feed Floor near chargehole	0.30
				(1) Dross Plant Crane Cab	0.06
				(1) Post Near Slag Tapping Site	0.05

Total: 90 Range 0.01 - 2.9

Mean of Means 0.27

- -

E L P A S O

Report Month	Report Year	Sampler Description	No. of Samples by Department	No. of Samples by Job or Operation		Lead Conc'n. (mg/m^3)
Feb.	1976	1-Hour Tape	(22) Lead Dross Reverb	(22) Charge Deck	Mean Max.	0.98 4.35
			(69) Copper Converters	(23) Between Converter #2 & 3	Mean Max.	0.41 1.57
				(23) Between Converter #1 &2	Mean Max.	0.14 0.43
				(23) Rear of Converter #2	Mean Max.	0.15 0.70
			(67) Copper Reverb	(24) Charge Deck	Mean Max.	0.15 0.38
				(43) Matte Tapping Launder	Mean Max.	0.11 5.0
			(100) Zinc Fuming Furnace	(34) Between Main and Holding Furnaces	Mean Max.	0.12 1.69
				(24) Charge Deck North Side	Mean Max.	0.26 1.72
				(17) Holding Furnace South Side	Mean Max.	0.06 0.10
				(25) Charge Deck South Side	Mean Max.	0.25 0.70
			(56) Cadmium	(29) Ground Floor Godfrey Roaster	Mean Max.	0.07 0.24
				(27) First Floor Godfrey Roaster	Mean Max.	0.46 1.20

Total: 314 Range 0.04 - 5.0

Mean of Means 0.25

E L   P A S O

Report Month	Report Year	Sampler Description	No. of Samples by Department	No. of Samples by Job or Operation	Lead Conc'n. (mg/m^3)
Feb.	1976	Personal Monitor	(2) Lead Dross Reverb	(1) Craneman	0.88
				(1) Furnaceman	2.40
			(4) Lead Sinter Plant	(2) Fireman	2.14
					0.78
				(2) Beltman	2.12
					2.0
			(3) Lead Blast Furnace	(1) Cat Operator	0.11
				(1) Furnaceman	2.67
				(1) Charge Car Operator	0.38
			(5) Cadmium	(3) Fireman	0.35
					1.74
					0.16
				(1) Asst. Fireman	0.92
				(1) Crane Operator	1.15
			(10) Zinc Kilns	(3) Kiln Loader	1.42
					0.47
					0.08
				(1) Asst. Foreman	0.65
				(4) Kiln Operator	2.39
					1.52
					0.11
					0.40
				(2) East Helena Zinc Oxide Dust Unloader	0.36
					0.86
			(3) Zinc Fuming Furnace	(2) Furnaceman	0.15
					0.15
				(1) Helper	0.27
			(7) Copper Converters	(4) Craneman	0.24
					0.14
					0.13
					0.15

EL PASO

Report Month	Report Year	Sampler Description	No. of Samples by Department	No. of Samples by Job or Operation	Lead Conc'n. (mg/m^3)
Feb. (con't)	1976	Personal Monitor	(7) Copper Converters	(1) Crane Chaser	0.05
				(1) Skimmer	0.24
				(1) Puncher	0.10
			(2) Mill	(1) Unloader	1.28
				(1) Feederman	0.12
			(3) Unloading	(1) Clean-up	0.12
				(1) Motor Crane Operator	0.07
				(1) Switchman	0.03
			(3) Sample Mill	(3) High Grade Sample Cutter	0.42 0.60 0.32
			(2) Boiler Shop	(2) Welder	0.07 0.10
			(2) Leach Plant	(1) Helper	0.24
				(1) Operator	0.46
			(1) Umpire Lab	(1) Fire Assayer	0.42
			(2) Ore Bins Copper	(2) Beltman	0.17 0.19
			(2) Cottrell	(1) Operator	0.04
				(1) Conditioner Man	0.04

Total: 51

Range 0.03 - 2.4

Mean 0.63

G L O V E R

Report Month	Report Year	Sampler Description	No. of Samples by Department	No. of Samples by Job or Operation		Lead Conc'n. (mg/m^3)
June	1976	1-Hour Tape	(113) Sinter Plant	(26) West Side of Mixing Drum	Mean Max.	1.5 5.4
				(26) Top of "O" Hopper	Mean Max.	0.94 3.3
				(21) East End of Pelletizing Drum	Mean Max.	2.7 4.0
				(5) Ignition End of D&L Machine	Mean Max.	2.4 5.3
				(23) Ignition end of D&L Machine	Mean Max	2.3 4.4
				(12) Transfer Point on Long Belt to "Q" Hopper	Mean Max.	2.0 4.7

Total: 113 Range 0.09 - 5.4

Mean of Means 1.85

- -

Report Month	Report Year	Sampler Description	No. of Samples by Department	No. of Samples by Job or Operation		Lead Conc'n. (mg/m^3)
June	1976	Personal Monitor	(18) Sinter Plant	(3) Upstairs Helper		2.6
					(resp.)	3.9 0.59
				(4) Downstairs Helper		0.54
					(resp.)	0.09
					(resp.)	0.59 0.10
				(1) Helper		0.23
				(4) Weightsman		0.70 6.0
					(resp.)	0.86 0.17

G L O V E R

Report Month	Report Year	Sampler Description	No. of Samples by Department	No. of Samples by Job or Operation	Lead Conc'n. (mg/m^3)
June	1976	Personal Monitor	(18) Sinter Plant	(3) Craneman	0.57
				(resp.)	1.1 0.11
				(2) Operator	3.8 5.5
				(resp.)	1.1 0.08
				(1) Foreman	5.7
			(7) Refinery Floor	(3) Kettleman	0.09 0.16 0.09
				(2) Craneman	0.30 0.11
				(1) Top of No. 6 Kettle Cover	0.08
				(1) West Wall of Fire Assay Room	0.62
			(2) Refinery-Moulding	(2) Lead Moulder	0.14 0.11
			(4) Blast Furnace	(2) Baghouse Cleanout	4.8 4.2
				(2) Barrying out Furnace	1.2 1.0
			(2) Laboratory	(1) Fire Assay	0.11
				(1) Fire Assay Helper	0.09
			(2) Shop	(1) Kettle Welder	0.19
				(1) Welder	1.1

Total: 35 Range 0.08 - 6.0

Mean of Means 1.18

N E W A R K

Report Month	Report Year	Sampler Description	No. of Samples by Department	No. of Samples by Job or Operation		Lead Conc'n. (mg/m^3)
April	1976	1-Hour Tape	(53) Kettles	(53) Rear of Nolan Casting Machine	Mean Max.	0.19 0.63
			(51) Furnace Room	(51) Back of #4 Kettle	Mean Max.	0.18 0.90

Total: 104 Range 0.03 - 0.90

Mean of Means 0.19

Report Month	Report Year	Sampler Description	No. of Samples by Department	No. of Samples by Job or Operation	Lead Conc'n. (mg/m^3)
April	1976	Personal Monitor	(1) Wire Room	(1) Sheet Lead Operator	0.41
			(6) Kettle Room	(2) Slugomatic Operator	0.17 0.15
				(2) Nolan Casting Machine Operator	0.07 0.08
				(1) Castomatic Operator	0.15
				(1) Between Kettle and Slugomatic Machine	0.30
			(2) Charge Mixing	(1) Weigher	0.41
				(1) Laborer	0.95
			(1) Casting Room	(1) Castomatic Operator	0.09
			(11) Furnace Room	(3) Furnaceman	0.04 0.90 1.59
				(3) Furnace Helper	0.42 2.89 1.00
				(2) Crane Operator	0.15 0.43
				(2) Kettleman	0.14 5.24

N E W A R K

Report Month	Report Year	Sampler Description	No. of Samples by Department	No. of Samples by Job or Operation	Lead Conc'n. (mg/m^3)
April	1976	Personal Monitor	(11) Furnace Room	(1) Inside Crane Cab	0.51
			(2) Cottrell	(2) Flue Puller	3.87 4.17
			(2) Magnesium	(2) Kettle Worker	<0.02 <0.02

Total: 25

Range <0.02 - 5.24

Mean 0.97

- -

O M A H A

Report Month	Report Year	Sampler Description	No. of Samples by Department	No. of Samples by Job or Operation		Lead Conc'n. (mg/m^3)
March	1976	1-Hour Tape	(66) Refinery (Shut down)	(66) South of #2 Softening Furnace	Mean Max.	0.07 0.25
			(60) Retort	(60) Above Foreman's Desk, Opposite #8 Retort	Mean Max.	0.08 0.35

Total: 126 Range 0.01 - 0.35

Mean of Means 0.075

- -

Report Month	Report Year	Sampler Description	No. of Samples by Department	No. of Samples by Job or Operation	Lead Conc'n. (mg/m^3)
March	1976	Personal Monitor	(13) Refinery (Shut down)	(2) Kettle #14	0.03, 0.06
				(2) Kettle #12	0.03, 0.05
				(2) #1 Molding Machine	0.03 0.02
				(3) South end of Kettle Floor	0.05 0.04 0.02
				(2) #1 Softening Furnace	0.08 0.02
				(1) Crane Operator	0.04
				(1) Laborer	0.06
			(13) Bismuth Retort	(2) Fence East of #15 Retort	0.02 0.01
			(Refinery Shut down)	(2) Fence East of #14 Retort	0.05 0.02
				(2) Fence East of #7 Retort	0.06 0.02
				(1) Foreman	0.13
				(2) Retort Tapper	0.09 0.18

O M A H A

Report Month	Year	Sampler Description	No. of Samples by Department	No. of Samples by Job or Operation		Lead Conc'n. (mg/m^3)
March	1976	Personal Monitor	(Refinery Shut down)	(2) Retort Shoveler		0.18 0.13
				(1) Helper		0.78
				(1) Leadman		0.12
			(8) Bismuth Cupel (Refinery Shut down)	(2) Fence East of #2 Cupel		0.08 0.01
				(2) Post East of Cupels		0.10 0.02
				(2) Fence on Outside of Refinery Building		0.03 0.02
				(2) Cupelman		0.60 0.21
		Total 34	Range	0.01 - 0.78		
			Mean	0.10		
Oct.	1976	1-Hour Tape	(111) Refinery	(62) West Wall Between Kettles #12 & #13	Mean Max.	0.17 0.84
				(7) Dock, Slab Moulding Area	Mean Max.	0.11 0.18
				(34) Antimony Kettle	Mean Max.	< .01 0.01
				(8) Northwest of Kettle #17	Mean Max	<0.01 <0.01
			(99) Bismuth	(20) Pelletizer	Mean Max.	0.02 0.04
				(39) Opposite #9 Retort	Mean Max.	0.09 0.23
				(40) Bismuth Kettle	Mean Max.	2.62 11.65

OMAHA

Report Month	Report Year	Sampler Description	No. of Samples by Department	No. of Samples by Job or Operation		Lead Conc'n. (mg/m^3)
Oct.	1976	1-Hour Tape	(19) Residue	(19) Foreman's Desk by Reverb	Mean Max.	0.21 0.46
		Total 229	Range	<0.01 - 11.65		
			Mean of Means	0.13		

- -

Report Month	Report Year	Sampler Description	No. of Samples by Department	No. of Samples by Job or Operation	Lead Conc'n. (mg/m^3)
Oct.	1976	Personal Monitor	(34) Refinery	(8) Desil Kettle	0.40 0.39 0.83 0.26 0.05 0.07 0.08 0.33
				(1) Dry Dross	1.26
				(3) Softenerman	0.07 0.41 0.02
				(1) Antimony Kettleman	0.18
				(4) Craneman	0.10 0.07 0.09 0.12
				(1) Slab Moulder	0.23
				(1) Canned Caulker	0.14
				(1) Moulding Machine Operator	0.01
				(1) Forklift Operator	0.12
				(1) Stacker	0.04

O M A H A

Report Month	Report Year	Sampler Description	No. of Samples by Department	No. of Samples by Job or Operation	Lead Conc'n. (mg/m^3)
Oct. (con't)	1976	Personal Monitor	(34) Refinery	(6) Floorman	0.38
					0.47
					0.31
					0.72
					0.14
					0.39
				(1) Antimony Floorman	0.23
				(3) Dock, South Moulding Machine	0.03
					0.02
					0.03
				(2) Between Kettles #12 and #13	0.10
				(resp.)	0.06
			(17) Bismuth	(3) Retortman	0.66
					0.50
					0.47
				(1) Laborer	0.13
				(3) Cupelman	0.54
					0.50
					0.19
				(2) Head Kettleman	0.21
					0.05
				(1) Leadman	0.47
				(1) Mechanic	6.43
				(2) Foreman	0.10
					0.24
				(2) Between Cupels #1 and #2	0.50
				(resp.)	0.36
			(6) Residue	(1) Laborer	3.47
				(1) Foreman	0.27
				(1) Craneman	0.47
				(3) Furnaceman	0.37
					0.21
					0.83

O M A H A

Report Month	Report Year	Sampler Description	No. of Samples by Department	No. of Samples by Job or Operation	Lead Conc'n. (mg/m^3)
Oct.	1976	Personal Monitor	(7) Maintenance	(7) Kettle Welder	0.37
					1.44
					2.22
					0.75
					0.38
					0.14
					0.51

Total: 64

Range 0.01 - 6.43

Mean 0.48

W H I T I N G

Report Month	Report Year	Sampler Description	No. of Samples by Department	No. of Samples by Job or Operation		Lead Conc'n. (mg/m^3)
Oct.	1975	1-Hour Tape	(23) Brass	(23) Wall behind "C" Furnace Skimming Ports	Mean Max.	0.15 0.46
			(20) Larvik	(20) #2 Packing Station	Mean Max.	0.10 0.37

Total: 43 Range 0.03 - 0.46

Mean of Means 0.13

- -

Report Month	Report Year	Sampler Description	No. of Samples by Department	No. of Samples by Job or Operation	Lead Conc'n. (mg/m^3)
Oct.	1975	Personal Monitor	(3) "C" Furnace	(1) Furnaceman	0.18
				(1) Furnace Helper	0.08
				(1) Tram Operator	0.12
			(1) Crucibles	(1) Furnaceman	0.06
			(1) U.S. Furnaces	(1) Furnaceman	0.03
			(2) Larvik	(2) Furnace Helper	0.17 0.17
			(1) White Metals	(1) Castomatic Packer	0.95
			(5) Dross Plant	(1) Mixer Operator	0.72
				(1) Lift Truck Operator	0.69
				(1) Tram Operator	0.39
				(1) Laborer	1.6
				(1) Front-end Loader	2.1

Total: 13 Range 0.03 - 2.1

Mean 0.56

- -

W H I T I N G

Report Month	Report Year	Sampler Description	No. of Samples by Department	No. of Samples by Job or Operation		Lead Conc'n. (mg/m^3)
July	1976	1-Hour Tape	(69) Brass	(28) Wall north of "G" U.S. Furnace	Mean Max.	0.09 0.16
				(41) On top of "C" Furnace Cab	Mean Max.	0.014 0.04
			(23) White Metals	(23) Between Kettles #7 and 8 on North Side	Mean Max.	0.12 0.48
			(22) Larvik	(22) Between Furnace #2 and Packing Station	Mean Max.	0.013 0.02

Total: 114 Range <0.01 - 0.48

Mean of Means 0.05

Report Month	Report Year	Sampler Description	No. of Samples by Department	No. of Samples by Job or Operation		Lead Conc'n. (mg/m^3)
July	1976	Personal Monitor	(17) Brass	(2) North Wall, U.S. "G" Furnace	(resp.)	0.02 0.02
				(4) "C" Furnace Charge Floor	 (resp.)	0.05 0.045
					(resp.)	0.08 0.04
				(5) Furnace Helper		0.03 0.03 0.04 0.04 0.05
				(1) Furnaceman		0.03
				(2) U.S. Furnaceman		0.01 0.02
				(1) U.S. Furnace Helper		0.03
				(2) Charge Makeup		0.03 0.03

W H I T I N G

Report Month	Report Year	Sampler Description	No. of Samples by Department	No. of Samples by Job or Operation	Lead Conc'n. (mg/m^3)
July	1976	Personal Monitor	(6) Larvik	(2) Platform Between Furnace #2 and Packing station	(resp.) 0.03 0.01
				(2) Furnaceman	0.02 0.01
				(2) Laborer	0.43 0.01
			(2) Sampling	(1) Preparation Room Sampler	0.12
				(1) Dross Sampler	0.16
			(14) White Metals	(1) Asarcomatic Operator	0.06
				(1) Castomatic Operator	0.15
				(4) Packer	0.14 0.06 0.36 0.27
				(2) Pourer	0.04 0.05
				(1) Charge Makeup	0.10
				(2) Die Cast Pourer	0.07 0.12
				(1) Asarcomatic Framework Near Kettle #15	0.01
				(2) Castomatic #3 (not in operation)	(resp.) 0.11 0.01

Total: 39

Range 0.01 - 0.43

Mean 0.08

Blood Lead Levels at ASARCO's Omaha Refinery

Date	Name	Department	µg/100g	Comment
7-20-76	Adler	Truck Driver Transp.	66.0	Conf. H
11-8-76	Adler	Truck Driver Transp.	74.0	Conf. H
1-7-77	Adler	Truck Driver Transp.	69.0	Conf. H
7-20-76	Havener	Pipefitter-Maint.	65.0	Conf. H
9-21-76	Havener	Pipefitter-Maint.	78.0	Alert
12-30-76	Havener	Pipefitter-Maint.	75.0	Alert
7-20-76	Horne	Desil Kttle-Refinery	72.0	Alert
8-30-76	Horne	Desil Kttle-Refinery	88.0	Action
11-24-76	Horne	Desil Kttle-Refinery	86.0	Conf. H
1-7-77	Horne	Desil Kttle-Refinery	84.0	Conf. H
8-6-76	Horne	Utility	61.0	Conf. H
8-18-76	Horne	Utility	70.0	Conf. H
8-6-76	Minard	Foundryman-Maint.	63.0	Conf. H
12-22-76	Minard	Foundryman-Maint.	71.0	Alert
8-12-76	Latimer	Craneman-Refinery	78.0	Alert
8-30-76	Reno	Floorman-Refinery	70.0	Alert
8-30-76	Collins	Foreman-Bismuth	78.0	Alert
8-30-76	Smith	AST Foreman-Refinery	75.0	Alert
8-30-76	Moberly	Floorman-Refinery	74.0	Alert
8-30-76	Adams	Floorman-Refinery	70.0	Alert
8-30-76	Sorenson	Laborer-Residue	75.0	Alert
1-7-77	Sorenson	Baghouseman-Residue	88.0	Action
8-30-76	Cooper	Floorman-Refinery	83.0	Action
10-6-76	Cooper	Floorman-Refinery	89.0	Conf. H
9-2-76	Washa	Foreman-Residue	71.0	Alert
9-2-76	Aldrich	Desil Kttle-Refinery	74.0	Alert
1-7-77	Aldrich	Desil Kttle-Refinery	77.0	Alert
9-2-76	Hicks	Desil Kttle-Refinery	96.0	Action
2-30-76	Hicks	Desil Kttle-Refinery	62.0	Conf. H
9-13-76	Holiday	Moulder-Refinery	73.0	Alert
2-30-76	Holiday	Moulder-Refinery	74.0	Alert
9-13-76	Dofner	Foreman-Residue	71.0	Alert

Date	Name	Department	µg/100g	Comment
10-19-76	Dofner	Foreman-Residue	82.0	Action
1-24-76	Dofner	Foreman-Residue	84.0	Conf. H
1-7-77	Dofner	Foreman-Residue	72.0	Conf. H
9-13-76	Miller	Station Tender-Power	73.0	Alert
9-13-76	Camden	Mechanic-Bismuth	71.0	Alert
1-7-77	Camden	Kettleman-Bismuth	70.0	Alert
9-13-76	Rech	Retortman-Bismuth	77.0	Alert
9-13-76	Walling	Furnaceman-Residue	91.0	Action
11-8-76	Walling	Furnaceman-Residue	82.0	Conf. H
1-7--7	Walling	Furnaceman-Residue	75.0	Conf. H
9-13-76	Larsen	Desil Kttle-Refinery	76.0	Alert
9-13-76	Dougherty	Softenerman-Refinery	76.0	Alert
9-21-76	Magnuson	Construction-Maint.	125.0	Action
10-6-76	Magnuson	Construction-Maint.	81.0	Conf. H
10-28-76	Magnuson	Construction-Maint.	84.0	Conf. H
11-8-76	Magnuson	Construction-Maint.	73.0	Conf. H
1-7-77	Magnuson	Construction-Maint.	62.0	Conf. H
11-8-76	Cooper	Utility	72.0	Conf. H
12-1-76	Cooper	Utility	68.0	Conf. H
11-16-76	Zoucha	Foreman-Residue	70.0	Alert
12-1-76	Wheeler	Foreman-Bismuth	104.0	Action
1-7-77	Wheeler	Foreman-Bismuth	81.0	Conf. H
12-1-76	Hill	Foreman-Bismuth	70.0	Alert
12-1-76	Horne	Softenerman-Refinery	74.0	Alert
12-1-76	Wilwerding	Softenerman-Refinery	82.0	Action
12-10-76	Klavins	Craneman-Refinery	80.0	Action
12-10-76	Soseman	Laborer-Bismuth	74.0	Alert
12-10-76	Burnett	Cupelman-Bismuth	79.0	Alert
12-21-76	Blair	Construction-Maint.	88.0	Action
12-21-76	Adams	Dezinc Kttl-Refinery	71.0	Alert
12-30-76	Meysenburg	Unidentified Job	70.0	Alert
12-30-76	Sexton	Mason-Maint.	72.0	Alert

Date	Name	Department	ug/100g	Comment
12-30-76	Brink	Baghouseman-Residue	77.0	Alert
12-30-76	Nevson	Moulder-Refinery	71.0	Alert
1-7-77	Alley	Craneman-Refinery	72.0	Alert
1-7-77	Camden	Foreman-Bismuth	75.0	Alert
1-7-77	Roebuck	Flooman-Refinery	78.0	Alert
1-7-77	Scott	Mechanic-Refinery	86.0	Action
1-7-77	Rech	Kettleman-Bismuth	77.0	Alert
1-7-77	Larsen	Desil Kttle-Refinery	75.0	Alert
1-7-77	Odell	Foreman-Residue	74.0	Alert
1-7-77	Grabowski	Foreman-Residue	77.0	Alert