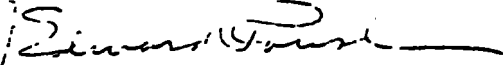# UNITED STATES ENVIRONMENTAL PROTECTION AGENCY

DATE: July 27, 1978

SUBJECT: National Ambient Air Quality Standards

FROM: J. Edward Roush, Director
Office of Regional & Intergovernmental Operations

TO: All Regional Administrators

　　　　Attached for your review is the National Ambient Air Quality Standard (Red Border Clearance). Please review this package and provide me with your comments by C.O.B. August 11, 1978. If you have any questions concerning the attached package, please contact Marvin Fast on 755-0444.

Attachment

SUBJECT: National Ambient Air Quality Standard and State Implementation
Plan Regulations for Lead--ACTION MEMORANDUM

FROM   : David G. Hawkins, Assistant Administrator
for Air, Noise, and Radiation

MEMO TO: Administrator (A-100)

THRU   : AX (A101)

I.   PURPOSE

This memorandum forwards for the approval of the Administrator the
final National Ambient Air Quality Standard and State Implementation
Plan Regulations for lead. Signature of these materials will promulgate
the standard and begin the schedule for attainment set by the Clean Air
Act. States will have nine months to submit implementation plans demon-
strating attainment of the standard. EPA will then have four months to
approve or reject the State Implementation Plans. The standard must be
attained as soon as practicable, and no later than three years after
plan approval unless a two year extension is granted. Included with the
standard and regulations are the final Federal Reference Method for
lead, proposed regulations for establishing equivalent lead monitoring
methods, and an advance notice of proposed rulemaking for ambient moni-
toring near lead point sources.

II. BACKGROUND

As a result of litigation, NRDC, Inc., et al. v. Train, 411FSupp.
864 (S.D. N.Y., 1976), aff'd 545 F.2d 320 (2nd Cir. 1976), lead was
listed as a criteria pollutant under Section 108 of the Clean Air Act on
March 31, 1976. Section 109 of the Act instructs EPA to set an ambient
air quality standard for each criteria pollutant:

"The attainment and maintenance of which in the judgment
of the Administrator based on such criteria and allowing for
adequate margin of safety are requisite to protect the public
health."

The air quality criteria for lead, the control techniques document, the proposed standard, and the proposed regulations for State Implementation Plans were issued on December 14, 1977.

The proposed standard was 1.5 micrograms lead per cubic meter (1.5 μg Pb/m³), monthly average. This was based on the view that young children are particularly sensitive to lead, and that the lead induced impairment of the biosynthesis of heme in cells—indicated by elevation of erythrocyte protoporphyrin (EP)—is adverse to health.

For the final standard, OANR is recommending a level of 1.5 μg Pb/m³, calendar quarter average. The final preamble and standard are attached under Tab A, and the final preamble and regulations for State Implementation Plans are attached under Tab B. The final page of this memo provides a full listing of the attached tabs.

III. SUMMARY OF SIGNIFICANT COMMENTS

A. Proposed Standard

OANR received comments on the proposed standard and regulations from 81 individuals and organizations. All comments opposing the proposed level of the standard (25) as excessively stringent came from industry representatives. Extensive comments came from: the Lead Industries Association; ASARCO, DuPont, Ethyl, and St. Joe Minerals. Sixteen of the comments received from industry representatives counterproposed a 5 μg/m³ 90-day standard.

Comments supporting the proposal or advocating a lower level (20) came from the medical community, Federal agencies, state agencies, and public interest groups. Endorsement of the proposed standard came from the Center for Disease Control/Public Health Service, the Occupational Health and Safety Administration, the Food and Drug Administration, the American Academy of Pediatrics, and state health or environmental agencies in California, Massachusetts, New York, Tennessee, and Wisconsin. A summary of comments received opposing and supporting the proposal are attached under Tab C.

No comments were received on three elements of the proposed rationale:

1. The structure of the rationale used to derive the proposed standard.

2. The selection of children as the sensitive population.

3. The adoption of a blood lead level of 12 ug Pb/dl as an estimate of non-air contribution of blood lead levels.

Comments received did address:

1. The health significance of EP elevation.

2. The blood lead threshold level for adverse effects.

3. The relationship between air lead and blood lead.

4. The contribution of air emissions to blood lead, EP elevation, and health effects in the vicinity of smelters.

5. The need for a respirable particulate standard.

A summary of the significant comments received is attached under Tab D, and a summary and comparison of the rationales for the proposed and final standards is presented under Tab E.

B. Proposed State Implementation Plan Requirements

Tab B contains the Federal Register preamble and final rulemaking that revises the implementation plan requirements of 40 CFR Part 51 to account for the national ambient air quality standard for lead. The requirements differ only slightly from those proposed; changes were made either for clarification or to reflect the change in the averaging time of the standard. The preamble contains a discussion of the significant comments received on the proposed SIP regulations.

OANR intends to propose a requirement that the State implementation plans for lead contain provisions for owners and operators of primary and seconday lead smelters to monitor air quality in the vicinity of their plants. This requirement was not proposed previously, and OANR has not yet developed criteria for placement of air quality monitors in the vicinity of point sources. Because this requirement will result in expenditures by the owners and operations of point sources of lead particulate emissions, OANR is giving advance notice of the proposal of this requirement.

C. Economic Impact Assessment

Comments on the EPA draft Economic Impact Assessment forecast more severe impacts on the industries affected, but did not include data which would allow OANR to confirm the more severe estimate. The EIA has been revised to take into account a quarterly averaging period.

IV. ISSUES

OANR sees a number of issues associated with the decision on the final standard and SIP regulations. These can be divided into three areas: estimating the safe level for children's blood lead; estimating the

relative contribution to blood lead from air and non-air sources of lead; and, assessing the economic impacts of the standard and the attainment program. The principal issues in these areas are discussed below.

A. Estimating the Safe Blood Lead Level for Children

Because of the multiple routes and sources of environmental lead, the air standard is derived in two stages. First, OANR has estimated the blood lead level in children which can be regarded as the maximum safe goal for total exposure to lead. Second, OANR has made judgments as to the extent that sources of lead unrelated to air pollution should be taken into account in calculating the maximum safe contribution from exposure to air lead.

For the final standard OANR's judgment of the maximum safe blood lead level from all sources is based on two factors:

1. Estimating the maximum safe blood lead level for an individual child, and,

2. Determining where the blood lead level for a group of children should be in order to maintain most children below the maximum level for individuals.

ISSUE: In determining the maximum safe blood lead level, should the standard be based on a subclinical effect (elevated EP) rather than a clinical effect (anemia)?

In the proposed standard, EPA took the position that the impariment of heme synthesis indicated by elevated EP was an adverse health effect. The criteria document reported the threshold for EP elevation in children at 15-20 μg Pb/dl, and the proposed standard was developed from data showing a correlation between EP elevation and blood lead as low as 15 μg Pb/dl. In the comments received, this position was challenged with the following arguments: (1) there was no evidence linking the effect with disease or impaired performance; (2) hemoglobin levels were not affected; and (3) there was not evidence that the levels or functions of other heme proteins were affected. Commentors supporting the proposed standard argued that: (1) the impairment of heme synthesis due to lead as indicated by elevated EP is adverse to health, in the same sense that other indicators, such as blood pressure or changes in liver chemistry indicate an abnormal state, (2) the vital nature of heme synthesis in the function of hemoglobin and other heme proteins, (3) the apparent ability of lead to alter the structure and processes of the intracellular mitochondria; (4) the adverse effects of accumulating intermediate products in the heme synthesis pathway; and (5) the need to manage subclinical effects short of disease state as an established and prudent practice of preventive medicine.

From review of these points, OANR concludes that lead's interference with heme synthesis to the extent that there is an accumulation of the final substrate, protoporphyrin, is of sufficient medical concern that public health measures should be designed to avoid this state as a chronic condition in children. OANR also recognizes that the health significance of the effect increases progressively from the point where it can just be detected. OANR does not believe that there is sufficient information to conclude that this effect is adverse to health at the threshold for detection. In the preamble, OANR adopts 30 μg Pb/dl as the best available estimate of the safe maximum blood lead level for individual children. This is in accord with the guidelines established by the Center for Disease Control of the Public Health Service in consultation with the American Academy of Pediatrics.

The criteria document reports that clinically observable symptoms of anemia can be detected above 40 μg Pb/dl, and several commenters advocated that this level be adopted as the maximum safe blood lead level in an individual child. OANR cannot agree that the air standard should be based on an individual maximum safe blood lead goal which is at the threshold for clinical anemia.

ISSUE: What percentage of children should the standard protect?

From actual measured data, the air quality criteria report that there is an individual variation of blood lead in a population with uniform lead exposure. This variation is consistent for different groups and different exposure levels. Because of this individual variation, a population whose average blood lead level is 30 μg Pb/dl will have 50 percent of its members above the safe level. Because the variation of individual blood lead levels within a group are log normally distributed, the target geometric mean which will place a given percentage of the population below a particular level can be calculated from the standard geometric deviation of that population. OANR has calculated that a geometric mean blood lead of 15 μg Pb/dl would place 99.5-99.9 percent of children below the threshold of 30 μg Pb/dl. OAWM believes that this percentage range is appropriate in view of the large size of the sensitive population. In the United States in 1970 about 12 million children under five years of age lived in urban areas. Approximately five million of these lived in central city areas.

Alternative standards based on other judgments about the maximum safe blood lead and percentages of children protected are presented under Tab F.

B.   Estimating Non-Air Contributions to Population Blood Lead

In the preamble to the proposed standard, EPA argued that an air standard which did not consider the possible contribution to blood lead

from other sources would not be protective of the population. This was not challenged by the comments responding to the proposal. Based on studies of blood lead levels where air lead levels were very low and upon other clinical studies showing the rough proportion of blood lead derived from air sources, OANR has estimated that 12 µg Pb/dl of the allowable geometric mean population blood lead of 15 µg Pb/dl would be derived from non-air sources.

ISSUE: Is 12 µg Pb/dl EPA's best estimate of non-air contribution to blood lead?

While there is fairly good information linking the change in blood lead level to air lead level, it is difficult to determine contribution to blood lead from typical exposure to lead in water, lead in food, and lead ingested in non-food items. The situation is further complicated by the deposition of lead from the air which then moves through other media to an exposure situation. NRDC has argued that almost all lead in inner city children is ultimately derived from lead in gasoline and that the ambient level of 1.5 µg/m^3 will not protect young children. On the other hand, in a study performed by EPA's Drinking Water Program, MITRE Corporation has attempted to estimate the relative contribution of various media to blood lead levels by calculating daily intake and absorption factors. Their results predict that less than 1 percent of lead in the blood derives from air lead. OANR believes that, on balance, the weight of information available does not favor either of these extreme views. Epidemiological and clinical studies reported in the Criteria Document suggest that blood leads do change with air lead levels, but that the lead content in food and beverages can be significant. Without new information, OANR has retained its belief that a 12 µg Pb/dl level based both on scientific and policy considerations, is the best available projection of non-air contribution to blood lead, and the extent to which the air program can attempt to control total exposure.

C. Economic Impacts and Possible Non-Attainment of Point Sources of Lead Emissions

In the Economic Impact Assessment, OANR estimates that attainment of the national ambient air quality standard for lead may cause severe localized economic impacts--including possible plant shutdown, for primary and secondary lead smelters and primary copper smelters. The data upon which this conclusion is based are of limited accuracy due to the difficulties in estimating emission factors for fugitive lead particulate. The severity of the actual impact may differ from that estimated. The

final Economic Impact Assessment and an addendum addressing cost differences resulting from the change from a monthly to quarterly averaging period are attached under Tab J.

ISSUE: How can EPA minimize the economic impact of the standard while complying with Section 109 of the Act?

From the Act's requirement that the standard be based on health criteria, OANR concludes that the level of the standard cannot be adjusted to ease the economic impact on smelters.

OANR notes, however, that the forthcoming lead standard is only one of a number of regulatory impacts on the non-ferrous smelters including regulations from Water Programs and OSHA. Other EPA air regulatory impacts include revisions of current State implementation plans for fugitive particulate matter and sulfur oxide emissions, regulations for designated pollutants under § 111(d) of the Act, and possible National Emission Standards for Hazardous Air Pollutants under § 112 of the Act for emissions of arsenic. Non-ferrous smelters face compliance difficulties even without a lead standard.

OANR has looked at a number of ideas for lessening the economic impact of the lead ambient air standard, and concludes that there are no options under the Act for totally alleviating the impacts on stationary sources of lead emissions. A discussion of the non-attainment problem is attached under Tab G.

OANR envisions the following scenario for dealing with possible point source non-attainment:

A. The States would be required to develop their SIPs under a traditional approach. That is, they would have to (1) analyze the air quality impact of all primary and secondary lead smelters and primary copper smelters (among other source categories) based upon available data and emission factors, (2) develop and evaluate control strategies where needed, (3) select a control strategy that is adequate on paper to attain and maintain the lead standard, and (4) submit the plan to EPA. States will request two-year extensions of the attainment dates under § 110(e) of the Act as needed.

B. In cooperation with EPA regions, State agencies, and affected plants, OAQPS will act to improve data on critical point sources (non-ferrous smelters) to the extent possible in the SIP development review.

C. Sources will request extensions of compliance dates under § 113(d) of the Act.

D. OAQPS will provide guidance to the States on the applicability of land acquisitions as an acceptable control strategy.

E. OAQPS will re-assess economic impacts of the attainment program at the time of SIP review, and inform all interested groups about the results of this projection and what ameliorative steps EPA can take under the Act. This will include discussions with members of Congress, the executive branch, and affected industries.

F. OAQPS is issuing an advance notice of proposed rulemaking on a requirement for air quality monitoring in the vicinity of primary and secondary lead smelters, and primary copper smelters. This will initiate a program for obtaining the air quality data that is essential to both a better definition of the problem and the determination of the effect of control measures.

G. OAQPS will request ORD to obtain more representative information on fugitive lead emissions and will also make available reports that describe several techniques for estimating fugitive lead emissions.

H. OAQPS will request OPM to undertake a study of the impact of EPA regulations on the primary non-ferrous smelters. The study would investigate which smelters will have difficulty meeting the various environmental regulations, the magnitude of the nonattainment problem, the area of impact around the sources, the cost of control, and the various options available for alleviation of severe economic impacts.

V. AVERAGING PERIOD FOR THE STANDARD

OANR recommends that the averaging period for the standard be lengthened from a calendar month to a calendar quarter (approximately 90 days). This change will improve the validity of the lead air quality data gathered to monitor attainment without requiring additional monitoring by state and local agencies, or significantly reducing the protectiveness of the final standard.

With current practice of operating hi-vol TSP samplers on every sixth day, the use of a monthly period to average lead values can result in too few observations to be statistically valid. In most months, only four or five samples would be taken, and it is possible that one or more of these might be omitted as invalid. The resulting averages could vary widely and the small number of observations would increase the error introduced by a single uncharacteristic value. Increasing the frequency of sampling would improve the quality of the average, but this alternative is costly for state and local agencies charged with monitoring responsibilities. The quarterly mean provides a larger number of values, and a more accurate representation of average air quality.

The key criterion for the averaging period is the protection of health of the sensitive population. In proposing the 1.5 $\mu g/m^3$ standard, OANR concluded that this air level was safe for indefinite exposure of young children. Critical to the determination of the averaging period

is the health significance of possible evaluations of air lead above 1.5 µg/m³ which could be encountered without violation of the standard. In the proposed standard, OANR chose a monthly averaging period on the basis of a study (Griffin 1975) showing an adjustment period of blood lead level with a change of exposure. Because of the scientific and technical difficulties of the monthly standard, OANR has re-examined this question and concludes that there is little reason to expect that the slightly greater possibility of elevated air lead levels sustainable by the quarterly standard is significant for health. This conclusion is based on the following factors.

(1) from actual ambient measures there is evidence that the distribution of air lead levels is such that there is little possibility that there could be sustained periods greatly above the average value.

(2) while it is difficult to relate the extent to which a monitoring network actually represents the exposure situation for young children, it seems likely that where elevated air lead levels do occur, they will be close to point or mobile sources. Typically, young children will not encounter such levels for the full twenty-four hour period reported by the monitor.

(3) there is medical evidence indicating that blood lead levels re-equilibrate slowly to changes in air exposure which serves to dampen the impact of a short-term period of exposure to elevated air lead.

(4) since direct exposure to air is only one of several routes of total exposure, a change in air lead would not impact proportionately on blood lead levels.

On balance, the Agency concludes that a requirement for the averaging of air quality data over calendar quarter will improve the validity of air quality data gathered without a significant reduction of the protectiveness of the standard.

VI.   IMPLICATIONS FOR OTHER CONTROL PROGRAMS

OANR has coordinated the development of the lead air standard with other regulatory programs of EPA, and with FDA, OSHA, and CPSC. This coordination has included discussion of the health basis for regulatory standards, as well as the contribution of various media to total exposure. EPA's drinking water program expressed concern about the adoption of a population blood lead target of 15 µg Pb/dl, and the basis for allocating total population exposure to lead between air, water, and other media. The water program agrees, however, that 30 µg Pb/dl is an appropriate goal for the maximum safe blood lead level of individual children, and that the air program is within its discretion in calculating the percentage of children to be protected by an air standard based on this goal. Similarly, while the water program is uncertain as to the appropriate allocation of lead exposure to non-air sources, it is recognized that such an estimate must be made, and that OANR is making a policy judgment as well as an estimate from the available scientific data.

The promulgation of this standard will occur just before the OSHA's final rulemaking for air lead in the workplace. Both standards will impact non-ferrous smelters. Costs for these facilities estimated by OSHA in its draft environmental impact statement were factored into the EPA economic impact assessment. OANR is discussing with OSHA ways to coordinate the compliance phase of these regulations, to the extent possible under the Agency's separate legislative responsibilities.

Summaries of comments on the proposed standard from other Federal programs are attached under Tab H.

VII. SECONDARY AMBIENT AIR QUALITY STANDARD

OANR has concluded that the secondary ambient air quality standard for lead should be at the same level as the primary standard. This is because (1) plants and animals do not appear to be more sensitive to lead than man; (2) effects of airborne lead on visibility and climate are minimal; and (3) significant damage of man-made materials resulting from lead concentrations has not been documented. No comments were received on the secondary standard.

VIII. ENVIRONMENTAL IMPACTS

The principal environmental impact of setting the lead standard will be the reduction of airborne levels of lead and reversal over time of the present trend of accumulation of lead in natural ecosystems, principally soil and sediments. Reduction of lead emissions will also , result in reduction of emissions of particulate matter and other metals at sources requiring control. The final environmental impact statement for the standard is under Tab I.

IX. ECONOMIC AND ENERGY IMPACT

Economic impacts will result primarily from control of lead emissions from primary lead and copper smelters, secondary lead smelters, grey iron foundries, gasoline lead additive manufacturers, and lead acid storage battery manufacturers. Plant closures are possible in the primary copper and lead industry and the secondary lead industry.

Comments on the Economic Impact Assessment forecast more severe impacts within these industries than did the EIA. Because the comments do not include data which would allow OANR to confirm the allegations of more severe impact, the EIA has not been revised.

Changing the averaging time of the lead standard from a monthly mean to a quarterly mean lowers estimated investment costs by 15 percent and annualized costs by 14 percent. This is due primarily to lower control requirements for the grey iron foundry casting, primary copper smelting, and primary lead smelting industries. Although control requirements are also reduced for the secondary lead smelting, gasoline lead additive

manufacturing, and lead-acid battery manufactuing industries, control costs are not noticeably reduced.

Estimated investment costs which may be incurred by affected industries to attain the recommended air lead standard of 1.5 µg Pb/m^3, quarterly averaging period are:

Table 1. NATIONAL CONTROL COST ESTIMATES FOR STATIONARY SOURCES
(1976 dollars, in millions)

Industry	1.5 µg/m^3 Quarterly Avg.	
	Invest.	Annual Cost **
Primary Lead Smelting	30*	7*
Secondary Lead Smelting	99*	22*
Primary Copper Smelting	235	51
Grey Iron Foundry Casting	148	31
Gasoline Lead Additives	3	2
Lead Acid Batteris	13	6
TOTAL	530	120

*BACT is costed where necessary but may not be sufficient for this standard to be met at. all plants.
**Annualized investment plus operating and maintenance cost.

Besides lowering control costs, the quarterly averaging period reduces the number of sources which have to install controls. This is especially true for grey iron foundries.

The phased reduction of lead in gasoline and the continued increase in the use of unleaded gasoline will result in sufficient reductions in lead emissions from mobile sources for achievement of the standard in most areas by the 1982 attainment data. For remaining problem areas, little or no control of mobile source lead emissions may be needed if EPA grants a two-year extension for attainment as provided for in the Clean Air Act.

It is estimated that at least sixteen air quality control regions will not attain the lead standard by 1982 without stationary source emission controls for primary lead and copper smelters and gasoline lead additive plants. Depending on the lead emissions from other stationary sources and the extent to which individual plants are already controlled, other air quality control regions may not attain the standard by 1982.

The final Economic Impact Assessment is attached under Tab J.

X. STATE AND REGIONAL RESOURCE REQUIREMENTS

OANR estimates state and local control agencies' costs to be $1.0 to $1.7 million for development and implementation of control strategies during the first year, and ongoing costs of $1.4 to $2.8 million annually. The ongoing costs represent 1 to 2 percent of current state and local air agency expenditures.

OANR estimates that EPA Regional Offices may incur costs of $100,000 to $500,000 to aid states in developing state implementation plans, to approve such plans, and provide technical assistance where necessary. Yearly costs after development of implementation plans may range from $100,000 to $300,000.

A more detailed table of the resources impact of the standard on State programs, summarized by region, is attached under Tab J.

XI. PUBLIC PARTICIPATION

There has been extensive external review, comment, and participation in the development of this standard. In the development of the Air Quality Criteria Document by ORD, three drafts of the criteria document were circulated for external review, 165 written comments were received on the final draft. The criteria document was written with extensive input from experts and consultants from outside the Agency. The criteria document was reviewed at three public meetings of the lead subcommittee of the Science Advisory Board. OANR development of the proposed standard involved external participation. In March, 1977, before initial drafting, a workshop of industry representatives, environmentalists, state agency officials and others was convened at Research Triangle Park, N.C. OANR held a pre-proposal public meeting in Washington in April, 1977. Following proposal of the standard in December, 1977, OANR held a public hearing in February, 1978 to receive comments. Eighty-one written comments have been received along with a number of Congressional and executive branch correspondence referrals. A summary of comments received and their disposition by the Agency is attached under Tab D. A review of each significant comment has been placed in the rulemaking docket (OAQPS 77-1).

XII. ANTICIPATED REACTIONS

Based on the comments received, OANR anticipates the following reactions:

A. Industry representatives will continue to hold that the standard is excessively stringent, questioning the health significance of a subclinical effect, the relative importance of air pollution to blood lead levels, and the importance of considering economic consequences when making judgments about the standard. Those most seriously affected, lead primary and secondary smelters, battery plants, and copper smelters may initiate litigation, individually or through representative institutions such as the Lead Industries Association.

B. Most Federal and State public health agencies, much of the medical community, and environmental groups will support the standard, particularly in light of recent media attention to possible neurological/ behavioral implications of low level chronic lead exposure and environmental contamination of soil with lead.

C. NRDC and others in the New York area will respond that the standard is not sufficiently stringent because New York children have blood leads above safe levels even though measured air quality has been near the standard. They may point out that the standard will not accelerate lead phasedown in gasoline, and so will have little effect in urban areas away from point sources. NRDC disagress with EPA's monitoring guidelines, and may sue for more protective monitoring.

RECOMMENDATIONS

OANR recommends that you approve and sign the Federal Register Rulemaking which amends 40 CFR Part 50 by adding an NAAQS for lead of 1.5 µg/m^3, quarterly average (Signature Tab 1). OANR recommends that you similarly approve and sign the Federal Register Rulemaking which amends 40 CFR Part 51 by adding specific requirements for State Implementation Plans for lead (Signature Tab 2), the Notice of Proposed Rulemaking under 40 CFR Parts 51 and 53 establishing equivalent monitoring methods for lead (Signature Tab 3), and the Advance Notice of Proposed Rulemaking under 40 CFR Part 51 for the requirement of ambient monitoring in the vicinity of certain lead point sources (Signature Tab 4).

LIST OF TABS

A - <u>Federal Register</u> Preamble, Standard and Federal Reference Method (Signature item)

B - <u>Federal Register</u> Preamble and Regulations for State Implementation Plans (Signature item)

C - List of External Comments Opposing or Endorsing the Proposed Standard

D - Summary of Significant Comments and Agency Disposition

E - Summary and Comparison of Rationales Underlying the Proposed and Final Standard

F - Table of Alternative Standards

G - Options for Dealing with Point Source Economic Impacts and Attainment Difficulties

H - Comments from Other Federal Regulatory Programs for Lead

I - Final Draft Environmental Impact Statement

J - Final Draft Economic Impact Assessment

K - Equivalency Regulation (Signature item)

L - Advance Notice of Proposed Rulemaking--requirements for ambient monitoring in the vicinity of certain lead point sources (Signature item)

TAB A- Federal Regester Preamble, Standard and Federal Reference
        Method (Signature item)

From promulgation, States will have nine months to prepare and submit to EPA plans demonstrating attainment of the standard by no later than September of 1982. Final regulations for the development of the State Implementation Plans appear elsewhere in this Federal Register.

FOR FURTHER INFORMATION CONTACT:

Mr. Joseph Padgett, Director
Strategies and Air Standards Division
Office of Air Quality Planning and Standards
U.S. Environmental Protection Agency, RTP, N.C. 27711
Telephone: 919-541-5204

AVAILABILITY OF RELATED INFORMATION: A docket (Number OAQPS-77-1) containing the information used by EPA in the development of the proposed standard is available for public inspection and copying between 8:00 a.m. and 4:30 p.m. Monday through Friday, at EPA's Public Information and Reference Unit, Room 2922, Waterside Mall, 401 M Street SW, Washington, D. C. 20460.

The Federal Reference Method for collecting and measuring lead and its compounds in the ambient air is published in Appendix G to this promulgation. This Federal Register also contains proposed regulations under 40 CFR Parts 51 and 53 for equivalent lead air monitoring methods, final rules for the development of State Implementation Plans promulgated under 40 CFR Part 51, and an advance notice of proposed rulemaking under 40 CFR Part 51 for ambient monitoring in the vicinity of certain lead point sources. Additional information on the development of the plans is contained in the document Supplementary Guidelines for Lead Implementation Plans. The environmental and economic impact of implementing this standard are described in an Environmental Impact Statement and an Economic Impact Assessment. These documents are available for public inspection and copying at the Public Information and Reference Unit (address above). Copies may be obtained upon request from Mr. Joseph Padgett at the above address.

TITLE 40 - PROTECTION OF ENVIRONMENT

CHAPTER 1 - ENVIRONMENTAL PROTECTION AGENCY

SUBCHAPTER C - AIR PROGRAMS

PART 50 - NATIONAL PRIMARY AND SECONDARY AMBIENT AIR QUALITY STANDARDS

NATIONAL PRIMARY AND SECONDARY AMBIENT AIR QUALITY STANDARDS FOR LEAD

AGENCY: Environmental Protection Agency

ACTION: Final Rulemaking.

SUMMARY: EPA is setting a National Ambient Air Quality Standard for lead
at a level of 1.5 µg Pb/m^3, averaged over a calendar quarter. This final
rulemaking follows a 1976 court order to list lead as a criteria pollutant
for the development of an ambient standard, and the Agency's issuance of a pro-
posed standard on December 14, 1977. In response to comments received on
the proposed standard, EPA has changed the averaging period for the standard
from a calendar month to a calendar quarter, and has clarified the health
basis used in selecting the standard level.

In establishing the level of the final standard, EPA has determined
that young children (age 1-5 years) should be regarded as a group within
the general population that is particularly sensitive to lead exposure.
The final standard for lead in air is based on a goal of preventing most
children in the United States from exceeding a blood lead level of 30 µg Pb/dl.
Blood lead levels above 30 µg Pb/dl are associated with the alteration of
certain biochemical processes within the cell, including the impairment of
heme synthesis indicated by elevated erythrocyte protoporphyrin, which EPA
regards as adverse to the health of chronically exposed children. There
are a number of other adverse health effects in children and the general
population associated with blood lead levels above 30 µg Pb/dl, including the
possibility that some type of neural damage may exist in children without
overt symptoms of lead poisoning.

The documents <u>Air</u> <u>Quality</u> <u>Criteria</u> <u>for</u> <u>Lead</u> and <u>Control</u> <u>Techniques</u> <u>for</u>
<u>Lead</u> <u>Air</u> <u>Emissions</u> were issued at the time of proposal. Both documents
are available upon request from Mr. Joseph Padgett at the above address.
SUPPLEMENTARY INFORMATION:

BACKGROUND

Lead is emitted to the atmosphere by vehicles burning leaded fuel and by
certain stationary sources. Lead enters the human body through ingestion
and inhalation with consequent absorption into the blood stream and distri-
bution to all body tissues. Clinical, epidemiological, and toxicological
studies have demonstrated that exposure to lead adversely affects human health.

EPA's initial approach to controlling lead in the air was to limit the
lead emissions from automobiles, the principal source of lead air emissions.
Regulations for the phasedown of lead in the total gasoline pool were
promulgated in 1973, and, following litigation, modified and put into effect
in 1976. EPA has also established regulations requiring the availability of
no-lead gasoline for catalyst-equipped cars. EPA also intended to control ·
emissions from certain categories of industrial point sources under Section 111
of the Clean Air Act.

In 1975, the Natural Resources Defense Council (NRDC) and others
brought suit against EPA to list lead under Section 108 of the Clean Air
Act as a pollutant for which air quality criteria would be developed and
a National Ambient Air Quality Standard established under Section 109 of
the Act. The Court ruled in favor of NRDC. <u>NRDC,</u> <u>Inc.</u> <u>et al.</u> <u>v.</u> <u>Train,</u>
411 F.Supp. 864 (S.D.N.Y., 1976) <u>aff'd</u> 545 F.2d 320 (2nd Cir. 1976). EPA
listed lead on March 31, 1976, and proceeded to develop air quality criteria
and the standard.

On December 14, 1977, EPA proposed a standard of 1.5 µg Pb/m^3, calendar
month average ,proposed the Federal Reference Method, issued the documents
<u>Air</u> <u>Quality</u> <u>Criteria</u> <u>for</u> <u>Lead</u> and <u>Control</u> <u>Techniques</u> <u>for</u> <u>Lead</u> <u>Air</u> <u>Emissions</u>

and proposed regulations for State Implementation Plans. EPA invited

public comments during the period from December 14, 1977 to March 17, 1978

on the standard, reference method, and the SIP regulations. Additional

comments on these matters were provided to EPA at a public hearing held on

February 15-16, 1978.

LEGISLATIVE REQUIREMENTS FOR NATIONAL AMBIENT AIR QUALITY STANDARDS

Sections 108 and 109 of the Clean Air Act govern the development of

National Ambient Air Quality Standards. Section 108 instructs EPA to

document the scientific basis for the standard:

"Sec. 108(a)(2)" The Administrator shall issue air quality criteria

for an air pollutant within 12 months after he has included such pollutant

in a list under paragraph (1). Air quality criteria for an air pollutant

shall accurately reflect the latest scientific knowledge useful in indicating

the kind and extent of all identifiable effects on public health or welfare

which may be expected from the presence of such pollutant in the ambient air,

in varying quantities. The criteria for an air pollutant, to the extent

practicable, shall include information on --

(A) those variable factors (including atmospheric conditions) which

of themselves or in combination with other factors may alter the effects

on public health or welfare of such air pollutant;

(B) the types of air pollutants which, when present in the

atmosphere, may interact with such pollutant to produce an adverse effect

on public health or welfare; and

(C) any known or anticipated adverse effects on welfare."

Section 109 addresses the actual setting of the standard:

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"Section 109(b)(1) National primary ambient air quality standards, prescribed under subsection (a) shall be ambient air quality standards the attainment and maintenance of which in the judgment of the Administrator, based on such criteria and allowing an adequate margin of safety, are requisite to protect the public health. Such primary standards may be revised in the same manner as promulgated.

(2) Any national secondary ambient air quality standard prescribed, under subsection (a) shall specify a level of air quality the attainment and maintenance of which in the judgment of the Administrator, based on such criteria, is requisite to protect the public welfare from any known or anticipated adverse effects associated with the presence of such air pollutant in the ambient air. Such secondary standards may be revised in the same manner as promulgated."

In order to conform to the requirements of Section 109, EPA is required to base the level of the lead air quality standard on information presented in the criteria document pertaining to the health and welfare implications of lead air pollution. This is in contrast to other sections of the Act under which EPA considers economic costs and technical availability of air pollution control systems in determining the standard. The Act also requires that the Agency should not attempt to place the standard at a level estimated to be at the threshold for adverse effects, but should set the standard at a lower level in order to provide a margin of safety. EPA believes that the extent of the margin of safety represents a judgment in which the Agency considers the severity of reported effects, the probability that such effects may occur, and un-certainties as to the full biological significance of exposure to lead.

Comments resulting from external review of the air quality criteria and the proposed standard highlight disagreements on a number of areas critical to EPA's judgments underlying the level of the standard. However, the scientific data base provided in the document Air Quality Criteria for Lead is as extensive as that for any other regulated air pollutant. Also, at every stage of development of the air quality criteria and the standard, EPA has facilitated and received broad external participation. EPA regards as inevitable the presence of scientific disagreement and uncertainty about key factors relevant to environmental standards. Provisions of the Act requiring timely promulgation of the standard, and requirements for periodic future review of air quality criteria and standards, however, indicate Congressional intent that the Agency proceed even where scientific knowledge is not complete or where there is an absence of full scientific consensus.

SUMMARY OF GENERAL FINDINGS FROM AIR QUALITY CRITERIA FOR LEAD

Following the listing of lead as a criteria pollutant, EPA developed the document, Air Quality Criteria for Lead. In the preparation of this document, EPA provided opportunities for external review and comment on three successive drafts. The document was reviewed at three meetings of the Subcommittee on Scientific Criteria for Environmental Lead of EPA's Science Advisory Board. Each of these meetings was open to the public and a number of individuals presented both critical review and new information for EPA's consideration. The final criteria document was issued on December 14, 1977.

From the scientific information summarized in the criteria document, conclusions in several key areas have particular relevance for the ambient air quality standard for lead.

1. There are multiple sources of lead exposure. In addition to air lead, these sources include: lead in paint and ink, lead in drinking water, lead in pesticides, and lead in fresh and processed food.

2. Exposure to air lead can occur directly by inhalation, or indirectly by ingestion of lead contaminated food, water, or non-food materials including dust and soil.

3. There is significant individual variability in response to lead exposure. Even within a particular population, individual response to lead exposure may vary widely from the average response for the same group. Certain subgroups within the general population are more susceptible to the effects of lead or have greater exposure potential. Of these, young children represent a population of foremost concern.

4. Three systems within the human body, appear to be most sensitive to the effects of lead -- the blood-forming or hematopoietic system, the nervous system, and the renal system. In addition, lead has been shown to affect the normal functions of the reproductive, endocrine, hepatic, cardiovascular, immunologic, and gastrointestinal systems.

5. The blood lead level thresholds for various biologic effects range from the risk of permanent, severe, neurological damage or death as blood leads approach and exceed 80 to 100 ug Pb/dl in children down to the inhibition of cellular enzyme systems at as low as 10 μg Pb/dl.

6. Lead is a stable compound, ubiquitously distributed, which persists and accumulates both in the environment and in the human body.

In developing the proposed standard, EPA used these findings to arrive at a standard level of 1.5 μg Pb/m^3 calendar month average. This level was derived from the Agency's judgment on two matters: first, that the maximum safe population blood lead level for young children was 15 ug Pb/dl, and second, of this amount, 12 μg Pb/dl should be attributed to non-air sources. The difference

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of 3.0 μg Pb/dl was then estimated to be the allowable safe contribution to mean population blood lead from lead in the air. With epidemilogical data indicating a 1:2 relationship between air lead (μg Pb/m^3) and blood lead (μg Pb/dl), EPA determined that the level for the proposed standard should be 1.5 μg/m^3.

SUMMARY OF COMMENTS RECEIVED

During the comment period from December 14, 1977 to March 17, 1978, and at the public meeting on February 15-16, 1978, EPA received 95 written and oral comments addressing the proposed standard or the requirements for State Implementation Plans. All comments opposing the standard as excessively stringent (25) came from representatives of affected industries, and twenty of these counter-proposed 5.0 μg Pb/m^3 calendar quarter average, as the appropriate level for the standard.

COMMENTS RECEIVED OPPOSING THE PROPOSED STANDARD
OF 1.5 µg/m^3 AS EXCESSIVELY STRINGENT

COMPANY	OPPOSED 1.5 µg/m^3, calendar month	ENDORSED 5.0 µg/m^3, calendar quarter (or other averaging period)
Amax Lead and Zinc, Inc.	X	X
American Mining Congress	X	X
American Petroleum Institute	X	
ASARCO	X	X
Associated Octel	X	X
Battery Council International	X	X
Bethlehem Steel	X	X
Bunker Hill Company	X	X
C & D Batteries	X	X
DuPont	X	X
ESA Laboratories	X	X
Ethyl	X	X
General Battery Corporation	X	X
General Motors Corporation		
Getty Refining and Marketing	X	
HECLA Mining Company	X	
Houston Chemical	X	X
Hunt Oil	X	
Kerr-McGee		
Lead Industries Association	X	X
Nalco Chemical	X	X
N L Industries	X	X
Prestolite Battery	X	X
Secondary Lead Smelters Association	X	X
Shell Oil	X	
St. Joe Minerals	X	X
Texaco, Inc.	X	X
United Machinery Group		
Vulcan Materials Company		

Summary: 45 comments received from 29 corporations or their representatives.

25 of the 29 firms opposed the proposed standard of 1.5 µg/m^3, calendar month average;

20 endorsed an alternative standard of 5.0 µg/m^3, calendar quarter average (or other averaging period).

Four comments opposed the proposed standard on the grounds that it was not sufficiently protective of health.

COMMENTS RECEIVED OPPOSING PROPOSED LEAD AIR QUALITY
STANDARD OF 1.5 $\mu g/m^3$, CALENDAR MONTH
IN FAVOR OF A MORE STRINGENT STANDARD

Natural Resources Defense Council

Sergio Piomelli, Pediatric Hematology, New York University Medical Center

Public Interest Campaign

University of Connecticut Health Center

Comments supporting the level of the proposed standard (17) came from the medical community, Federal agencies, state and local public health agencies, and public interest groups.

COMMENTS RECEIVED ENDORSING PROPOSED LEAD AIR QUALITY
STANDARD OF 1.5 $\mu g/m^3$, CALENDAR MONTH AVERAGE

State and Local Agencies

California Department of Health
Massachusetts Department of Public Health
New York State Department of Environmental Conservation
New York City Department of Environmental Protection
Tennessee Department of Public Health
Texas Air Control Board
Wisconsin Department of Natural Resources

Federal Agencies

Center for Disease Control, Public Health Service
Department of Transportation
Food and Drug Administration
Occupational Safety and Health Administration

Public Interest Groups and the Medical Community

Committee on Environmental Hazards, American Academy of Pediatrics
D.C. Committee for Lead Elimination in the District
League of Women Voters of the U.S.
National Urban League
Herbert Needleman, Boston Children's Hospital Medical Center
University of North Carolina School of Public Health

The comments received by EPA did not challenge three aspects of the proposed standard:

1. the basic structure of the rationale used by the Agency in deriving the level of the proposed standard.

2. the selection of young children as a population particularly at risk to lead exposure.

3. the Agency's estimate of 12 μg Pb/dl as an appropriate target for the mean population blood lead level attributable to non-air sources of lead exposure.

Significant comments were received, however, on the following key areas relating to the standard:

1. the validity of using a subclinical effect, EP elevation, as the critical adverse health effect rather than clinically detectable anemia.

2. the appropriate blood lead threshold for elevated EP.

3. the incidence of health effects in populations residing in the vicinity of industrial sources of lead particulate emissions.

4. the appropriate relationship between micrograms of lead in the air and micrograms of lead in the blood.

5. the statistical form and period of the standard.

6. the appropriate margin of safety.

7. the importance of the respirable fraction of total air lead level.

8. the economic impact of the standard.

9. the State Implementation Plan regulations.

10. the Federal Reference Method for monitoring lead air quality.

11. the administrative procedures employed by EPA in the development of the standard and the provision for public participation.

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A review of the comments received and their disposition has been placed in the rulemaking docket (OAQPS 77-1) for public inspection. The following paragraphs summarize the significant comments and present the Agency's findings.

The Health Significance of Erythrocyte Protoporphyrin Elevation

Ten commentors disagreed with EPA's conclusion that the impairment of heme synthesis indicated by elevated erythrocyte protoporphyrin (EP) constituted an adverse health effect. Reasons for this disagreement included:

1. An elevated level of EP is not itself toxic to the cells in blood or other tissues.

2. EP elevation, while indicating a change in heme synthesis, does not indicate an insufficient production of heme, or hemoglobin.

3. EP elevation and the alteration of heme synthesis does not cause impairment of other mitochondrial functions.

4. EP elevation is not associated with impairment of other heme proteins, particularly cytochrome P-450.

5. Elevated EP may be caused by conditions other than exposure to lead, particularly iron deficiency.

Five other commentors agreed with EPA's conclusions about the health significance of elevated EP citing the following arguments:

1. the interference of lead in a fundamental cellular metabolic function to the extent that there is accumulation of a substrate is physiological impairment even without the presence of clinical evidence of disease.

2. it is prudent medical practice to intervene where subclinical indicators of physiological impairment are present.

3. the impairment of heme synthesis resulting from genetic or dietary factors places a child at enhanced risk to lead exposure.

4. there is evidence to suggest that impaired heme synthesis effects the function of neural or hepatic tissue even at levels where heme production is sufficient for hematopoiesis.

Agency Response

EPA agrees with the comments received that the onset of EP elevation as a result of exposure to lead may not be a diseased state or be seen as a clinically detectable decrement in performance. Also the extent of impairment of the heme synthesis due to lead in an amount sufficient to move an individual child beyond the threshold for EP elevation does not immediately lead to a clinical disease. However, the Criteria Document points out that this impairment does increase progressively with lead dose.

> "The hematological effects described above are the earliest physiological impairments encountered as a function of increasing lead exposures as indexed by blood lead elevations; as such, those effects may be considered to represent critical effects of lead exposure. Although it may be argued that certain of the initial hematological effects (such as ALAD inhibition) constitute relatively mild, nondebilitating symptoms at low blood lead levels, they nevertheless signal the onset of steadily intensifying adverse effects as blood lead elevations increase. Eventually, the hematological effects reach such magnitude that they are of clear-cut medical significance as indicators of undue lead exposure."

The fact that other conditions, such as iron deficiency, may also produce impairment of heme synthesis, does not obviate the concern that lead in these circumstances is interfering with an essential biological function. The possibility of a nutritional imbalance is an additional stress to this system which may increase the sensitivity of a child to lead exposure.

EPA notes that there is general agreement that heme and heme-containing proteins play important roles in the oxygen fixation pathways in all cells. While the effects of low-level lead exposure on the heme synthetic pathway in erythroid tissue have been extensively studied in part because of the ease

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with which this tissue may be obtained, other cellular metabolic systems
utilizing heme are less well understood. EPA does not have sufficient
information to conclude that impairment of heme synthesis in other tissue
is not of concern until blood lead levels greater than those associated with hema-
tological effects are reached. The air quality criteria does point out that this
effect has been established in other tissues and that other dose-response
factors may apply.

> "The effect of lead on the formation of heme is not limited to the
> hematopoietic system. Experimental animal studies have shown a
> lead effect on the heme-requiring protein, cytochrome P-450, an
> integral part of the hepatic mixed-function oxidase (Chapter 11),
> the systemic function of which is detoxification of exogenous sub-
> stances. Heme synthesis inhibition also takes place in neural
> tissue."

In summary, the Criteria Document stated:

> "Elevation in protoporphyrin is considered not only to be a biological
> indicator of impaired mitochondrial function of erythroid tissue but
> also an indicator of accumulation of substrate for the enzyme
> ferrochelatase. It therefore has the same pathophysiological
> meaning as increased urinary δ-ALA (vide supra). For these reasons
> accumulation of protoporphyrin has been taken to indicate physiological
> impairment in humans, and this clinical concensus is expressed in
> the 1975 Statement of the Center for Disease Control (CDC), USPHS.
> The criterion used by.CDC to indicate an effect of lead on heme
> function is an FEP level of 60 µg/dl in the presence of a blood lead
> level above 30 µg/dl whole blood.

> More recent.information relating to threshold of lead effects indicates
> that FEP levels begin to increase at a blood lead value of 15 to 20 µg Pb/dl
> blood in children and women and, at a somewhat higher value, 20 to 25
> µg Pb/dl blood, in adult men."

EPA concludes that the state of elevated EP must be regarded as potentially
adverse to the health of young children. While the onset or a mild experience
of this condition may be tolerated by an individual, as with other subclinical
manisfestations of impaired function, it is prudent to public health practice
to exercise corrective action prior to the appearance of clinical symptoms.
The criteria document reports that symptoms of anemia in children may occur

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at blood lead levels of 40 μg/dl. EPA has adopted 30 μg Pb/dl as the maximum
safe blood lead level for individual children.

The Blood Lead Threshold for Elevated Erythrocyte Protoporphyrin

Comments provided by ten organizations challenged EPA's conclusion
that the threshold for the elevation of EP occurs at a blood lead level
in children of 15 μg/dl. Evidence offered for a higher threshold included:

1. the threshold accepted by EPA is based on a study in which an
   inappropriate statistical technique, probit analysis, was employed.
2. application of a more appropriate technique, segmented line
   analysis, results in a higher threshold.
3. the study in question excluded data on children with blood lead
   levels in excess of 30 μg/dl.
4. other investigators have reported higher thresholds.

Comments in support of the 15 μg/dl threshold maintained:

1. it is proper to exclude values considered abnormal if the intent
   of the analysis is to determine an unbiased effect threshold.
2. other studies have reported thresholds with error bands which
   include 15 μg/dl.
3. probit analysis is an appropriate technique and differs only
   slightly from the results obtained from segmented line analysis.

Agency Response

EPA agrees that the segmented line technique provides a more
accurate estimate of the correlation threshold, about 16.7 μg Pb/dl,
and has for this reason considered changing its judgments as to the
maximum safe blood lead level for a population of children. However, as the
target geometric mean is increased the variability in response of individual

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children within the group will cause a greater percentage of children to exceed the maximum safe individual level of 30 µg Pb/dl. EPA estimates that at a population level of 15 µg Pb/dl 99.5 to 99.9 percent of children will be below 30 µg Pb/dl. At 16.7 µg Pb this percentage falls to 98.7. EPA points out that the number of children predicted to be below 30 µg Pb/dl is the critical health consideration, not the detection threshold for the correlation. For this reason, EPA has maintained its estimate of 15 µg Pb/dl as the target for population blood lead.

The Incidence of Health Effects in Populations Residing in the Vicinity of Industrial Sources of Lead Particulate Emissions

Several comments cited situations in which proximity to significant point sources of airborne lead emissions appear to have little or no health impact on resident populations. This was taken to imply that the air standard was not necessary to protect public health.

Agency Response

EPA acknowledges the variability of the impact of exposure to air lead on the potential for adverse health consequences. It is clear that direct exposure to air lead is only one of the routes through which human exposure occurs. For this reason, the Agency accepts that only a portion of the safe population mean blood lead level is attributable to air lead exposure. The presence or absence of health effects in an exposed population is influenced by a variety of factors including: meteorology, terrain characteristics, geological and anthropological history, personal and domestic hygiene, the occupations of the population members, and the food and non-food materials with which they come into contact. Taking into account such variability, it remains the Agency's belief that airborne

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lead directly and indirectly contributes to the risk of adverse health

consequences and that sufficient clinical and epidemiological evidence

is present to form a judgment as to the extent of this contribution. This

evidence includes epidemiological studies showing higher blood lead levels

in urban areas where air lead levels were elevated in comparison to rural

areas. There have also been a number of studies linking elevated blood leads

to industrial sources of lead emissions. With regard to the 1972 study

at El Paso, Texas, by the Center for Disease Control, the Criteria Document

reports:

> "It was concluded that the primary factor associated with elevated
> blood lead levels in the children was ingestion or inhalation or dust
> containing lead. Data on dietary intake of lead were not obtained
> because the climate and proximity to the smelter prevented any farming
> in the area. It was unlikely that the dietary lead intakes of the
> children from near the smelter and farther away were significantly
> different."

(Human lead absorption - Texas. Center for Disease Control. Morbidity
and Mortality Weekly. Report 22(49): 405-407, December, 1973).

With regard to the report of Yankel et. al at Kellogg, Idaho, the Criteria

Document states:

> "Five factors influenced, in a statistically significant manner, the
> probability of a child developing an excessive blood lead level:
>
> 1. Concentrations of lead in ambient air ($\mu g/m^3$).
>
> 2. Concentration of lead in soil (ppm).
>
> 3. Age (years).
>
> 4. Cleanliness of the home (subjective evaluation coded 0, 1, and 2, with
>   2 signifying dirtiest).
>
> 5. General classification of the parents' occupation (dimensionless).
>
> Although the strongest correlation found was between blood lead level and
> air lead level, the authors concluded that it was unlikely that inhalation
> of contaminated air alone could explain the elevated blood lead levels
> observed. "

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(Yankel, A.J., I. von Lindern, and S. D. Walter. The Silver
Valley lead study.. The relationship between childhood blood
lead levels and environmental exposure. J. Air Pollut. Cont.
Assoc. 27:763-767, 1977.)

The Appropriate Relationship Between Lead in Air and Lead in Blood

Several commenters questioned the Agency's estimate that, for children,
one microgram of lead per cubic meter air results in an increase of two
micrograms lead per deciliter blood.

Agency Response:

EPA acknowledges that the air lead to blood lead relationship in
children has been reported by some investigators as closer to 1:1. However,
as the criteria document states:

"One assumption inherent in the calculation of the regression of
blood lead on air lead using standard least squares is that the air lead
values have been measured with no error. Obviously, the monitored air
lead values are not the exact values inhaled by the subjects in the
exposure area." "In general, the calculation regression coefficients are
underestimates of the true values." The use of personal dosimeters to
measure exposure reduces the measurement error. For this reason, EPA
regards the study of Azar in adult males using dosimeters as one of the
strongest for estimating the air lead/blood lead relationship. The
grouping of data by an air lead level indicates that the relation is
curvilinear, that is, the ratio changes with changing air and blood leads.
In the range of the proposed air standard, Azar's data indicate a ratio
of 1:1.43 to 1:2.57. Because children are known to have a greater net
respiratory intake of lead as well as greater net absorption and retention
of this metal than adults, it is reasonable to assume that the air lead
to blood lead relationship for this sensitive population, exposed to air
lead levels in the range of the proposed standard, is equal to if not greater

than that for adults. EPA also notes that the air lead/blood lead
relationship is non-linear and may have a higher ratio at lower air levels.
Finally, EPA has estimated this factor at the top of the range given in the
Criteria Document for margin of safety considerations. It is the conclusion
of the Agency therefore, that an air lead to blood lead relationship of 1:2
is the appropriate factor for deriving the standard.

The Statistical Form and Period of the Standard

One commenter expressed the view that, due to the log normal distribution
of air leads, a not to be exceeded standard of 1.5 $\mu g/m^3$ calendar month
average would require sources of air lead to achieve control of their
emissions to a geometric monthly mean of 0.41 $\mu g/m^3$ in order to prevent the
occurrence of a violation. Another individual expressed the opinion that, with
the continued operation of a six day sampling regimen, the number of samples
which could be collected in the course of a calendar month would not provide
a statistically valid estimate of the actual lead air quality for the period.

Comments by several individuals questioned the health basis for the
selection of the calendar month averaging period.

EPA Response

EPA accepts the consensus of comments received on the scientific and
technical difficulties presented by the selection of a calendar month averaging
period. The Agency believes that the key criterion for the averaging period is
the protection of health of the sensitive population. In proposing the 1.5 $\mu g/m^3$
standard, EPA concluded that this air level was safe for indefinite exposure
of young children. Critical to the determination of the averaging period is the
health significance of possible elevations of air lead above 1.5 $\mu g/m^3$ which
could be encountered without violation of the standard. In the proposed
standard, EPA chose a monthly averaging period on the basis of a study showing
an adjustment period of blood lead level with a change of exposure. Because of

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the scientific and technical difficulties of the monthly standard, EPA
has reexamined this question and concludes that there is little reason to
expect that the slightly greater possibility of elevated air lead levels
sustainable by the quarterly standard is significant for health. This
conclusion is based on the following factors:

(1) from actual ambient measurements, there is evidence that the
     distribution of air lead levels is such that there is little
     possibility that there could be sustained periods greatly
     above the average value.

(2) while it is difficult to relate the extent to which a monitoring
     network actually represents the exposure situation for young
     children, it seems likely that where elevated air lead levels
     do occur, they will be close to point or mobile sources. Typically
     young children will not encounter such levels for the full twenty-
     four hour period reported by the monitor.

(3) there is medical evidence indicating that blood lead levels reequili-
     brate slowly to changes in air exposure which serves to dampen
     the impact of a short-term period of exposure to elevated air lead.

(4) since direct exposure to air is only one of several routes of
     total exposure, a change in air lead would not impact proportionately
     on blood lead levels.

On balance, the Agency concludes that a requirement for the averaging of
air quality data over calendar quarter will improve the validity of air quality
data gathered without a significant reduction of the protectiveness of the
standard.

The Appropriate Margin of Safety

Several comments received by the Agency criticized the proposed standard
as incorporating an excessively large margin of safety. Conversely, some

EPA Response

One approach to the satisfaction of the Clean Air Act requirement for an "adequate margin of safety" in ambient air quality standards has been the establishment of a threshold for adverse effects in the sensitive population with the selection of the final standard at some point below this level. The extent of the margin applied is largely dependent on the severity of the health effects and uncertainties associated with the scientific data base.

In the case of lead air pollution, the estimate of margin of safety is complicated by the multiple sources and media of lead exposure. EPA has elected to use margin of safety considerations in determinations of each of the intermediate factors rather than in a single final adjustment to the calculated air level. It is EPA's conclusion that the incorporation of conservative estimates of intermediate factors, where uncertainty exists, is a reasonable approach to margin of safety determination, and that the Agency's judgments have not been shown to be excessively or deficiently protective of human health.

The Importance of the Respirable Fraction of Total Air Lead Level

The Agency received a number of comments expressing concern that because the respirable fraction of airborne particulate lead is more readily absorbed into the blood stream, an air standard based on total air lead is unnecessarily protective of health.

Agency Response

EPA acknowledges the important role of respirable lead as a contributor to total lead body burden. It is not reasonable to conclude, however, that the presence of particles beyond this range do not represent an exposure condition. In addition to the indirect route of ingestion and

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absorption from the gastrointestinal tract, non-respirable lead in the
environment may, at some point, become respirable through weathering
or mechanical action. EPA concludes, therefore, that total airborne
lead, both respirable and non-respirable fractions, is appropriate as a
measure of total air exposure.

The Economic Impact of the Proposed Standard

In general, the comments received by the Agency were supportive of
the draft Economic Impact Assessment. Commentors critical of the
assessment argued that the forecast underestimated the severity of the
economic impact to certain lead industries.

Agency Response

The comments critical of the draft impact statement did not include
data which would allow EPA to confirm the possibility of more severe
economic impacts. Since the analytical methods employed were not brought
into question, it is the Agency's view that the impact statement, with
modifications necessitated by the change in averaging period, is a reasonable
forecast of the economic consequences of implementation of the standard.

The Proposed State Implementation Plan (SIP) Regulations

A summary of comments and the Agency response is included in the
preamble to the final regulations published elsewhere in this Federal Register.

The Federal Reference Method for Monitoring Lead Air Quality

A summary of comments and the Agency's resolution is included in the
preamble to the final method published elsewhere in this Federal Register Notice.

The Administrative Procedures Employed by EPA in the Development of the Proposed Standard and the Provision for Public Participation

Two commenters requested that cross examination of witnesses be
allowed in the post-proposal public hearing on the proposed standard and

implementation regulations. EPA also received a request to postpone the public hearing and to extend the comment period, citing the need to complete ongoing studies.

Agency Response

Both the request for cross examination and for extension of the comment period were denied by the Agency. In the former case, it is the Agency's view that cross examination would be counter to the informal rulemaking procedures followed by the Agency. Due to the extensive review opportunities available at all stages of regulatory development, an extension of the comment period was not felt to be sufficiently necessary to further delay the schedule for the preparation of the final rule.

Clarification of Elements of the Standard

From reviewing the comments received, EPA wishes to clarify the following points in the presentation of the proposed standard:

(1) EPA is making a distinction between the blood lead level that is seen as the threshold for detection of the biological effect, EP elevation, and the blood lead level seen as the point where that effect can be regarded as adverse to health.

(2) EPA is making a distinction between estimating a maximum safe blood lead level for an individual, and establishing a target as the geometric mean for the blood lead level for the sensitive population.

(3) EPA is making a distinction between estimating what the contribution to blood lead levels from non-air sources actually is and estimating the appropriate goal for blood lead attributed to non-air sources.

Derivation of the Numerical Level of the Final Standard

EPA's objective in setting the level of the standard is to estimate the concentration of lead in the air to which all groups within the general population can be exposed for protracted periods without an unacceptable risk to health.

This estimate is based on EPA's judgment in four key areas:

(1) determining the "sensitive population" as that group within the general population which has the lowest threshold for adverse effects or greatest potential for excessive exposure. EPA concludes that young children, aged 1-5, are the sensitive population.

(2) determining the safe level of total lead exposure for the sensitive population, measured as concentration of lead in the blood. EPA concludes that the maximum safe level of blood lead for an individual child is 30 µg Pb/dl and that population blood lead, measured as the geometric mean, must be 15 µg Pb/dl in order to place 99.5 - 99.9 percent of children in the United States below 30 µg Pb/dl.

(3) determining the contribution to blood lead from non-air pollution sources. EPA concludes that 12 µg Pb/dl of population blood lead for children should be attributed to non-air exposure.

(4) determining the air lead level which is consistent with maintaining population blood lead below 15 µg Pb/dl. Taking into account exposure from other sources, 12 µg Pb/dl, EPA has designed the standard to limit air contribution to 3 µg Pb/dl. On the basis of an estimated relationship of air lead to blood

lead of 1:2, EPA concludes that the ambient air standard should be 1.5 µg Pb/m^3.

Each of these four areas is discussed further in the following sections.

SENSITIVE POPULATION

As in the discussion supporting the proposed lead standard, EPA believes that the health of young children is at increased risk due to lead exposure. This is because children have a greater physiological sensitivity to the effects of lead than do adults, and are at higher risk of greater exposure to environmental lead. Other sensitive populations identified by EPA include those occupationally exposed, and pregnant women and the fetus. Comments received on the proposed standard did not challenge EPA's arguments for the selection of young children as the most sensitive population for determining the standard. A number of comments did point out that within the general population of children there were subgroups with enhanced risk due to genetic factors, dietary deficiencies, or residence in urban areas. EPA acknowledges the higher risk status of such groups but does not have information either in the air quality criteria or in the comments received for estimating a threshold for adverse effects separate from that of all children. Concern about these high risk subgroups has, however, influenced EPA's determination of an adequate margin of safety.

EPA continues to be concerned about the possible health risk of lead exposure for pregnant women and fetuses. This concern is based on the suggestion that the stress of pregnancy may place pregnant women in a state more susceptible to the effects of lead, and that transplacental transfer of lead may effect the prenatal development of the child. There is, however, insufficient scientific information for EPA to either confirm or dismiss this suggestion, and to establish that pregnant women and fetuses are more at risk than young children.

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THE MAXIMUM SAFE EXPOSURE FOR CHILDREN

In determining the maximum safe exposure to lead for children, EPA

has taken the measurement of blood lead as the indicator of total lead

dose. There are other possible indicators of exposure, for example

the level of zinc protoporphyrin (ZPP), but the great preponderance of

health studies reported in the criteria have utilized blood lead levels

as indications of mobile body burden. The criteria document reports the

following table of effect thresholds for children at increasing blood

lead levels.

Summary of Lowest Observed Effect Levels in Young Children

δ-ALAD inhibition	10 µg Pb/dl
Erythrocyte protoporphyrin elevation	15-20 µg Pb/dl
Increased urinary δ-ALA excretion	40 µg Pb/dl
Anemia	40 µg Pb/dl
Coproporphyrin elevation	40 µg Pb/dl
Cognitive (CNS) deficits	50-60 µg Pb/dl
Peripheral neuropathies	50-60 ug Pb/dl
Encephalopathic symptoms	80-100 µg Pb/dl

The first physiological effect associated with increasing blood lead levels

is the inhibition of the enzyme δ- Amino - levulinic - acid - dehydratase

(δ-ALAD), both in red blood cells, erythrocytes, and in cells in other

tissues. This enzyme catalyzes the condensation of two molecules of

δ-aminolevulinic acid (δ-ALA) to form porphobilinogen, one of the components

involved in the cellular synthesis of heme. The criteria document reports

that the threshold for δ-ALAD inhibition in children is 10 µg Pb/dl.

At blood lead levels above 10 µg Pb/dl, the function of δ-ALAD is

increasingly inhibited by lead. The criteria document states that

40 µg Pb/dl is the threshold for elevation of δ-ALA-U in the urine, an indication that δ-ALA has begun to accumulate in cells.

EPA does not regard the inhibition of δ-ALAD above 10 µg Pb/dl as adverse to health because of the absence of the evidence that there is an impairment of heme synthesis until a threshold of 40 µg Pb/dl is reached. The accumulation of δ-ALA above normal levels, indicated by δ-ALA-U in urine, is regarded as adverse to health, both because of impaired heme synthesis, and the possibility that δ-ALA accumulation is toxic to cells.

The criteria document reports that above a threshold of 15-20 µg Pb/dl there is an elevation of protoporphyrin in erythrocytes.

Protoporphyrin is an organic chemical compound used by all cells in the production of heme. In the final stage of heme synthesis protoporphyrin and iron are brought together in the cell mitochondria. In the presence of lead, this step is blocked, possibly by inhibition of the enzyme ferrochelatase or by interference in the transport of iron across the mitochondrial membrane. As the impairment of heme synthesis increases, a declining amount of heme is available for formation of critical heme proteins, such as hemoglobin.

Without incorporation into heme, the levels of protoporphyrin in the cell become elevated. In red blood cells, protoporphyrin takes the place of heme in hemoglobin, and persists for the life of the cell as a defective hemoglobin molecule which cannot carry oxygen.

From its review of the information provided by air quality criteria as well as the evidence and arguments offered by medical professionals commenting on the proposed standard, EPA concludes that the effects of lead on the cellular synthesis of heme, as indicated by elevated erythrocyte

protoporphyrin, are potentially adverse to the health of young children. EPA does not believe that there is significant risk to health at the point where the elevation of EP can first be correlated with an increase in blood lead. For this reason, this correlation threshold was adopted as a maximum safe population blood lead level in deriving the level of the proposed standard. On the other hand, EPA regards as clearly adverse to health the impairment of heme synthesis, and other lead effects which result in clinically detectable anemia above 40 μg Pb/dl. For this reason, EPA has concluded that the maximum safe blood lead level for an individual child is in the range between 15 and 40 μg Pb/dl.

EPA believes that information provided in the air quality criteria is consistent with the recommendation of the Center for Disease Control of the Public Health Service, as endorsed by the American Academy of Pediatrics that a blood lead level of 30 μg Pb/dl should be considered undue lead exposure for an individual child.

The criteria document points out that data from epidemiological studies show that the log values of measured individual blood lead values in a uniformly-exposed population are normally distributed with a standard geometric deviation of 1.3 to 1.5. Using standard statistical techniques, it is possible to calculate the mean population blood lead level which would place a given percentage of the population below the level of an effects threshold. With a standard geometric deviation of 1.3, a mean population blood lead level of 15 μg Pb/dl would place 99.5 to 99.9 percent of a population of children below the Center for Disease Control guidelines of 30 μg Pb/dl, depending on the effect of measurement error.

In EPA's view, use of the 99.5 - 99.9 percent range is not excessive. From 1970 statistics, there are approximately 20 million children in the United States below the age of 5 years, 12 million in urban areas, and 5 million in the center city where lead exposure may be high. Again, knowledge that there are special high risk groups of children within the general population deters EPA from considering lower percentages.

CONTRIBUTION TO TOTAL LEAD EXPOSURE FROM NON-AIR SOURCES

In the proposed standard, EPA argued that the air standard should
take into account the contribution to blood lead levels from lead sources
unrelated to air pollution. No comments were received challenging this
argument. EPA continues to base its calculation of the ambient air
standard on the assumptions that, to an extent, the lead contribution
to blood lead from non-air sources should be subtracted from the
estimate of safe mean population blood lead. Without this subtraction
the combined exposure to lead from air and non-air sources would result
in a blood lead concentration exceeding the safe level.

In its proposal, EPA also argued that it was appropriate to use
a reasonable target for non-air contribution to blood lead rather than
a more typical exposure level which alone may exceed the total safe
blood lead level. EPA contends that this approach recognizes the need
for multimedia regulation of environmental lead and the need to avoid
placing extreme requirements on sources of air lead emissions where non-
air sources have made a significant contribution to population blood lead
levels.

Finally, in the preamble to the proposed standard, EPA presented data
which it used to estimate 12 µg Pb/dl as the appropriate target for non-air
contribution to blood lead. In the absence of criticial comment, this
information is presented in the form it appeared in the proposal preamble.

The level of the standard is very strongly influenced by judgments made regarding the size of non-air contribution to total exposure. EPA has encountered difficulties in attempting to estimate exposure from various lead sources in order to determine the contribution of such sources to blood lead levels:

(1) Studies reviewed in the Criteria Document do not provide detailed or widespread information about relative contribution of various sources to young children. Estimates can only be made by inference from other empirical or theoretical studies, usually involving adults.

(2) It can be expected that the contribution to blood lead levels from non-air sources can vary widely, is probably not in constant proportion to air lead contribution, and in some cases may alone exceed the target mean population blood lead level.

In spite of these difficulties, EPA has attempted to assess available information in order to estimate the general contribution to population blood lead levels from air and non-air sources. This has been done with evaluation of evidence from general epidemiological studies, studies showing decline of blood lead levels with decrease in air lead, studies of blood lead levels in areas with low air lead levels, and isotopic tracing studies.

Studies reviewed by the Criteria Document show that mean blood lead levels for children are frequently above 15 µg Pb/dl. In studies reported, the range of mean population blood lead levels for children was from 16.5 µg Pb/dl to 46.4 µg Pb/dl with most studies showing mean levels greater than 25 µg Pb/dl (Fine, 1972; Landrigan, 1975; von Lindern, 1975). EPA believes that for most of these populations, the contribution to blood lead levels from non-air sources exceeds the desired target mean blood lead level.

In a number of studies, it is apparent that reduction in air lead levels results in a decline in children's blood lead levels. A study of blood lead levels in children in New York City showed that children's mean blood lead levels from from 30.5 µg Pb/dl to 21.0 µg Pb/dl from 1970 to 1976, while during the same period air lead levels at a single monitoring site fell from 2.0 µg Pb/dl to 0.9 µg/Pb (Billick, 1977). Studies at Omaha, Nebraska (Angle, 1977) and Kellogg, Idaho (Yankel, von Lindern, 1977) also show a drop in mean blood lead levels with declines in air lead levels. However, as air lead levels decline there appears to be a rough limit to the drop in blood lead levels. EPA has also examined epidemiological studies in the Criteria Document where air lead exposure is low, and can be assumed to be a minor contributor to blood lead. These studies provide an indication of blood lead levels resulting from a situation where non-air sources of lead are predominant.

Studies Reporting Blood Lead Levels in Children Exposed to Moderate to Low Air Lead Levels

Investigator	Blood lead (in micrograms of lead per deci- liter)	Air lead (in micrograms of lead per cubic meter)	Comment
Hammer, 1972	11.6	0.1	Children in Helena, Mont.
Angle, 1974	14.4	0.14	Suburban children ages 1 to 4 in Omaha
Goldsmith, 1974	13.7	0.2-0.7	Children in Benecia, Calif.
	13.8	0.3-0.6	Children in Crocket, Calif.
Johnson, Tillery, 1975	10.2	0.6	Female children - mean age 9 in Lancaster, Calif.

The range of mean blood lead levels in those studies is from 10.2 µg Pb/dl to 14.4 µg Pb/dl, with an average at 12.7 µg Pb/dl.

In addition to epidemiological investigations, EPA has reviewed studies that examine the source of blood lead by detecting characteristic lead isotopes. A study using isotopic tracing (Manton, 1977) suggests that for several adults in Houston, Texas, 7 to 41 percent of blood lead could be attributed to air lead sources. An earlier isotopic study (Rabinowitz, 1974) concluded that for two adult male subjects studied, approximately one-third of total daily intake of lead could be attributed to exposure to air lead levels of 1-2 µg Pb/m^3. While these results cannot be directly related to children, it is reasonable to assume that children may exhibit the same or higher percentages of air lead contribution to blood lead level because of a greater potential for exposure to indirect air sources, soil and dust.

From reviewing these areas of evidence, EPA concludes that:

1. In studies showing mean blood lead levels above 15 µg Pb/dl, it is probable that both air and non-air sources of lead contribute significantly to blood lead with the possibility that contributions from non-air sources exceed 15 µg Pb/dl.

2. Studies showing a sustained drop in air lead levels show a corresponding drop in blood lead levels, down to an apparent limit in the range of 10.2 to 14.4 µg Pb/dl. These studies show the rough range of the lowest blood lead levels that can be attributed to non-air sources.

3. Isotopic tracing studies show air contribution to blood lead to be 7-41 percent in one study and about 33 percent in another study.

In considering this evidence, EPA notes that if, from the isotopic studies, approximately two-thirds of blood lead is typically derived

from non-air sources, a mean blood lead target of 15 μg Pb/dl would

attribute 10 μg Pb/dl to non-air sources. On the other hand, the

average blood lead level from studies EPA believes to represent the least

amount of blood lead attributable to non-air sources is 12.7 μg Pb/dl. In the

absence of more precise information, EPA is proposing that the lead

standard be based on the assumption that in general, 12 μg Pb/dl of the

blood lead level in children is derived from lead sources unaffected by the

lead air quality standard. EPA is aware that actual population blood

lead levels, either individually or as a population mean, may exceed this

benchmark. However, if EPA were to use a larger estimate of non-air

contribution to blood lead, the result would be an exceptionally stringent

standard, which would not address the principal source of lead exposure.

Conversely, EPA believes that it should not adopt an estimate of non-air

contribution below the level shown in available studies to be the lowest

mean blood lead level documented in the Criteria Document.

THE RELATIONSHIP BETWEEN AIR LEAD EXPOSURE AND RESULTING BLOOD LEAD LEVEL

On the basis of clinical and epidemiological studies evaluated, the

Criteria Document concludes:

> "The increase in blood lead level resulting from an increase in
> air lead concentration is not constant in magnitude over the
> range of air lead levels commonly found in the environment. The
> relationship is dependent on many factors, including rate of
> current exposure and the history of past exposure. The observed
> ratios vary from air lead level to air lead level; they are generally
> between 1 and 2. Evidence suggests that the ratios for children
> may be higher than those of adults; also it suggests that ratios
> for males may be higher than those for females."

The range of ratios for children's blood lead response to a one μg increase in air lead cited in the Criteria Document is from 1.2 to 2.3. The lower ratio comes from studies at Kellogg, Idaho, where dust levels of lead were separately correlated with blood lead. In view of the tendency of children to experience higher ratios both due to greater intake and absorption of air lead, EPA has selected a ratio of 1:2 in calculating the impact of air lead levels on blood lead levels in children.

EPA recognizes the difficulty in selecting a single air lead/blood lead relationship which describes the contribution of air lead to blood lead levels in children. This is in part because there is evidence in the literature that the relationship between lead in air and lead in blood is not a simple linear regression which can be expressed as a ratio, but that it is actually curvilinear in nature. However, for use as a basis for calculating an air standard, EPA has chosen the constant relationship of 1:2 for children, which appears appropriate over the range of observed air lead levels.

Although available data which associate air lead levels with blood lead levels in children are limited, there are a number of studies which develop air lead/blood lead relationships for adults. Among these, the Azar study and the Rabinowitz study provide evidence that the air lead/ blood lead relationship for adults may exceed 1:2. EPA has not data to indicate that the air lead/blood lead relationship for children would be lower than those observed for adults. To the contrary, in view of the fact that children are more susceptible to the adverse effects of lead exposure and that ingestion of air-derived lead from dust and dirt is a significant source of exposure for children, the relationship of 1:2

for children is reasonable. Margin of safety considerations have also entered into the judgment that the relationship of 1:2 is appropriate for the most sensitive population.

CALCULATION OF THE AIR STANDARD

EPA has calculated the standard based on the conclusions reached in the previous sections:

1. Sensitive population: children, ages 1-5.

2. Health basis: impaired heme synthesis as indicated by elevated erythrocyte protoporphyrin (EP) in a significant proportion of the sensitive population at a level of lead in the blood of 30 µg/dl.

3. Maximum safe blood lead mean for the sensitive population, based on the maintenance of 99.5 - 99.9 percent of the sensitive population below the 30 µg/dl level of concern: 15 µg/dl.

4. Assumed goal for contribution to blood lead level from non-air sources: 12 µg/dl.

5. Allowable contribution to blood lead from air sources: 15 µg Pb/dl - 12 µg Pb/dl = 3 µg Pb/dl.

6. Air lead target consistent with blood lead contribution from air sources:

$$3 \text{ µg Pb/dl} \times \frac{1 \text{ µg/m}^3 \text{ air}}{2 \text{ µg/dl blood}} = 1.5 \text{ µg Pb/m}^3$$

SELECTION OF THE AVERAGING PERIOD FOR THE STANDARD

Based on comments received and consideration by the Agency, the proposed averaging period of a calendar month is extended to a calendar quarter. EPA believes that the change will significantly improve the validity of the lead air quality data which will be gathered to monitor progress towards attainment without placing an undue burden on state and local environmental agencies or significantly reducing the protectiveness of the final standard.

The Agency believes that the key criterion for the averaging period is the protection of the health of the sensitive population. In proposing the 1.5 $\mu g/m^3$ standard, EPA concluded that this air level was safe for the indefinite esposure of young children. Critical to the determination of the averaging period is the health significance of possible elevations of air lead above 1.5 $\mu g/m^3$ which could be encountered without violation of the standard. In the proposed standard, EPA chose a monthly averaging period on the basis of a study showing an adjustment period of blood lead level with a change in exposure. Because of the scientific and technical difficulties of the monthly standard, EPA has reexamined this question and concluded that there is little reason to expect that the slightly greater possibility of elevated air lead levels sustainable by the quarterly standard is significant for health. This conclusion is based on the following factors:

(1) from actual ambient measurements, there is evidence that the distribution of air lead levels is such that there is little possibility that there could be sustained periods greatly above the average value.

(2) while it is difficult to relate the extent to which a monitoring network actually represents the exposure situation for young children, it seems likely that where elevated air lead levels do occur, they will be close to point or mobile sources. Typically, young children will not encounter such levels for the full twenty-four hour period reported by the monitor.

(3) there is medical evidence indicating that blood lead levels reequilibrate slowly to changes in air exposure which serves to dampen the impact of a short-term period of exposure to elevated air lead.

(4) since direct exposure to air is only one of several routes of total exposure, a change in air lead would not impact proportionally on blood lead levels.

On balance, the Agency concludes that a requirement for the averaging of air quality data over a calendar quarter will improve the validity of air quality data gathered without a significant reduction in the protectiveness of the standard.

MARGIN OF SAFETY

The Clean Air Act instructs EPA to set the level of an ambient air quality standard at a level which protects the public health with a margin of safety. This is normally achieved by estimating the air concentration of a pollutant that is the threshold for the first adverse effect detected with increasing air levels, and then setting the air standard at a somewhat lower level. The extent of the margin between the standard and the estimated threshold for adverse effects is influenced by such factors as the severity or irreversibility of effects, the degree of uncertainty about known or suspected health effects, the size of the population at risk, and possible interactions of several pollutants in potentiating health effects.

While the margin of safety is based on available scientific information, this factor is judgmental in that the Administrator must weigh the acceptability of known risk and uncertainty along with scientific data.

In actual practice, selecting a standard is rarely straight forward. In the case of lead air pollution, the estimate of margin of safety is complicated by the multiple sources and media of lead exposure EPA has elected to consider a margin of safety in determining each of the intermediate factors rather than in a single final adjustment to the calculated air level.

Some commenters on the proposed standard argued that the process is in fact a multiple addition of safety factors which results in an unreasonably large margin, the magnitude of which is not presented as a single factor.

Other commenters have argued that in determining the intermediate factors EPA has done nothing more than make reasonable judgments which do not constitute a margin of safety at all.

EPA believes that determining the appropriate margin of safety for air lead should include consideration of the above points as well as the following considerations:

1) in addition to the pivotal health effect discussed in
    determining the health effects threshold - impaired heme synthesis
    indicated by EP elevation - the air quality criteria document
    reports multiple biological involvements of lead in practically
    all cell types, tissues, and organ systems.

2) the criteria document reports that there are well documented and increasingly serious toxic effects of lead at levels close to the CDC estimate for undue exposure - 30 µg Pb/dl. These include anemia at a threshold of 40 µg Pb/dl and CNS deficiencies at 50 µg Pb/dl.

3) there are no beneficial effects of lead at environmental levels.

4) EPA has incomplete data about the extent to which children are indirectly exposed to lead from air lead which moves to other other environmental media, such as water, soil & dirt, and food.

5) lead is persistent and accumulates both in human tissue and in the environment.

6) there is a possibility that lead exposure resulting in blood lead levels previously considered safe may in fact influence the neurological development and learning abilities of the young child. EPA does not have evidence, however, that provides more than a suggestion that this could occur at blood lead levels below 30 Pb/dl for individual children.

From all of these factors, EPA concludes that while the air standard which it has calculated has used some conservative estimates of intermediate factors, the net effect of these is not excessive in terms of margin of safety.

IMPACT OF LEAD DUSTFALL ON BLOOD LEAD

In the preamble for the proposed air standard for lead, EPA pointed out that the significance of dust and soil lead as indirect routes of

exposure has been of particular concern in the case of young children.
Play habits and mouthing behavior between the ages of one and five have
led to the conclusion that greater potential may exist in these children
for ingestion and inhalation of the lead available in dust and soil.
EPA is also concerned that the deposition of lead particles can lead to
general contamination of the environment and increased lead exposure from
surface waters and foodstuffs.

Studies reviewed in the Criteria Document indicate a correlation between
soil and dust levels and childrens' blood lead levels in highly con-
taminated environments (Yankel and von Lindern, 1977; Barltrop, 1974;
Galke, in press). The lead threshold for concern has been reported as
1,000 ppm in soil (Yankel and von Lindern, 1977); at exposures of 500
and 1,000 ppm soil the document concludes that blood levels begin to in-
crease. A two-fold increase in soil concentration in this range is
predicted to result in a 3-6 percent rise in blood lead levels. Below
500 ppm soil, no correlation has been observed with blood lead levels.

The normal background for lead in soil is cited in the Criteria
Document as 15 ppm. Due to human activities, the average levels in most
areas of the U.S. are considerably higher. Soil studies conducted by
EPA's Office of Pesticides Programs from 1974-1976 in 17 urban areas
reported only 3 cities with arithmetic mean concentrations in excess of
200 ppm, with the highest value 537 ppm. Concentrations in the soils
surrounding large point sources of lead emissions, or heavily-travelled
roads may reach several thousand ppm.

Because of the many factors involved, EPA is unable to predict the relationship between air lead levels, dustfall rates, and resulting soil accumulation. Complicating factors include: particle size distribution, rain-out, other meteorological factors, topographical features affecting deposition, and removal mechanisms.

EPA believes, however, that significant impacts on blood lead of soil and dust lead are mainly limited to areas of high soil concentration (in excess of 1,000 ppm) around large point sources and in major urban areas which also experience high air lead levels. Evidence suggests that soil lead levels in areas with air lead levels in the range of the proposed standard are well below the threshold for lead impact (Johnson, Tillery, 1975; Johanson, 1972; EPA, 1975 Air Quality Data and Soil Levels).

Some comments received on the proposed standard argued that the lead air standard should be limited to respirable size of lead particulate, as larger particles would fall to the ground without being deposited or absorbed by the lung. EPA has decided not to accept this recommendation because as discussed above, larger particles can contribute to lead dose by human ingestion of airborne particles or by contamination of other environmental media.

WELFARE EFFECTS

Comments received on the proposed lead air quality standard did not address the issue of welfare effects and the need for a secondary air quality standard more restrictive than the primary standard. EPA maintains its position that the primary air quality standard will adequately protect against known and anticipated adverse effects on public welfare. A more restrictive secondary standard does not appear justified by evidence at this time.

Available evidence cited in the Criteria Document indicates that animals do not appear to be more susceptible to adverse effects from lead than man, nor do adverse effects in animals occur at lower levels of exposure than comparable effects in humans.

There is evidence that lead has both harmful and beneficial effects on plants. Lead is absorbed but not accumulated to any great extent by plants from soil. Lead is either unavailable to plants or is fixed in the roots and only small amounts are transported to the above ground portions. Lead may be deposited on the leaves of plants and present a hazard to grazing animals. Although some plants may be susceptible to lead in the natural environment, it is generally in a form that is largely non-available to them.

There is no evidence to indicate that ambient levels of lead result in significant damage to man-made materials. Effects of lead on visibility and climate are minimal.

Based on such data, EPA promulgates the secondary air quality standard for lead at 1.5 μg Pb/m^3, calendar quarter average.

Economic Impact Assessment

As required by Executive Orders 11821, 12044, March 24, 1978, EPA has conducted a general analysis of the economic impact which might result from the implementation of the lead regulations. This analysis was not intended for nor was it used in the development or promulgation of the standard and was issued for informational purposes only. Ten organizations submitted written comments or presented testimony regarding the Economic Impact Assessment at the February public hearing for the implementation of the lead air quality standard.

The comments were basically supportive of the Economic Impact Assessment in terms of industries which would be impacted. However, the comments forecast more severe impacts within some of these industries than did the

Economic Impact Assessment. Because the comments do not include data which would allow EPA to confirm the assertions of more severe impact, the Economic Impact Assessment has not been revised.

The Economic Impact Analysis points out that the categories of sources likely to be affected by control of lead emissions are primary lead and copper smelters, secondary lead smelters, gray iron foundries, gasoline lead additive manufacturers, and lead storage battery manufacturers. This analysis further indicates that primary and secondary lead smelters and copper smelters may be severely strained economically in achieving emission reductions that may be required in implementing the proposed air quality standard.

There are, however, uncertainties associated with evaluating the impact of attaining the standard. For smelters and foundries, attaining the standard may require control of fugitive lead emissions, i.e., those emissions escaping from individual process operations, other than emissions from smoke stacks. Fugitive emissions are difficult to estimate, measure, and control; and it is also difficult to predict their impact on air quality near the facility. From the information available to EPA, non-ferrous smelters may have great difficulty in achieving lead air quality levels consistent with the proposed standard in areas immediately adjacent to the smelter complex.

The change in averaging time from a monthly average to a calendar quarter average will affect the economic impacts associated with the lead standard because for the given level of the standard, a longer averaging time is theoretically less stringent than a shorter averaging time.

Other Lead Regulatory and Control Programs

EPA's ambient air quality standard is only one of a number of Federal, state, and local programs designed to limit exposure to lead. Within EPA, there exist standards and regulations relating to lead in drinking water, industrial effluent, ambient waters, pesticides,and hazardous waste. Lead in food is controlled by FDA, and CPSC and HUD have programs addressing lead in paint on environmental surfaces. CDC has a program of blood lead screening for children. There are a large number of control programs operated by state, local, and private organizations. Also, Federal and academic institutions sponsor a diverse program of research relating to environmental lead and its effects. EPA expects that the ambient air standard can, by control of one of the principal sources of environmental lead, contribute to goals and objectives common to all of these programs.

In developing the lead air standard, EPA has estimated both individual and population blood lead levels which it regards as safe targets. The Agency believes that these targets should not necessarily serve as precedents for other regulatory programs. There are two reasons for this view:

1) these targets were selected on the basis of what the Clean Air Act requires. Other programs have other legislative requirements which would lead to adoption of different but equally legitimate goals.

2) the scientific data provided by the air quality criteria allowed comparison of air levels with blood lead levels, but analagous information is not available for other media. At this time, there does not appear to be the same extent of information about the impact on blood lead of lead in food, water, and non-food ingested items. Because of this EPA, FDA and CPSC standards have been based on estimates of acceptable daily dose rather than on blood lead targets.

Comments by other Federal Agencies

Comments on the proposed lead air quality standard were received from eight Federal agencies. Five of the agencies endorsed the air standard while three of the agencies commented on specific issues and neither endorsed nor opposed the standard. The Center for Disease Control and the U.S. Public Health Service voiced support for the proposed standard of 1.5 μg Pb/m^3 and urged basing the decision on the standard solely on considerations of the public health. CDC is fully satisfied that EP elevation does indeed represent a subclinical manifestation of lead toxicity and that young children are the population most at risk from lead exposure, while some subgroups of children are at special risk to lead because of conditions such as malnutrition, genetic factors, or iron deficiency.

The Consumer Product Safety Commission endorsed the approach and some of the judgments made in arriving at the air standard. CPSC concurs with the position that children are the population at enhanced risk to lead exposure, and that the goal of a mean population blood lead level for children of 15 μg Pb/dl is sufficiently low to be protective of the population at enhanced risk of exposure. CPSC views the selection of EP elevation as the adverse health effect of concern as open to challenge and suggests basing the standard on a more generally recognized severe health effect. CPSC concurs that the contribution of non-air

sources to lead body burden must be evaluated in setting the air standard and suggests that a larger non-air contribution, such as 13.5 µg Pb/dl used in the California standard, might be considered.

The Food and Drug Administration commended EPA's proposal of an ambient air quality standard for lead. FDA agrees that children aged 1-5 years old comprise the most critically sensitive population. FDA concurs that 15 µg Pb/dl is a reasonable maximum blood lead level to use as an average national goal for children aged 1 to 5, although FDA suggests that for young children the margin of safety is disturbingly narrow. The division of the 15 µg Pb/dl into 12 µg Pb/dl for non-air sources and 3 µg Pb/dl for air sources was not unreasonable in FDA's view.

The Occupational Safety and Health Administration endorsed EPA's proposed standard for lead and agrees with EPA that 15 µg Pb/dl as an average national blood lead level goal for young children is reasonable. OSHA views their proposed standard of 100 µg Pb/m^3, 8-hour time weighted average, and their establishment of 40 µg Pb/dl as the threshold effect level for workers as consistent with the EPA proposed standard.

The Department of Transportation (DOT) endorsed the proposed standard of 1.5 µg Pb/m^3. Based on an analysis of the impact of the proposed standard on the highway program, DOT concluded that it is highly probable that transportation-related violations of the proposed standard would be limited to large urban areas.

In commenting on the proposed standard, the Department of the Interior (DOI) expressed concern that the burden for meeting the proposed standard will fall primarily on lead and copper smelters and battery manufacturers, and commented on the impact of lead dustfall on ground water quality. The Tennessee Valley Authority provided specific comments on the proposed State Implementation Plan Regulations and the proposed Federal Reference

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Method. The Department of Commerce offered comments on the potential impacts of the standard , pointing out that more consideration should be given to the potential impact of the standard on the petroleum industry.

The Occupational Safety and Health Administration proposed regulations in 1975 to limit occupational exposure to lead to 100 µg Pb/m^3, 8-hour time weighted average. The exposure limit was based on protecting against effects, clinical or subclinical, and the mild symptoms which may occur below 80 µg Pb/dl, providing an adequate margin of safety. The level of 100 µg Pb/m^3 anticipated to limit blood lead levels in workers to a mean 40 µg Pb/dl and a maximum of 60 µg Pb/dl. OSHA is presently reviewing the latest information on lead exposure and health effects in preparation for promulgation of the workplace standard for lead.

The Department of Housing and Urban Development (HUD) has requirements for reducing human exposure to lead through the prevention of lead poisoning from ingestion of paint from buildings, especially residential dwellings. Their activities include (1) prohibition of use of lead-based paints on structures constructed or rehabilitated through Federal funding and on all HUD-associated housing; (2) the eliminations of immediate lead based paint hazard; (3) notification of purchases of HUD-associated housing constructed prior to 1950 that such dwellings may contina lead-based paint; and (4) research activities to develop improved methods of detection and elimination of lead-based paint hazards, and the nature and extent of lead poisoning.

The Consumer Product Safety Commission (CPSC) promulgated regulations in September 1977 which ban:(1) paint and other surface coating materials containing more than 0.06 percent lead; (2) toys and other articles intended for use by children bearing paint or other similar surface coating

material containing more than 0.06 percent lead; and (3) furniture coated with materials containing more than 0.06 percent lead. These regulations are based on CPSC's conclusion that it is in the public interest to reduce the risk of lead poisoning to young children from ingestion of paint and other similar surface-coating materials.

The Food and Drug Administration adopted in 1974 a proposed tolerance for lead of 0.3 ppm in evaporated milk and evaporated skim milk. This tolerance is based on maintaining children's blood lead levels below 40 µg Pb/dl. FDA also has a proposed action level of 7 µg/ml for leachable lead in pottery and enamelware, although the exact contribution of such exposure to total human dietary intake has not been established.

The Center for Disease Control concluded in 1975 that undue or increased lead absorption exists when a child has confirmed blood lead levels of 30-70 µg Pb/dl or an EP elevation of 60-189 µg Pb/dl except where the elevated EP level is caused by iron deficiency. This guideline is presently accepted by the scientific community but because of more recent data is being reevaluated.

Other EPA Regulations on Lead

In 1975, EPA promulgated the national interim primary drinking water regulation for lead. The standard was aimed at protecting children from undue lead exposure and limiting lead to 0.05 milligrams per liter (mg/l) which was considered as low a level as practicable. In 1977, the National Academy of Sciences evaluated the interim drinking water standards and concluded that a lead level at which adverse health effects are observed cannot be

set with assurance at any value greater than 0.025 mg/l. The Office of Water Supply is currently reviewing the need to revise the interim drinking water standard for lead.

Based on its toxicity, EPA included lead on its 1977 list of priority pollutants for which effluent guidelines will be developed by early 1979. Effluent guidelines for non-ferrous smelters, the major stationary source emitters of airborne lead, are being developed based on achievement of best available technology.

EPA's Office of Pesticide Programs has promulgated regulations based on toxicity of lead which require the addition of coloring agents to the presticide lead arsenate and specify disposal procedures for lead pesticides. Use of lead in pesticides is a small and decreasing proportion of total lead consumption in the U.S.

The Resource Conservation and Recovery Act of 1976 through which EPA is to establish standards on how to treat, dispose, or store hazardous wastes, provides a means for specifying how used crankcase oil and other waste streams containing lead should be recycled or safely disposed of. At the present time, no regulatory actions related to wastes containing lead have been proposed.

EPA has regulations for reducing the lead content in gasoline to 0.5 grams/ gallon by October 1, 1979, and regulations providing for lead-free gasoline required for cars equipped with catalytic converters and other vehicles certified for use of unleaded fuel. The former regulations are based on reducing exposure to airborne lead to protect public health. Other EPA actions which result in the reduction of airborne lead levels include ambient standards and State implementation plans for other pollutants such

as particulate matter and sulfur dioxide and new source performance standards limiting emissions of such pollutants. Existing and new sources of particulate matter emissions generally use control techniques which reduce lead emissions as one component of particulate matter.

The Federal Reference Method

The Federal Reference Method for Lead describes the appropriate techniques for determining the concentration of lead and its compounds as measured as elemental lead in the ambient air. A total of eight organizations submitted written comments on the method and two persons made comments at EPA's February public hearing on the proposed air quality standard. Since proposal of the Federal Reference Method for lead, EPA has completed additional testing of the method and added new information on the precision of the extraction analysis procedure.

Two of the commenters recommended the addition of a nitric plus hydrochloric acid extraction procedure. The extraction procedure of the proposed method contains only nitric acid. Use of a mixed acid procedure would permit the analyst to quantitatively extract more metals than just lead, thereby allowing him to analyze the same extract for more than one metal. The analysis for lead would not be affected. EPA agrees that a mixed acid extraction procedure should be added, and the revised method contains a mixed nitric-hydrochloric acid extraction procedure.

One commenter questioned the reliability of the air volume measured in the sampling procedure because of differences between initial and final flow rates caused by build-up of particulate matter on the collecting filter. The method of sampling specifies that initial and final flow

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rates must fall between 40 and 60 cubic feet per minute and variations within this range cause only a slight error. If the flow rate specification is not met, the sample should be voided. For these reasons, EPA believes the air volume measurement does not suffer unduly from inaccuracies.

A question was raised as to the effect of variation in lead content across the filter of the collected sample on lead analysis, since the method calls for analysis of only one strip or one-twelfth of the filter. Our work has shown that strips taken from different positions within the filter can, on occasion, produce different lead values, but the effect appears to be significant only when sampling near a heavily traveled roadway. The proposed method recommends analyzing additional strips, when sampling near a roadway, to minimize this error.

One commenter pointed out that the proposed sampling procedure does not collect gaseous (organic) lead compounds and recommended that EPA consider requiring the use of a method for monitoring gaseous lead. As the Criteria Document states, reported ambient levels of gaseous lead are very low and EPA has determined that the effort required to carry out the difficult task of monitoring for ambient gaseous lead is not justified in view of the extremely low concentration.

It was pointed out in the preamble to the proposed method that other analytical principles would probably be handled by provision for approval of the equivalent methods (40 CFR Part 53) proposed elsewhere in this Federal Register. Two organizations submitted requests that alternate methods (x-ray fluorescence and anodic stripping voltametry) for lead analysis be declared equivalent to the reference method. These requests will be considered when the procedures for determining equivalency are promulgated.

The final Federal Reference Method is based on measuring the lead content of suspended particulate matter or glass fiber filters using high

volume sampling. The lead is then extracted from the particulate matter with nitric acid facilitated by heat or by a mixture of nitric acid and hydrochloric acid facilitated by ultrasonication. Finally, the lead content is measured by atomic absorption spectrometry.

The reference method specified for lead measures the lead for a single sampling period by extraction of a portion of a high-volume glass fiber filter used to collect particulate matter over a 24-hour period. Some agencies may perfer to composite filter strips from a number of sampling periods and extract and analyze it for lead. This procedure is acceptable provided the agency shows that the compositing procedure results in the same average lead value as would be obtained from averaging individual values.

_____   _____
        Date   Administrator

The Agency amends Title 40, Part 50, of the Code of Federal
Regulations by adding a new §50.12 and a new Appendix G as follows:

The national primary and secondary air quality standards

for lead and its compounds, measured as elemental lead

by a reference method based on Appendix G to this Part, or

by an equivalent method, are: 1.5 micrograms per cubic

meter, maximum arithmetic mean averaged over a calendar

quarter.

(Sections 109 and 301(a) of the Clean Air Act as amended
(42 U.S.C. 7409, 7601(a)).)

*   *   *   *   *

REFERENCE METHOD FOR THE DETERMINATION OF LEAD IN

SUSPENDED PARTICULATE MATTER COLLECTED FROM AMBIENT AIR

REFERENCE METHOD FOR THE DETERMINATION OF LEAD IN

SUSPENDED PARTICULATE MATTER COLLECTED FROM AMBIENT AIR

1. **Principle and Applicability**

    1.1   Ambient air suspended particulate matter is collected on a glass-fiber filter for 24-hours using a high volume air sampler.

    1.2   Lead in the particulate matter is solubilized by extraction with nitric acid (HNO_3), facilitated by heat or by a mixture of HNO_3 and hydrochloric acid (HCl) facilitated by ultrasonication.

    1.3   The lead content of the sample is analyzed by atomic absorption spectrometry using an air-acetylene flame, the 283.3 or 217.0 nm lead absorption line, and the optimum instrumental conditions recommended by the manufacturer.

    1.4   The ultrasonication extraction with HNO_3/HCl will extract metals other than lead from ambient particulate matter.

2. **Range, Sensitivity and Lower Detectable Limit**

    The values given below are typical of the methods capabilities. Absolute values will vary for individual situations depending on the type of instrument used, the lead line, and operating conditions.

    2.1   Range. The typical range of the method is 0.07 to 7.5 µg Pb/m^3 assuming an upper linear range of analysis of 15 µg/ml and an air volume of 2400 m^3.

    2.2   Sensitivity. Typical sensitivities for a 1% change in absorption (0.0044 absorbance units) are 0.2 and 0.5 µg Pb/ml for the 217.0 and 283.3 nm lines, respectively.

2.3   Lower Detectable Limit (LDL). A typical LDL is 0.07 μg Pb/m^3. The above value was calculated by doubling the between-laboratory standard deviation obtained for the lowest measurable lead concentration in a collaborative test of the method.[15] An air volume of 2400 m^3 was assumed.

3. Interferences

Two types of interferences are possible: chemical, and light scattering.

3.1   Chemical. Reports on the absence [1,2,3,4,5] of chemical interferences far outweigh those reporting their presence,[6] therefore, no correction for chemical interferences is given here. If the analyst suspects that the sample matrix is causing a chemical interference, the interference can be verified and corrected for by carrying out the analysis with and without the method of standard additions.[7]

3.2   Light Scattering. Non-atomic absorption or light scattering, produced by high concentrations of dissolved solids in the sample, can produce a significant interference, especially at low lead concentrations.[2] The interference is greater at the 217.0 nm line than at the 283.3 nm line. No interference was observed using the 283.3 nm line with a similar method.[1]

Light scattering interferences can, however, be corrected for instrumentally. Since the dissolved solids can vary depending on the origin of the sample, the correction may be necessary, especially when using the 217.0 nm line. Dual beam instruments with a continuum source give the most accurate correction. A less accurate correction can be obtained by using a non-absorbing lead line that is near the lead analytical line. Information on use of these correction techniques can be obtained from instrument manufacturers' manuals.

If instrumental correction is not feasible, the interference can be eliminated by use of the ammonium pyrrolidinecarbodithioate-methylisobutyl ketone, chelation-solvent extraction technique of sample preparation.[8]

4. <u>Precision and Bias</u>

4.1 The high-volume sampling procedure used to collect ambient air particulate matter has a between-laboratory relative standard deviation of 3.7% over the range 80 to 125 $\mu g/m^3$.[9] The combined extraction - analysis procedure has an average within-laboratory relative standard deviation of 5 to 6% over the range 1.5 to 15 μg Pb/ml, and an average between laboratory relative standard deviation of 7 to 9% over the same range. These values include use of either extraction procedure.

4.2 Single laboratory experiments and collaborative testing indicate that there is no significant difference in lead recovery between the hot and ultrasonic extraction procedures.[15]

5. <u>Apparatus</u>

5.1 Sampling.

5.1.1 High-volume sampler. Use and calibrate the sampler as described in reference 10.

5.2 Analysis.

5.2.1 Atomic Absorption Spectrophotometer. Equipped with lead hollow cathode or electrodeless discharge lamp.

5.2.1.1 Acetylene. The grade recommended by the instrument manufacturer should be used. Change cylinder when pressure drops below 50-100 psig.

5.2.1.2 Air. Filtered to remove particulate, oil and water.

5.2.2 Glassware. Class A borosilicate glassware should be used throughout the analysis.

5.2.2.1   Beakers. 30 and 150 ml. graduated, Pyrex.

5.2.2.2   Volumetric flasks. 100-ml.

5.2.2.3   Pipettes. To deliver 50, 30, 15, 8, 4, 2, 1 ml.

5.2.2.4   Cleaning. All glassware should be scrupulously cleaned. The following procedure is suggested. Wash with laboratory detergent, rinse, soak for 4 hours in 20% (w/w) HNO_3, rinse 3 times with distilled-deionized water, and dry in a dust free manner.

5.2.3   Hot plate.

5.2.4   Ultrasonication water bath, unheated. Commercially available laboratory ultrasonic cleaning baths of 450 watts or higher·"cleaning power", i.e., actual ultrasonic power output to the bath have been found satisfactory.

5.2.5   Template. To aid in sectioning the glass-fiber filter. See Figure 1 for dimensions.

5.2.6   Pizza cutter. Thin wheel. Thickness <1 mm.

5.2.7   Watch glass.

5.2.8   Polyethylene bottles. For storage of samples. Linear polyethylene gives better storage stability than other polyethylenes and is preferred.

5.2.9   Parafilm "M".* American Can Company, Marathon Products, Nennah, Wisconsin, or equivalent.

6.   Reagents

6.1   Sampling

6.1.1   Glass fiber filters. The specifications given below are intended to aid the user in obtaining high quality filters with reproducible properties. These specifications have been met by EPA contractors.

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*Mention of commercial products does not imply endorsement by the U.S. Environmental Protection Agency.

6.1.1.1   Lead content. The absolute lead content of filters is not critical, but low values are, of course, desirable. EPA typically obtains filters with a lead content of <75 μg/filter.

It is important that the variation in lead content from filter to filter, within a given batch, be small.

6.1.1.2   Testing.

6.1.1.2.1   For large batches of filters (> 500 filters) select at random 20 to 30 filters from a given batch. For small batches (< 500 filters) a lesser number of filters may be taken. Cut one 3/4" x 8" strip from each filter anywhere in the filter. Analyze all strips, separately, according to the directions in Sections 7 and 8.

6.1.1.2.2   Calculate the total lead in each filter as

$$F_b = \mu g \ Pb/ml \ x \ \frac{100 \ ml}{strip} \ x \ \frac{12 \ strips}{filter}$$

where:

F_b = Amount of lead per 72 square inches of filter, μg.

6.1.1.2.3   Calculate the mean, $\overline{F}_b$, of the values and the relative standard deviation (standard deviation/mean x 100). If the relative standard deviation is high enough so that, in the analysts opinion, subtraction of $\overline{F}_b$, (Section 10.3) may result in a significant error in the μg Pb/m^3, the batch should be rejected.

6.1.1.2.4   For acceptable batches, use the value of $\overline{F}_b$ to correct all lead analyses (Section 10.3) of particulate matter collected using that batch of filters. If the analyses are below the LDL (Section 2.3) no correction is necessary.

6.2   Analysis

6.2.1   Concentrated (15.6 M) HNO_3. ACS reagent grade HNO_3 and commercially available redistilled HNO_3 has been found to have sufficiently low lead concentrations.

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6.2.2   Concentrated (11.7 $\underline{M}$) HCl. ACS reagent grade.

6.2.3   Distilled-deionized water. (D.I. water).

6.2.4   3 $\underline{M}$ HNO_3. Add 192 ml of concentrated HNO_3 to D.I. water in a 1 ℓ volumetric flask. Shake well, cool, and dilute to volume with D.I. water. CAUTION: Nitric Acid Fumes Are Toxic. Prepare in a well ventilated fume hood.

6.2.5   0.45 $\underline{M}$ HNO_3. Add 29 ml of concentrated HNO_3 to D.I. water in a 1ℓ volumetric flask. Shake well, cool, and dilute to volume with D.I. water.

6.2.6   2.6 $\underline{M}$ HNO_3 + 0 to 0.9 $\underline{M}$ HCl. The concentration of HCl can be varied from 0 to 0.9 $\underline{M}$. Directions are given for preparation of a 2.6 $\underline{M}$ HNO_3 + 0.9 $\underline{M}$ HCl solution. Place 167 ml of concentrated HNO_3 into a 1ℓ volumetric flask and add 79 ml of concentrated HCl. Stir 4 to 6 hours, dilute to nearly 1ℓ with D.I. water, cool to room temperature, and dilute to 1ℓ.

6.2.7   0.40 $\underline{M}$ HNO_3 + X $\underline{M}$ HCl. Add 26 ml of concentrated HNO_3, plus the ml of HCl required, to a 1ℓ volumetric flask. Dilute to nearly 1ℓ with D.I. water, cool to room temperature, and dilute to 1ℓ. The amount of HCl required can be determined from the following equation:

$$y = \frac{79 \text{ ml} \times 0.15 \times}{0.9 \text{ M}}$$

where:

y = ml of concentrated HCl required

x = molarity of HCl in 6.26

0.15 = dilution factor in 7.2.2

6.2.8   Lead Nitrate, $Pb(NO_3)_2$. ACS reagent grade, purity 99.0%. Heat for 4-hours at 120°C and cool in a desiccator.

6.3   Calibration Standards

6.3.1   Master standard, 1000 µg Pb/ml in HNO_3. Dissolve 1.598 g of $Pb(NO_3)_2$ in 0.45 $\underline{M}$ HNO_3 contained in a 1 ℓ volumetric flask and dilute to volume with 0.45 $\underline{M}$ HNO_3.

6.3.2   Master Standard, 1000 μg Pb/ml in HNO_3/HCl. Prepare as in 6.3.1 except use the HNO_3/HCl solution in 6.2.7.

Store standards in a polyethylene bottle. Commercially available certified lead standard solutions may also be used.

7.   Procedure

7.1   Sampling. Collect samples for 24-hours using the procedure described in reference 10 with glass-fiber filters meeting the specifications in 6.1.1. Transport collected samples to the laboratory taking care to minimize contamination and loss of sample.[17]

7.2   Sample Preparation.

7.2.1   Hot Extraction Procedure

7.2.1.1   Cutt a 3/4" x 8" strip from the exposed filter using a template and a pizza cutter as described in Figures 1 and 2. Other cutting procedures may be used.

Lead in ambient particulate matter collected on glass fiber filters has been shown to be uniformly distributed across the filter[1,3,11] suggesting that the position of the strip is unimportant. However, another study[12] has shown that when sampling near a road-way lead is not uniformly distributed across the filter. The nonuniformity has been attributed to large variations in particle size.[16] Therefore, when sampling near a road-way, additional strips at different positions within the filter should be analyzed.

7.2.1.2   Fold the strip in half twice and place in a 150-ml beaker. Add 15 ml of 3 $\underline{M}$ HNO_3 to cover the sample. The acid should completely cover the sample. Cover the beaker with a watch glass.

7.2.1.3   Place beaker on the hot-plate, contained in a fume hood, and boil gently for 30 min. Do not let the sample evaporate to dryness. CAUTION: Nitric Acid Fumes Are Toxic.

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7.2.1.4   Remove beaker from hot plate and cool to near room temperature.

7.2.1.5   Quantitatively transfer the sample as follows:

7.2.1.5.1   Rinse watch glass and sides of beaker with D.I. water.

7.2.1.5.2   Decant extract and rinsings into a 100-ml volumetric flask.

7.2.1.5.3   Add D.I. water to 40 ml mark on beaker, cover with watch glass, and set aside for a minimum of 30 minutes. This is a critical step and cannot be omitted since it allows the HNO_3 trapped in the filter to diffuse into the rinse water.

7.2.1.5.4   Decant the water from the filter into the volumetric flask.

7.2.1.5.5   Rinse filter and beaker twice with D.I. water and add rinsings to volumetric flask until total volume is 80 to 85 ml.

7.2.1.5.6   Stopper flask and shake vigorously. Set aside for approximately 5 minutes or until foam has dissipated.

7.2.1.5.7   Bring solution to volume with D.I. water. Mix thoroughly.

7.2.1.5.8   Allow solution to settle for one hour before proceeding with analysis.

7.2.1.5.9   If sample is to be stored for subsequent analysis, transfer to a linear polyethylene bottle.

7.2.2   Ultrasonic Extraction Procedure

7.2.2.1   Cut a 3/4" x 8" strip from the exposed filter as described in Section 7.2.1.1.

7.2.2.2   Fold the strip in half twice and place in a 30 ml beaker. Add 15 ml of the HNO_3/HCl solution in 6.2.6. The acid should completely cover the sample. Cover the beaker with Parafilm.

The Parafilm should be placed over the beaker such that none of the Parafilm is in contact with water in the ultrasonic bath. Otherwise, rinsing of the Parafilm (Section 7.2.2.4.1) may contaminate the sample.

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7.2.2.3   Place the beaker in the ultrasonication bath and operate for 30 minutes.

7.2.2.4   Quantitatively transfer the sample as follows:

7.2.2.4.1   Rinse Parafilm and sides of beaker with D.I. water.

7.2.2.4.2   Decant extract and rinsings into a 100 ml volumetric flask.

7.2.2.4.3   Add 20 ml D.I. water to cover the filter strip, cover with parafilm, and set aside for a minimum of 30 minutes. This is a critical step and cannot be omitted. The sample is then processed as in Sections 7.2.1.5.4 through 7.2.1.5.9. NOTE: Samples prepared by the hot extraction procedure are now in 0.45 $\underline{M}$ HNO_3. Samples prepared by the ultrasonication procedure are in 0.40 $\underline{M}$ HNO_3 + X $\underline{M}HCl$.

8. <u>Analysis</u>

8.1   Set the wavelength of the monochromator at 283.3 or 217.0 nm. Set or align other instrumental operating conditions as recommended by the manufacturer.

8.2   The sample can be analyzed directly from the volumetric flask, or an appropriate amount of sample decanted into a sample analysis tube. In either case, care should be taken not to disturb the settled solids.

8.3   Aspirate samples, calibration standards and blanks (Section 9.2) into the flame and record the equilibrium absorbance.

8.4   Determine the lead concentration in μg Pb/ml, from the calibration curve, Section 9.3.

8.5   Samples that exceed the linear calibration range should be diluted with acid of the same concentration as the calibration standards and reanalyzed.

9. Calibration

9.1   Working Standard, 20 μg Pb/ml. Prepared by diluting 2.0 ml of the master standard (6.3.1 if the hot acid extraction was used or 6.3.2 if the ultrasonic extraction procedure was used) to 100 ml with the same acid concentration as in the master standard.

9.2   Calibration standards. Prepare daily by diluting the working standard, with the same acid matrix, as indicated below. Other lead concentrations may be used.

Volume of 20 μg/ml Working Standard, ml	Final Volume, ml	Concentration μg Pb/ml
0	100	0.0
1.0	200	0.1
2.0	200	0.2
2.0	100	0.4
4.0	100	0.8
8.0	100	1.6
15.0	100	3.0
30.0	100	6.0
50.0	100	10.0
100	100	20.0

9.3   Preparation of calibration curve. Since the working range of analysis will vary depending on which lead line is used and the type of instrument, no one set of instructions for preparation of a calibration curve can be given. Select standards (plus the reagent blank), in the same acid concentration as the samples, to cover the linear absorption range indicated by the instrument manufacturer. Measure the absorbance of the blank and standards as in Section 8.0. Repeat until good agreement is obtained between replicates. Plot absorbance

(y-axis) versus concentration in μg Pb/ml (x-axis). Draw (or compute) a straight line through the linear portion of the curve. Do not force the calibration curve through zero. Other calibration procedures may be used.

To determine stability of the calibration curve, remeasure - alternately - one of the following calibration standards for every 10th sample analyzed: concentration $\leq$ 1 μg Pb/ml; concentration $\leq$ 10 μg Pb/ml. If either standard deviates by more than 5% from the value predicted by the calibration curve, recalibrate and repeat the previous 10 analyses.

10. Calculation.

    10.1   Measured air volume. Calculate the measured air volume as

$$V_m = \frac{Q_i + Q_f}{2} \times T$$

where:

V_m = Air volume sampled (uncorrected), m^3

Q_i = Initial air flow rate, m^3/min.

Q_f = Final air flow rate, m^3/min.

T = Sampling Time, min.

The flow rates Q_i and Q_f should be corrected to the temperature and pressure conditions existing at the time of orifice calibration as directed in addendum B of reference 10, before calculation of V_m.

    10.2 Air volume at STP. The measured air volume is corrected to reference conditions of 760 mm Hg and 25°C as follows. The units are standard cubic meters, sm^3.

$$V_{STP} = V_m \times \frac{P_2 \times T_1}{P_1 \times T_2}$$

V_{STP} = Sample volume, sm^3, at 760 mm Hg and 298° K

V_m = Measured volume from 10.1

P_2 = Atmospheric pressure at time of orifice calibration, mm Hg

P_1 = 760 mm Hg

T_2 = Atmospheric temperature at time of orifice calibration, °K

T_1 = 298°K

10.3   Lead Concentration. Calculate lead concentration in the air sample.

$$C = \frac{(\mu g\ Pb/ml \times 100\ ml/strip \times 12\ strips/filter) - \overline{F}_b}{V_{STP}}$$

where:

C = Concentration, $\mu g\ Pb/sm^3$

$\mu g\ Pb/ml$ = Lead concentration determined from Section 8

100 ml/strip = Total sample volume

12 strips/filter = $\dfrac{\text{Useable filter area, 7" x 9"}}{\text{Exposed area of one strip, 3/4" x 7"}}$

$\overline{F}_b$ = Lead concentration of blank filter, μg, from Section 6.1.1.2.3

V_{STP} = Air volume from 10. 2

11. Quality Control

3/4" x 8" glass fiber filter strips containing 80 to 2000 μg Pb/strip (as lead salts) and blank strips with zero Pb content should be used to

determine if the method - as being used - has any bias. Quality control charts should be established to monitor differences between measured and true values. The frequency of such checks will depend on the local quality control program.

To minimize the possibility of generating unreliable data, the user should follow practices established for assuring the quality of air pollution data,[13] and take part in EPA's semi-annual audit program for lead analyses.

12. Trouble Shooting

1. During extraction of lead by the hot extraction procedure, it is important to keep the sample covered so that corrosion products - formed on fume hood surfaces which may contain lead - are not deposited in the extract.

2. The sample acid concentration of 0.45 $\underline{M}$ should minimize corrosion of the nebulizer. However, different nebulizers may require lower acid concentrations. Lower concentrations can be used provided samples and standards have the same acid concentration.

3. Ashing of particulate samples has been found, by EPA and contractor laboratories, to be unnecessary in lead analyses by Atomic Absorption. Therefore, this step was omitted from the method.

4. Filtration of extracted samples, to remove particulate matter, was specifically excluded from sample preparation, because some analysts have observed losses of lead due to filtration.

5. If suspended solids should clog the neublizer during analysis of samples, centrifuge the sample to remove the solids.

13. References

1. Scott, D. R. et al. Atomic Absorption and Optical Emission Analysis of NASN Atmospheric Particulate Samples for Lead. Envir. Sci. and

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Tech., <u>10</u>, 877-880 (1976).

2. Skogerboe, R. K. et al. Monitoring for Lead in the Environment.
    pp. 57-66, Department of Chemistry, Colorado State University,
    Fort Collins, Colorado 80523. Submitted to National Science
    Foundation for publication, 1976.

3. Zdrojewski, A. et al. The Accurate Measurement of Lead in Airborne
    Particulates. <u>Inter. J. Environ. Anal. Chem.</u>, <u>2</u>, 63-77 (1972).

4. Slavin, W. Atomic Absorption Spectroscopy. Published by Inter-
    science Company, New York, NY (1968).

5. Kirkbright, G. F., and Sargent, M. Atomic Absorption and Fluorescence
    Spectroscopy. Published by Academic Press, New York, N.Y. 1974.

6. Burnham, C. D. et al. Determination of Lead in Airborne Particulates
    in Chicago and Cook County, Illinois by Atomic Absorption Spectroscopy.
    <u>Envir. Sci. and Tech.</u>, <u>3</u>, 472-475 (1969).

7. Proposed Recommended Practices for Atomic Absorption Spectrometry.
    ASTM Book of Standards, Part 30, pp. 1596-1608 (July 1973).

8. Koirttyohann, S. R., and Wen, J. W. Critical Study of the APCD-MIBK
    Extraction System for Atomic Absorption. <u>Anal. Chem.</u>, <u>45</u>, 1986-1989
    (1973).

9. Collaborative Study of Reference Method for the Determination of
    Suspended Particulates in the Atmosphere (High Volume Method).
    Obtainable from National Technical Information Service, Department
    of Commerce, Port Royal Road, Springfield, Virginia 22151, as
    PB-205-891.

10: Reference Method for the Determination of Suspended Particulates in
    the Atmosphere (High Volume Method). Code of Federal Regulations, Title 40,
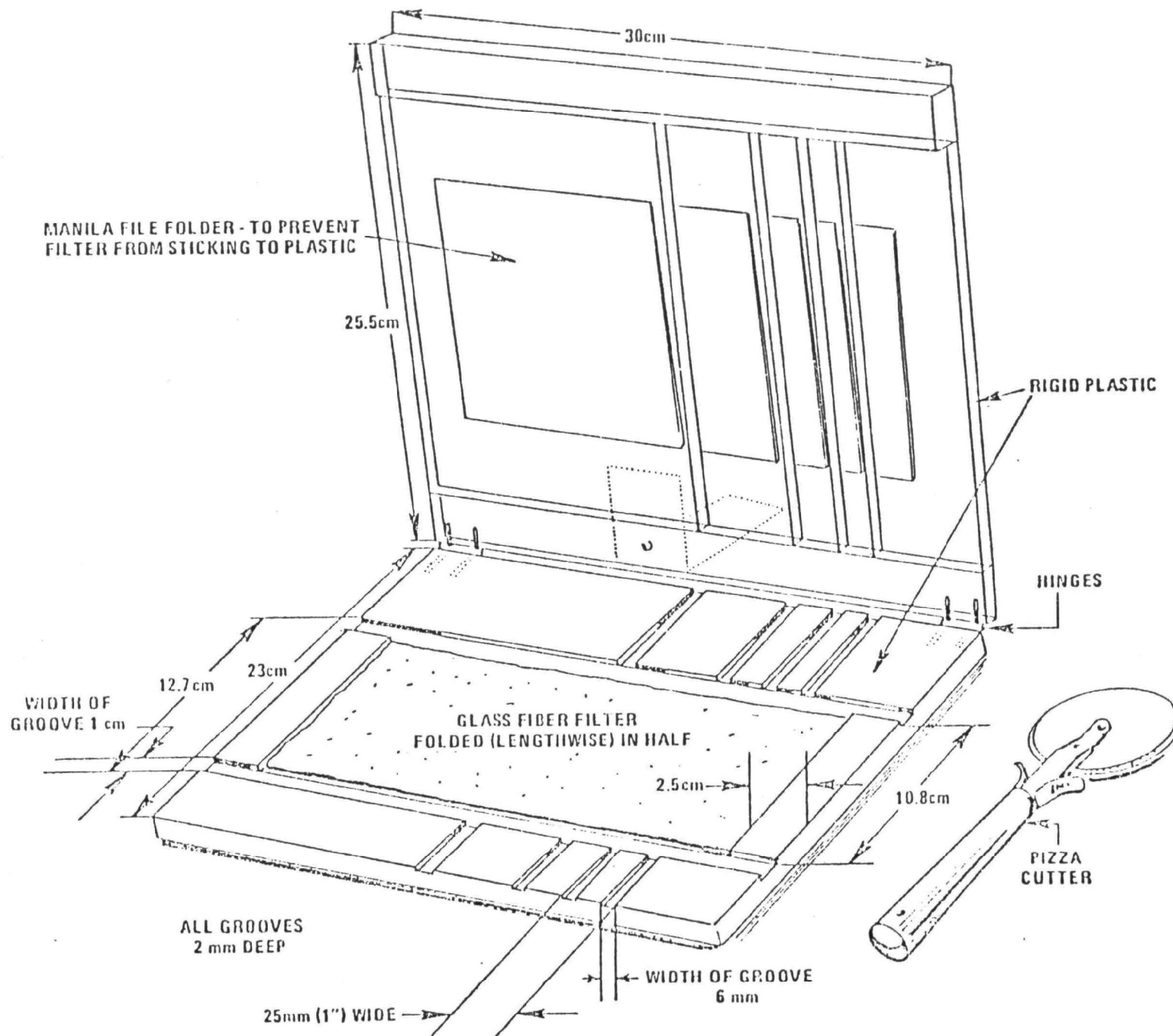   Part 50, Appendix B, pp. 12-16 (July 1, 1975).

14

MANILA FILE FOLDER - TO PREVENT
FILTER FROM STICKING TO PLASTIC

30cm

25.5cm

RIGID PLASTIC

HINGES

WIDTH OF
GROOVE 1 cm

12.7cm

23cm

GLASS FIBER FILTER
FOLDED (LENGTHWISE) IN HALF

2.5cm

10.8cm

PIZZA
CUTTER

ALL GROOVES
2 mm DEEP

WIDTH OF GROOVE
6 mm

25mm (1") WIDE

Figure 1

Apparatus and Procedure for Cutting Glass Fiber Filter Strips

19mm (¾")

1mm SLIT

STRIPS FOR
OTHER ANALYSES

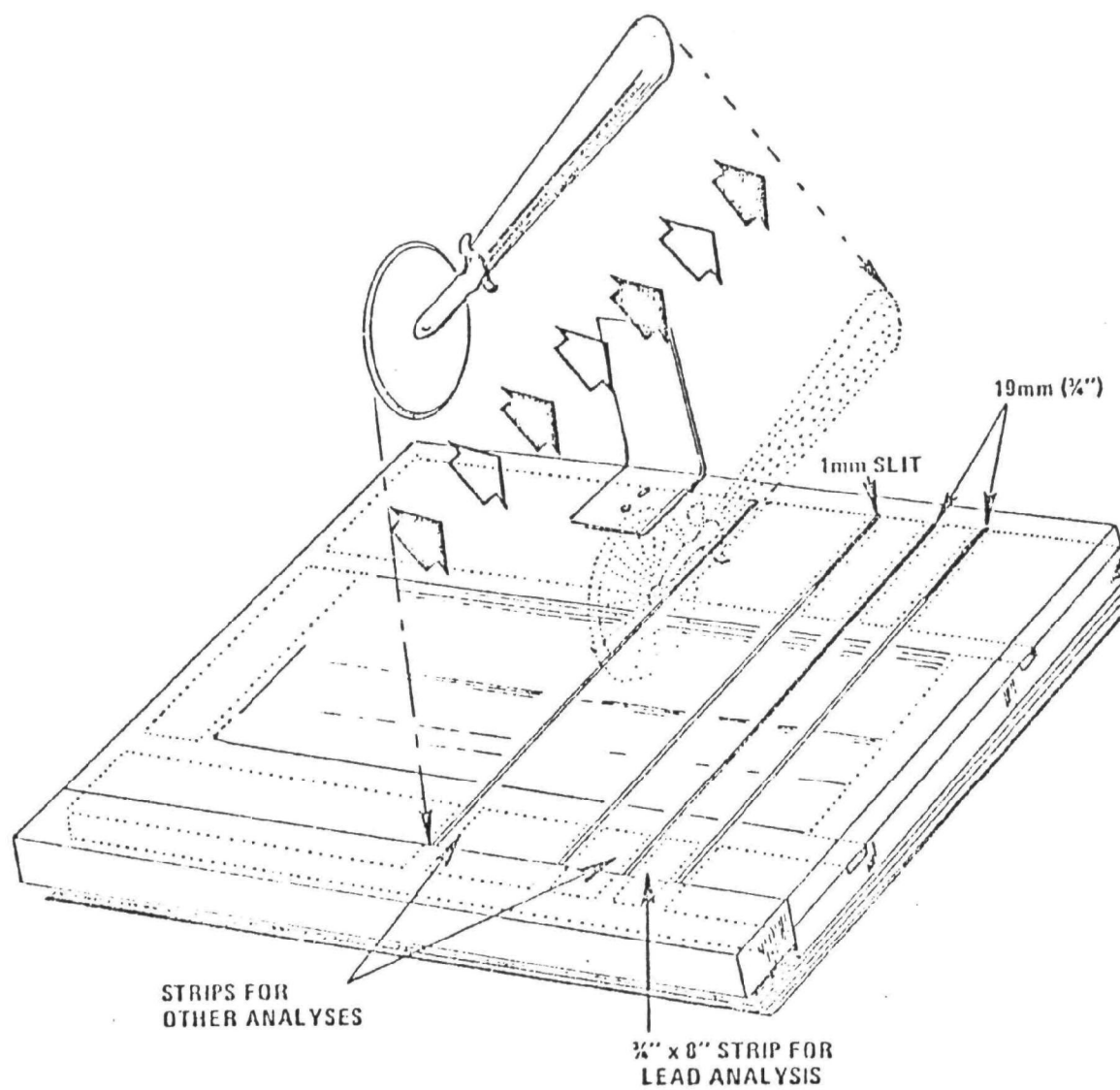¼" x 8" STRIP FOR
LEAD ANALYSIS

Figure 2

Apparatus and Procedure for Cutting Glass Fiber Filter Strips

11. Dubois, L., et al. The Metal Content of Urban Air. JAPCA, 16, 77-78 (1966).

12. EPA Report No. 600/4-77-034, June 1977. Los Angeles Catalyst Study Symposium. Page 223.

13. Quality Assurance Handbook for Air Pollution Measurement Systems. Volume 1 - Principles. EPA-600/9-76-005, March 1976.

14. Thompson, R. J. et al. Analysis of Selected Elements in Atmospheric Particulate Matter by Atomic Absorption. Atomic Absorption Newsletter, 9, No. 3, May-June 1970.

15. To be published. EPA, QAB, EMSL, RTP, N.C. 27711

16. Hirschler, D. A. et al. Particulate Lead Compounds in Automobile Exhaust Gas. Industrial and Engineering Chemistry, 49, 1131-1142 (1957).

17. Quality Assurance Handbook for Air Pollution Measurement Systems. Volume II - Ambient Air Specific Methods. EPA-600/4-77-027a, May 1977.

TAB 8- Federal Register Preamble and Regulations for State
       Implementation (Signature item)

Title 40--Protection of Environment

CHAPTER I--ENVIRONMENTAL PROTECTION AGENCY

PART 51--PREPARATION, ADOPTION, AND SUBMITTAL

OF IMPLEMENTATION PLANS

Implementation Plans for Lead National

Ambient Air Quality Standard

AGENCY: Environmental Protection Agency.

ACTION: Final Rulemaking.

SUMMARY: The regulations promulgated below, together with the current
requirements of 40 CFR Part 51, set forth the requirements for States to
follow in developing, adopting, and submitting acceptable implementation
plans for the lead national ambient air quality standards (NAAQSs),
promulgated elsewhere in this FEDERAL REGISTER. The implementation
plans are required under section 110 of the Clean Air Act.

Amendments to the existing regulations for implementation plans are
necessary because lead differs from other pollutants for which the
existing regulations were designed.

The amendments address the following topics:

--Definitions of point source and control strategy.

--Control strategy requirements.

--Air quality surveillance.

EFFECTIVE DATE: This rulemaking is effective upon publication; State
implementation plans for lead are due by [the date nine months from
publication].

ADDRESSES: U.S. Environmental Protection Agency, Office of Air Quality
Planning and Standards, Control Programs Development Division (MD 15),
Research Triangle Park, NC 27711.

FOR FURTHER INFORMATION CONTACT: Joseph Sableski, Chief, Plans Guide-lines Section, at the above address or at 919-541-5437 (Commercial) or 629-5437 (FTS).

SUPPLEMENTARY INFORMATION

1. BACKGROUND

On December 14, 1977, EPA proposed regulations for the preparation, adoption, and submission of implementation plans to achieve the national ambient air quality standards for lead, which were also proposed on that same date (42 FR 63087). EPA invited comments from interested persons and held a hearing on the proposed NAAQS and State implementation plan (SIP) regulations on February 15 and 16, 1978. EPA received comments on the proposed lead implementation plan requirements from 25 commenters. Of these, there were ten representatives from industry, nine from State and local governmental agencies, four from citizen's organizations and private citizens, and two from other federal agencies.

2. SUMMARY OF COMMENTS AND RESPONSES

The following discussion summarizes most of the comments received on the proposal. There were a few other comments that EPA felt were not significant to warrant discussion in the FEDERAL REGISTER and that did not affect the final regulation. A summary of all the comments received and EPA's response is available for public inspection during normal business hours in EPA's Public Information Reference Unit (PM 215), 401 M Street, S.W., Washington, D.C. 20460, telephone: 202-755-0707.

2.1 POINT SOURCE DEFINITION

There were several comments concerning the definition of a point source. One commenter indicated that the definition of a point source is confusing and differs from that used in the provisions in the Clean Air Act concerning prevention of significant deterioration (PSD). Parts of that comment were directed toward the existing definition of point source in § 51.1(k), which, as the commenter acknowledged, is not the subject of the proposal and will not be discussed here.

Currently, § 51.1(k) defines point sources in terms of emisssions per year and location of the source, as well as a listing of individual source categories. Currently, point sources of other pollutants for which NAAQSs exist that are located in urban areas are defined as those that emit pollutants in excess of 100 tons per year; point sources in less urbanized areas are defined as those that emit pollutants in excess of 25 tons per year. In light of the low level of the lead standard in relation to the other standards (e.g., for particulate matter), good reason exists to define point sources for lead at a lower level of emissions than that for the current set of pollutants for which EPA has established NAAQSs. Based on an analysis contained in EPA's "Supplementary Guidelines for Lead Implementation Plans,"[1] EPA is defining a point source of lead as "any stationary source causing emissions in excess of 4.54 metric tons (5 tons) per year of lead or lead compounds measured as elemental lead." This represents a slight change from the proposal, which failed to account for lead compounds.

The significance of the definition of § 51.1(k) is that the emission inventory, which is used to determine the extent of possible

violations of the air quality standard and determine the effectiveness of control strategies, must include a determination of emissions from each point source. All emissions from sources other than point sources may be grouped together as area (or line) sources.

The definition of point source, which was intended to be based on actual emissions, differs from the definition in section 169 of the Clean Air Act (which pertains to prevention of significant deterioration), which is based on potential emissions. The reason for the difference is that for planning purposes, the inventory of existing sources must be based on an actual situation to be used as a baseline upon which one develops a plan. For new source review (including review for prevention of significant deterioration), one must be aware of the emissions that could be emitted from the proposed source as well as actual emissions; hence, the source size criteria for selection of new sources to be reviewed under the recently-promulgated PSD regulations incorporate potential, as well as actual, emissions. The definitions of point source in § 51.1(k) for all pollutants have been revised from the proposal to clarify that the size criteria are based upon actual emissions. This implies the emissions that are emitted after any control is applied.

2.2 CONTROL STRATEGY

A number of persons provided comments concerning the control strategy aspects of the proposed regulations.

One commenter correctly noted a discrepancy between the list of source categories in §§ 51.80 ("Demonstration of attainment") and

51.84 ("Areas around significant point sources"), for which the State must perform an analysis. The lists should have been identical-- § 51.84(a) should have also included lead-acid storage battery manufacturing plants that produce 1200 or more batteries per day. The rulemaking promulgated below incorporates this change. The criterion for production of batteries, which was based on a monthly standard, has been raised to 2000 batteries per day, however, to account for the slightly less stringent quarterly lead ambient standard.

Several commenters indicated that the requirements in §§ 51.83 ("Certain urbanized areas") and 51.85 ("Other areas") appeared identical and therefore one of the sections was redundant. The difference between the two sections lies in the required geographical scope of the analysis. Section 51.83 requires that the plan contain an analysis of each urbanized area that has a measured lead air concentration that is in excess of 4.0 $\mu g/m^3$ quarterly mean (monthly mean in the proposal). The distinguishing provision is that the analysis must cover at least the entire urbanized area. Section 51.85, on the other hand, requires that for any area (urbanized or not) with a recorded lead concentration that does not meet the national standard of 1.5 $\mu g/m^3$ quarterly mean (monthly mean in the proposal), the plan must contain an analysis of at least the area in the vicinity of the monitor that has recorded the concentration. Therefore, the analysis may be restricted to an evaluation of only those sources within a relatively small radius from the monitor.

Several commenters suggested that the control strategy requirements ensure that the burden for solving the lead air problem be equitably distributed between mobile and stationary sources. The commenters realized that either kind of control is expensive and difficult to implement. In response, EPA maintains that the allocation of the burden of control in the SIP is the primary responsibility of the States,

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and therefore EPA will avoid setting criteria in 4C CFR 51 that favor control of one source category over another. EPA acknowledges that measures that are expensive and difficult to implement may have to be adopted in order to demonstrate attainment of the lead standard.

Two commenters indicated that the regulations did not provide a satisfactory treatment to problems related to background concentration. They claimed that a facility in an area of high background concentrations may be unduly penalized in efforts to attain the standard. EPA acknowledges that this problem may exist. In most cases, however, the high background air concentrations are generally due to other sources in the vicinity. It is the primary responsibility of the State to allocate the burden of emission control to the various sources causing the problem. Sources will have an opportunity to comment on the plan at the public hearing that is required before the plan is submitted to EPA.

One commenter suggested that EPA recommend analysis of fugitive dust and on-premise soil before a State initiates a program of prolonged monitoring in the vicinity of gray iron foundries. As mentioned in the preamble to the proposed regulations, EPA identified gray iron foundries as having the potential for causing violations of the national standard for lead, but this identification was based on limited data concerning the amount of fugitive emissions from the facilities. Although EPA does not feel that the degree of confidence in this identification justifies a requirement for States to analyze all gray iron foundries (of which approximately 1500 exist), EPA encourages States to consider analysis of these sources to the extent that time and resources permit.

The commenter's suggestion concerning the analysis of fugitive dust and on-premise soil before undertaking extensive monitoring and analysis appears to offer the potential for conserving scarce resources in that States may want to restrict their monitoring and analysis efforts to those plants with relatively high lead levels in dust and soil.

The same commenter also indicated that secondary lead smelters and similar sources probably cannot be modeled because of fugitive dust and low stacks. EPA recognizes the difficulty in quantifying fugitive dust and fugitive emissions and recognizes that low stacks will generally cause higher concentrations closer to the stack than will higher stacks. The Clean Air Act requires that an approved plan must demonstrate attainment of the standard, however. EPA has, based upon preliminary analyses, determined that secondary lead smelters and other sources listed in § 51.84 have the potential for causing violations of the lead standard. EPA also believes that attainment of the lead standard around such sources can best be demonstrated by the use of an atmospheric dispersion model. In many cases, States will not have the time or resources to perform detailed studies to quantify the fugitive dust and fugitive emissions from individual facilities and may have to rely on factors that were based on limited studies of other facilities or best estimates. In complying with § 51.84, for cases where no ambient lead data were collected in the vicinity of the source and where a State must thus estimate the air quality impact of the sources, the State will have to decide for itself what level of control is warranted by the confidence in the data upon which the analysis is based.

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In another comment concerning modeling, one commenter from a State agency claimed that the models used for assessing the monthly impact of point sources are not accessible to most air pollution control agencies. In the initial analysis of the impact of the proposed standard on point sources, it is true that EPA used the Oak Ridge National Laboratory Model, "Atmospheric Transport and Dispersion Model" (ATM),[2] which is probably not available to most agencies. That analysis was revised subsequently, and another model was used, however. Also, EPA is recommending the use of other models, specifically those models for particulate matter described in EPA's "Guideline on Air Quality Models,"[3] for modeling point sources for SIP development. These models are generally available.

The same commenter indicated that only ambient monitoring or upwind-downwind sampling can give a reliable assessment of the impact of sources with a large fugitive emission component. EPA acknowledges that monitoring studies generally give a more reliable estimate of the air quality impact of sources that emit fugitive emissions because no estimate need be made of the fugitive emissions, which are difficult to measure directly. Such studies cannot be done for many areas within the time and resource constraints facing the States, however, and therefore EPA's regulations require the use of modeling around such point sources. States will have to make estimates of the fugitive emissions based on whatever information may exist. EPA is, however, in another part of this FEDERAL REGISTER giving advance notice of proposed rulemaking to require the installation of ambient monitors in the vicinity of three categories of point sources that have major fugitive emissions--primary

and secondary lead smelters and primary copper smelters. Presumably, after these monitors have been in place for a few years, the data yielded will provide more accurate information concerning the nature and magnitude of the lead problem from these sources. After those data become available, EPA may require States to revise their implementation plans. Furthermore, EPA intends to develop fugitive lead emission factors that are more accurate than those that currently exist.

One commenter recommended that the regulations place the proof of compliance with emission regulations on the stationary source. The commenter claimed that local enforcement agencies do not have the funds for continuous monitoring. In response, EPA has found that there are no techniques for continuous monitoring of lead emissions. The State will be required under existing regulations (40 CFR 51.19) to carry out a source surveillance program, which generally consists of visual inspection of the installation of control equipment and testing of stack emissions.

Several comments addressed issues concerning control of lead in gasoline. One commenter indicated that any reduction of the lead content of gasoline or any other similar kinds of programs (presumably meaning control of fuels or the control of lead emissions from individual vehicles) that may be needed in the SIP over and above the current Federal program should be done through Federal rather than local regulation. EPA has already taken steps to control the amount of lead in gasoline through the phasedown of lead in leaded gasoline and the requirement that cars equipped with catalyst mufflers must burn unleaded gasoline. The level of control of lead in leaded gasoline was based on average conditions

concerning lead air quality concentrations. Areas that have unique problems and that will find it impossible to demonstrate attainment of the lead standard through stationary source control or through transportation control measures may have to adopt measures such as requirements for further reduction of lead in gasoline or control of lead emissions from the tailpipe of vehicles. Currently, EPA does not foresee the need for additional mobile source control strategies and does not intend to require further nationally-applicable lead-in-gasoline reductions.

Other comments concerning further reductions of the lead content of gasoline suggested that such reductions be undertaken only after sufficient data is available to indicate that the lead air quality problem is geographically broad enough and only after a finding that such a limitation is necessary to achieve a national ambient air quality standard. The commenters enumerated the problems with instituting further control of the lead content of gasoline. The commenters contended that application of more stringent local limitations of lead in gasoline could seriously disrupt the nation's gasoline distribution system, resulting in severe spot shortages, especially during the summer months when gasoline demand is at its highest.

EPA recognizes this problem and advises the States to consider the comment. Also, under § 211(c)(4)(C) of the Clean Air Act, EPA will not approve State or regional programs for further reductions of lead content of gasoline unless the State demonstrates that no other reasonable measures are available.

Also, two of the commenters recommended that the 40 CFR 51 regulations be modified to reflect the restrictions in § 211(c)(4)(C) of the Act regarding State limitation of the lead content of gasoline. In response, EPA has incorporated the intent of the Act into the definition of "control strategy" as it pertains to restrictions on fuel additives.

Two commenters representing primary lead smelting companies recommended an alternative approach to protecting the health of persons from the ambient lead levels in the vicinity of primary lead smelters. They recommended that sources that cannot control emissions so that the lead standard will be met be allowed to conduct a public health screening and hygiene program aimed at reducing the amount of lead that children in the vicinity of the source take in and ensuring that safe blood lead levels are satisfactorily maintained.

EPA believes that there are legal, technical, and equity problems with the program that render it unacceptable as the sole means of implementation of the national standard for lead.

Concerning the legal problem, such a program assumes that the air quality standard will be violated, and presumably, the plan will not

contain a demonstration that the air quality standard will be attained. Under the Clean Air Act, EPA must disapprove a plan that does not contain a demonstration that the air quality standard will be attained by the mandatory attainment date. The Act provides for the protection of health through the standard setting, planning, and implementation processes; it does not allow for a surrogate procedure whereby public health may be protected even though the ambient standards are not met.

Concerning technical problems, the relationship between emissions from a source and blood lead levels is not quantitatively certain. Even assuming a biological monitoring system were to be established, it is unclear what the source would have to do concerning its operation or emissions if the monitoring program revealed unacceptable blood lead levels. Even if a course of action were clear, the damage would have already been done, while the basic purpose of the standard setting and implementation process envisioned by § 110 of the Act is prevention of public health problems.

Concerning equity, the biological monitoring program would inconvenience the very people that are supposed to benefit from the Act. The Act invisioned that all people have an equal right to healthy air. The commenters who recommended the biological monitoring approach apparently believe that people who happen to live in areas with elevated lead levels should not be accorded equal protection, but should be made to pay extra for their health through presumably continuous participation in a blood

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sampling program. If a person did not want to participate, it is doubtful whether he could be forced to, so therefore his health could be placed in jeopardy.

One commenter representing a primary lead smelter warned that enclosure of smelter operations to control fugitive lead emissions may present a severe occupational health hazard to employees who must work within the enclosed space. EPA realizes these potential problems. If a source installs such enclosures, it must of course also meet any applicable regulations set forth by the Occupational Safety and Health Administration as well as control emissions to the extent specified in the applicable implementation plan.

One other commenter expressed concern that there appears to be nothing that can be done in areas where a source is employing best available control technology, yet the standard is still not being met. The Act requires that for approval, an implementation plan must demonstrate that the control strategy contained in the plan is adequate to attain and maintain the NAAQS. EPA realizes, however, that a plan which meets this criterion may, even after full implementation, not actually result in attainment by the attainment date. This would generally indicate that assumptions concerning the amount of emissions and the relationship

between emissions reductions and air concentrations that were made when the plan was developed eventually were proven erroneous. If an approved plan is later found to be inadequate to attain the standard, EPA will require the State to revise the plan. If that plan has already required all measures short of those that would force significant source closures, EPA will at that time decide whether the closure must be effected or whether there are alternatives to this in the discretion given to EPA under the Act in Sections 110 or 113. States should make every effort to develop and submit plans that demonstrate attainment of the standard using the best data available.

Several commenters from State air pollution control agencies indicated that the development of lead SIPs will be difficult within the time frame provided. EPA realizes that the development of the lead plans will be competing in priorities and resources with the development of plan revisions required by Title I, Part D, of the Clean Air Act for nonattainment areas. Where a State needs additional assistance in the development of its lead plan, or where it is unsure as to the priority of development of its lead plan, the State should consult with the appropriate EPA Regional Office.

2.3 AIR QUALITY MONITORING

Several commenters recommended that a minimum number of samples be taken to determine whether the standard is being attained. Also, several persons commented that the sampling should be performed more frequently, such as daily. One person indicated that determination of the attainment status should be done by annual rather than monthly averaging. At least a three month average would be more desirable. Another person indicated that the shorter the averaging period, the more the number of samples should be.

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Concerning the minimum number of valid samples needed to determine an average, it is general practice to require at least 75 percent of the scheduled samples to be valid. EPA will prepare a guideline on this and other issues concerning the determination of attainment of the standard. Concerning the frequency of sampling, EPA is promulgating a national ambient air quality standard for lead in this FEDERAL REGISTER that is based on a calendar quarter, rather than calendar month as had been proposed. EPA has determined that a sampling schedule of once every six days is adequate to give a representative sample for a quarter.

One commenter indicated that monitoring the inner city area should be given top priority because the vehicle mix in these areas favors older cars that burn leaded gasoline. EPA's response is that if maximum exposures occur in these areas, then monitoring these areas should in fact receive first priority. The determination of acceptability of the sites will be the joint responsibility of the States and the cognizant EPA Regional Office.

One commenter recommended that EPA change the recommendation in the draft "Supplementary Guidelines for Lead Implementation Plans"[1] for locating lead monitors near roadways that are at or below grade level rather than near elevated roadways. The commenter suggested that the guideline require measurements to be representative of emissions and environmental exposure. The commenter indicated that the proposed

guidance would exclude monitoring play areas that are located beneath

elevated roadways. EPA agrees with this comment. The purpose

behind excluding below grade level monitoring and monitoring near ele-

vated roadways was to ensure adequate exposure at the monitoring site.

If significant population exposures consistent with the averaging time

of the NAAQS were encountered in these situations, then monitoring in

these locations would meet the intent of the guidance. EPA has revised

the siting guidance to account for these considerations.

Several comments were directed toward the recommended location of

a monitor at a given location. Two persons indicated that the allowance

of 5 meters in elevation of lead air monitors is too high and that it

should be changed or should allow for numerical adjustment of the data.

One person suggested that the monitors be required to be placed closer

to roadways because he felt that would be more representative of

exposure; another suggested that the monitors are required to be placed

too close to the street already in some cases and that the data from the

monitors would be unrepresentative. EPA proposed a range of heights

for lead monitors from 0 to 5 meters above ground level. The proposed

required distance from major roadways for the peak concentration site

was 5 to 15 meters. The intent was to sample ambient air to which

significant portions of the population are being exposed over the

averaging time of the standard. During a typical day, even the most

susceptible population group does not spend more than one half of their

time in the ambient air below the 2 meter level or within 15 meters of

a major roadway. They are indoors or at considerable distances from

roadways for the remainder of their time. Consequently, requiring samplers to be placed below two meters above the ground or closer than 5 meters to a roadway would lead to concentration measurements that would be unrepresentative of lead exposures. Further, some range of heights and distances is necessary due to practicalities involved in finding suitable sites, power availability, protection against vandalism, allowing free pedestrian movement along sidewalks, etc.

One commenter recommended that the criteria for monitoring in the vicinity of roadways not include specific distance restrictions, such as the requirement for placement of monitors between 5 and 15 meters from the traffic lane. The commenter indicated that many areas do not have housing that close to major roadways and therefore the numerical restrictions would be counterproductive to ensuring accurate monitoring of maximum population exposure. EPA's response is that even though housing may not exist that close to roadways in all cases, the public has access to many such areas.

One commenter recommended that the monitoring guidelines require monitoring lead below ground level in public places such as subway stations and underground shopping areas. In response, EPA's monitoring guidance was written for purposes of determining attainment of a standard. Locating monitors in subways to determine exposures would be considered special purpose monitoring and thus could be performed if desired by the State or local agency. EPA however, does not feel that monitors placed in these situations would yield data suitable for developing implementation plans or determining national trends and strategies and thus will

not require it. Furthermore, since no member of the public spends more than perhaps eight hours out of twenty four in such locations, monitoring there would not be representative of population exposure for a standard based upon 24-hour sampling for an entire quarter.

One commenter recommended that the regulations require ambient monitoring in the vicinity of major point sources. Not doing so may allow potentially significant public health impacts that result from fugitive emissions at major point sources to be ignored. As mentioned above, in another part of this FEDERAL REGISTER, EPA is giving advance notice of proposed rulemaking to modify the regulations to require source owners or operators to monitor in the vicinity of primary and secondary lead smelters and primary copper smelters. EPA chose these source categories because they are considered to have the potential for causing the greatest concentrations of air lead in their vicinity and because the nature and magnitude of their fugitive emissions are relatively unknown compared to other source categories. The regulations will continue to vest authority in the Regional Administrators to require monitors in the vicinity of other sources. EPA will prepare guidance concerning the recommended number and siting of monitors in the vicinity of lead point sources.

Another commenter claimed that the regulations do not adequately address the locations where air quality samples will be taken and at what distance from a facility they will be taken. As mentioned above, EPA will develop guidance on the placement of lead monitors in the vicinity of point sources. The guidance for locating monitors elsewhere

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is highly specific in that the distances from obstructions and inter-ferences are quantitatively described. It is not possible from a national perspective, however, to develop general regulations that would cover every conceivable situation that could occur without making the regulations unduly complex.

One commenter suggested that the lead monitors should not be required to be permanent until the State has more experience in sampling and monitoring lead. Also, several commenters recommended that EPA require initial monitoring by mobile vans or other procedures to locate the most critical sites. EPA does not intend that the required monitoring stations would remain at one place in perpetuity. EPA does, however, need some stability in monitoring site locations to allow for trends analysis. If a station once established is later found to be unrepresen-tative, it should be moved to a new location. EPA agrees with the intent of the comments and has always encouraged special purpose monitoring prior to establishing a permanent monitoring station. EPA will not require resource-intensive procedures to locate critical sites, however.

Several commenters recommended that the regulations require more than a minimum of two monitors per area. EPA's response is that the regulations do not preclude placing out more than two monitors. EPA is interested nationally in obtaining only enough data to establish a data trend, determine if the federal programs that result in the reduction of automobile lead emission are causing decreases in lead air

concentrations, and determine the approximate attainment status of areas. Furthermore, the regulations would allow EPA to require additional monitors on a case-by-case basis where EPA believes that two monitors are insufficient to determine whether the national standard is being attained and maintained.

One of the commenters who recommended that the regulations require more than two monitors per area objected to placing responsibility on the EPA Regional Offices to require additional monitors and determine their location. The commenter claimed that this precludes both account-ability of the State's actions and public participation. EPA's response is that requiring a limited number of samplers specifically to meet data needs at the national level and leaving the determination of the number and location of the remaining stations in the State network to the State and the Regional Office is consistent with the recommendations of EPA's Standing Air Monitoring Work Group (SAMWG).[4] In a forthcoming action, EPA currently intends to propose that the locations of stations (for all pollutants) need not actually be included in the implementation plan, but the plan must contain a monitoring program which includes a monitoring network that is based upon negotiations between the State and the EPA Regional Office. The plan would also have to contain a commitment to annually review the adequacy of the network and to establish new stations and relocate or terminate existing stations as needed in order to keep the network responsive to data needs. EPA feels that if the entire system were part of the SIP, the only way the State could make modifica-tions would be to propose the change, hold a public hearing, and submit

the change to EPA as a plan revision. EPA would then have to propose to approve the revision, entertain public comment, and then finally promulgate its approval. EPA feels that this process is too time-consuming and would defeat the purpose of the annual review, which is to make timely adjustments to the network. Also, EPA feels that the potential benefits from this process would be too few to warrant its implementation. The forthcoming proposed requirements concerning air quality monitoring, however, will require that the locations of the monitors be available at all times for public inspection. Therefore, when the State revises its SIP in order to implement the forthcoming air quality monitoring requirements, the public can at that time comment on the State system. The public can also comment on changes to the networks at any time by submitting written comment on changes to the State or EPA Regional Office.

One commenter indicated that the low-volume sampler compares favorably in measurement with the high-volume sampler, which is the reference method for collection of the sample, and excludes larger particles that are not respirable and which the commenter feels are not significant from a health standpoint. The commenter implies that EPA should allow the use of the low-volume sampler. Low-volume sampling will be allowed if the agency that wishes to use it demonstrates that the method is equivalent to the reference method, using the procedures that EPA is proposing in another portion of this FEDERAL REGISTER.

3.0 OTHER CHANGES FROM PROPOSAL

3.1 AIR QUALITY SURVEILLANCE REQUIREMENTS

EPA has revised the air quality surveillance requirements for lead slightly from the proposal to render them clearer and more consistent

with the general air quality surveillance requirements currently under revision that will apply to all pollutants. These revised general requirements will closely follow and implement the recommendations of EPA's Standing Air Monitoring Work Group.[4] The significant revisions of the lead requirements from the proposal include the following:

--A change of the date by which the entire monitoring system must be established.

--Deletion of the references to the terms, "National Air Quality Trends Stations" (or "NAQTS") (which are now called "National Air Monitoring Stations") (or "NAMS") and "State and Local Air Monitoring Stations" (or "SLAMS"). These terms have not yet been defined by regulation, so reference to them is meaningless.

--Modification to the requirement that the plan contain a description of the monitoring system.

--Revision of the "Supplementary Guidelines on Lead Implementation Plans" to account for location of monitoring stations in urban street canyons.

As mentioned in the preamble to the proposal, EPA will eventually incorporate the lead monitoring requirements into the air quality monitoring requirements that apply to all pollutants for which NAAQSs exist.

3.2 REPORTING OF DATA BASE

Under the proposal in § 51.86(c), the State would have been required to submit the air quality data collected since 1974 in the format of EPA's Storage and Retrieval of Aerometric Data (SAROAD) system. The final regulation below retains this requirement, but provides the Regional Administrator with the authority to waive the requirement concerning the format of the data.

3.3 LISTS OF URBANIZED AREAS

There were several errors in the two tables of areas in the pre-amble to the proposal. In Table 2, "Urbanized areas with lead air concentrations exceeding or equal to 1.5 $\mu g/m^3$, maximum monthly mean (1975)", the Norfolk, Va. AQCR number should have read 223 instead of 233. Table 3, "Urbanized areas with lead air concentrations equal to or exceeding 4.0 $\mu g/m^3$, maximum monthly mean (1975)" should have read as follows:

"AQCR	URBANIZED AREA
15	Phoenix, Ariz.
24	Los Angeles--Long Beach, Cal.
29	San Diego, Cal.
30	San Francisco--Oakland, Cal.
30	San Jose, Cal.
67	Chicago, Ill.--Northwestern Ind.
215	Dallas, Tex.

Source: Data from EPA's Environmental Monitoring Support Laboratory, Statistical and Technical Analysis Branch."

These corrections, however, are now academic, since the averaging time of the lead standard is now quarterly. Therefore, Tables 2 and 3 are revised to reflect the quarterly average. Table 2 (renumbered Table 1) appears at the end of the preamble. Table 3, revised to reflect the quarterly average, now contains only one area, the Los Angeles--Long Beach, California, urbanized area. The list reflects only the data currently available to EPA, and generally the quarterly averages available are not truly representative due to insufficient data. There are other data available to State and local air pollution control agencies, however, that may indicate that other areas have concentrations in excess of the concentrations specified in the criteria for performing the analysis.

3.4 EXAMPLE LEAD CONTROL STRATEGY

The preamble to the proposal indicated that EPA was developing an example lead control strategy to assist the States in developing their lead implementation plans. The preamble indicated that the example was scheduled for completion by March 1978. Because EPA has received an extension for promulgating the national ambient air quality standard for lead, because the example control strategy would be based on the final implementation plan regulations promulgated below, and because of other delays, the example controls strategy will probably not be available until November or December of 1978.

4.0 REFERENCES

1. Supplementary Guidelines for Lead Implementation Plans. U.S. Environmental Protection Agency, Office of Air Quality Planning and Standards, Research Triangle Park, N.C. 27711. (OAQPS No. 1.2-104).

2. Culkowski, W.M. and M.R. Patterson, A Comprehensive Atmospheric Transport and Diffusion Model. (ORNL/NSR/EATS-17. Oak Ridge National Laboratory, Oak Ridge, Tenn., 1976.

3. Guideline on Air Quality Models. Monitoring and Data Analysis Division, Office of Air Quality Planning and Standards, U.S. Environmental Protection Agency, Research Triangle Park, N.C. EPA-450/2-78-027 (OAQPS No. 1.2-080), April, 1978.

4. Air Monitoring Strategy for State Implementation Plans. Prepared by the Standing Air Monitoring Work Group. U.S. Environmental Protection Agency, Office of Air and Waste Management, Office of Air Quality Planning and Standards, Research Triangle Park, N.C. 27711. EPA-450/2-77-010. June, 1977.

TABLE 1
URBANIZED AREAS WITH LEAD AIR CONCENTRATIONS
EXCEEDING OR EQUAL TO 1.5 $\mu g/m^3$, MAXIMUM QUARTERLY MEAN
(1975)

AQCR#	AREA
004	Birmingham, Ala.
005	Jackson, Miss.
015	Phoenix, Ariz.
031	Fresno, Calif.
024	Los Angeles--Long Beach, Calif.
028	Sacramento, Calif.
033	San Bernardino--Riverside, Calif.
029	San Diego, Calif.
030	San Francisco--Oakland, Calif.
030	San Jose, Calif.
036	Denver, Colo.
043	New York, N.Y.--Northeastern N.J.
042	Waterbury, Conn.
042	Springfield, Chicopee-Holyoke, Mass.--Conn.
045	Wilmington, Del.--N.J.
045	Philadelphia, Pa.--N.J.
047	Washington, D.C.--Md.--Va.
067	Chicago, Ill.--Northwestern Ind.
131	Minneapolis--St. Paul, Minn.
070	St. Louis, Mo.--Ill.
013	Las Vegas, Nev.
148	Reno, Nev.
184	Oklahoma City, Okla.
151	Scranton, Pa.
244	San Juan, P.R.
200	Columbia, S.C.
202	Greenville, S.C.
055	Chattanooga, Tenn.--Ga.
207	Knoxville, Tenn.
018	Memphis, Tenn.--Miss.
215	Dallas, Tex.
153	El Paso, Tex.
216	Houston, Tex.

Source: Data from EPA's Environmental Monitoring Support Laboratory, Statistical and Technical Analysis Branch.

_____   _____
        Date   Administrator

The _Code of Federal Regulations_, Title 40, Chapter I, Part 51, is amended as follows:

1. In section 51.1, paragraph (k) is revised and paragraph (n) is amended by adding subdivision (11) as follows:

§ 51.1 Definitions.

*   *   *   *   *

(k) "Point source" means the following:

(1) For particulate matter, sulfur oxides, carbon monoxide, hydrocarbons, and nitrogen dioxide--

(i) Any stationary source the actual emissions of which are in excess of 90.7 metric tons (100 tons) per year of the pollutant in a region containing an area whose 1970 "urban place" population, as defined by the U.S. Bureau of the Census, was equal to or greater than one million;

(ii) Any stationary source the actual emissions of which are in excess of 22.7 metric tons (25 tons) per year of the pollutant in a region containing an area whose 1970 "urban place" population, as defined by the U.S. Bureau of the Census was less than one million; or

(iii) Without regard to amount of emissions, stationary sources such as those listed in Appendix C to this part.

(2) For lead, any stationary source the actual emissions of which are in excess of 4.54 metric tons (five tons) per year of lead or lead compounds measured as elemental lead.

*   *   *   *   *

(n) * * *

(11) Control or prohibition of a fuel or fuel additive used in motor vehicles, if such control or prohibition is necessary to achieve

a national primary or secondary air quality standard and is approved by the Administrator under § 211(c)(4)(C) of the Act.

*   *   *   *   *

2.   Section 51.12, paragraph (e) is amended by adding subdivision (3) as follows:

§ 51.12 Control Strategy: General.

*   *   *   *   *

   (e) * * *

   (3) This paragraph covers only plans to attain and maintain the national standards for particulate matter, sulfur oxides, carbon monoxide, photochemical oxidants, hydrocarbons, and nitrogen dioxide.

*   *   *   *   *

3.   Section 51.17 is amended by (1) revising the heading to read "Air quality surveillance: Particulate matter, sulfur oxides, carbon monoxide, photochemical oxidants, hydrocarbons, and nitrogen dioxide," and (2) adding paragraph (d) as follows:

§ 51.17 Air quality surveillance: Particulate matter, sulfur oxides, carbon monoxide, photochemical oxidants, hydrocarbons, and nitrogen dioxide.

*   *   *   *   *

   (d) This section covers only plans to attain and maintain the national standards for particulate matter, sulfur oxides, carbon monoxide, photo-chemical oxidants, hydrocarbons, and nitrogen dioxide.

4. A new section 51.17b is added as follows:

§ 51.17b Air quality surveillance: Lead.

(a) This section covers only plans to attain and maintain the national standards for lead.

MONITORING IN CERTAIN AREAS

(b) The plan must provide for the establishment of a monitoring system that contains at least two permanent lead ambient air quality monitoring stations in each urbanized area (as defined by the U.S. Bureau of the Census)--

(1) That has a 1970 population greater than 500,000; or

(2) Where lead air quality concentrations currently exceed or have exceeded 1.5 $\mu g/m^3$ quarterly arithmetic mean measured since January 1, 1974.

(c) The EPA Regional Administrator may specify more than two monitoring stations if he finds that two stations are insufficient to adequately determine if the lead standard is being attained and maintained. He may also specify stations in areas outside the areas covered in paragraph (b) of this section.

(d) The monitoring system must contain at least one roadway type monitoring site and at least one neightborhood site and be sited in accordance with the procedures specified in EPA's "Supplementary Guidelines for Lead Implementation Plans."

(e) The monitors must be operated on a minimum sampling frequency of one 24-hour sample every six days.

(f) Existing sampling sites being used for sampling particulate matter may be designated as sites for sampling lead if they meet the siting criteria of "Supplementary Guidelines for Lead Implementation Plans."

(g) The plan must provide that all lead air quality monitoring stations will be established and operational as expeditiously as practicable but no later than two years after the date of the Administrator's approval of the plan for the stations specified under paragraph (b) of this section.

(h) The analysis of the 24-hour samples may be performed for either individual samples or composites of the samples collected over a calendar month or quarter.

(i) [Reserved].

REQUIREMENTS APPLICABLE TO ALL MONITORS

(j) The plan must provide for having a description of the system available for public inspection and submission to the Administrator at his request. The description must be available at all times after the date the plan is made available for public inspection. The description must include the following information:

(1) The SAROAD site identification form.

(2) The sampling and analysis method.

(3) The sampling schedule.

(k) The monitoring method used in any station in the monitoring systems required in this section must be a reference or equivalent method for lead as defined in § 50.1 of this chapter.

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5. A new subpart E is added as follows:

Subpart E--Control Strategy: Lead

§ 51.80 Demonstration of attainment.

§ 51.81 Emissions data.

§ 51.82 Air quality data.

§ 51.83 Certain urbanized areas.

·§ 51.84 Areas around significant point sources.

§ 51.85 Other areas.

§ 51.86 Data bases.

§ 51.87 Measures.

§ 51.88 Data availability.

----

§ 51.80 Demonstration of attainment.

(a) Each plan must contain a demonstration that the standard will be attained and maintained in the following areas:

(1) Areas in the vicinity of the following point sources of lead:

--Primary lead smelters.

--Secondary lead smelters.

--Primary copper smelters.

--Lead gasoline additive plants.

--Lead-acid storage battery manufacturing plants that produce 2000 or more batteries per day.

--Any other stationary source that actually emits 25 or more tons per year of lead or lead compounds measured as elemental lead.

(2) Any other area that has lead air concentrations in excess of the national standard concentration for lead, measured since January 1, 1974.

(b) The plan must demonstrate that the measures, rules, and regulations contained in the plan are adequate to provide for the attainment of the national standard for lead within the time prescribed by the Act and for the maintenance of that standard for a reasonable period thereafter.

(c) The plan must include the following:

(1) A summary of the computations, assumptions, and judgments used to determine the reduction of emissions or reduction of the growth in emissions that will result from the application of the control strategy.

(2) A presentation of emission levels expected to result from application of each measure of the control strategy.

(3) A presentation of the air quality levels expected to result from application of the overall control strategy presented either in tabular form or as an isopleth map showing expected maximum concentrations.

§ 51.81 Emissions data.

(a) The plan must contain a summary of the baseline lead emission inventory based upon measured emissions or, where measured emissions are not available, documented emission factors. The point source inventory on which the summary is based must contain all sources that emit five or more tons of lead per year. The inventory must be summarized in a form similar to that shown in Appendix D.

(b) The plan must contain a summary of projected lead emissions for--

(1) at least three years from the date by which EPA must approve or disapprove the plan if no extension under section 110(e) of the Clean Air Act is granted;

(2) at least five years from the date by which EPA must approve or disapprove the plan if an extension is requested under section 110(e) of the Clean Air Act; or

(3) any other longer period if required by the appropriate EPA Regional Administrator.

(c) The plan must contain a description of the method used to project emissions.

(d) The plan must contain an identification of the sources of the data used in the projection of emissions.

§ 51.82 Air quality data.

(a) The plan must contain a summary of all lead air quality data measured since January 1974. The plan must include an evaluation of the data for reliability, suitability for calibrating dispersion models (when such models will be used), and representativeness. When possible, the air quality data used must be for the same baseline year as for the emission inventory.

(b) If additional lead air quality data are desired to determine lead air concentrations in areas suspected of exceeding the lead national ambient air quality standard, the plan may include data from any previously collected filters from particulate matter high volume samplers. In determining the lead content of the filters for control strategy demon-stration purposes, a State may use, in addition to the reference method, x-ray fluorescence or any other method approved by the Regional Adminis-trator.

(c) The plan must also contain a tabulation of, or isopleth map showing, maximum air quality concentrations based upon projected emissions.

§ 51.83 Certain urbanized areas.

For urbanized areas with measured lead concentrations in excess of 4.0 $\mu g/m^3$, quarterly mean measured since January 1, 1974, the plan must employ the modified rollback model for the demonstration of attainment as a minimum, but may use an atmospheric dispersion model if desired.

§ 51.84 Areas around significant point sources.

(a) The plan must contain a calculation of the maximum lead air quality concentrations and the location of those concentrations resulting from the following point sources for the demonstration of attainment:

--Primary lead smelters.

--Secondary lead smelters.

--Primary copper smelters.

--Lead gasoline additive plans.

--Lead-acid storage battery manufacturing plants that produce 2000 or more batteries per day.

--Any other stationary source that actually emits 25 or more tons per year of lead or lead compounds measured as elemental lead.

(b) In performing this analysis, the State shall use an atmospheric dispersion model.

§ 51.85 Other areas.

For each area in the vicinity of an air quality monitor that has recorded lead concentrations in excess of the lead national standard concentration, the plan must employ the modified rollback model as a minimum, but may use an atmospheric dispersion model if desired for the demonstration of attainment.

§ 51.86 Data bases.

(a) For interstate regions, the analysis from each constituent State must, where practicable, be based upon the same regional emission inventory and air quality baseline.

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(b) Each State shall submit to the appropriate EPA Regional Office with the plan, but not as part of the plan, emissions data and information related to point and area source emissions as identified in the "Supplementary Guidelines for Lead Implementation Plans."

(c) Air quality data.

(1) Each State shall submit to the appropriate EPA Regional Office with the plan, but not as part of the plan, all lead air quality data measured since January 1, 1974. This requirement does not apply if the data has already been submitted.

(2) The data must be submitted in accordance with the procedures and data forms specified in chapter 3.4.0 of the "AEROS User's Manual" concerning Storage and Retrieval of Aerometric Data (SAROAD) except where the Regional Administrator waives this requirement.

§ 51.87 Measures.

The lead control strategy must include the following:

(1) A description of each control measure that is incorporated into the lead plan.

(2) Copies of or citations to the enforceable laws and regulations to implement the measures adopted in the lead plan.

(3) A description of the administrative procedures to be used in implementing each selected control measure.

(4) A description of enforcement methods including, but not limited to, procedures for monitoring compliance with each of the selected control measures, procedures for handling violations, and a designation of agency responsibility for enforcement or implementation.

§ 51.88 Data availability.

(a) The State shall retain all detailed data and calculations used in the preparation of the lead analyses and plan, make them available for public inspection, and submit them to the Administrator at his request.

(b) The detailed data and calculations used in the preparation of the lead analyses and control strategies are not considered a part of the lead plan.

(Sections 110 and 301(a) of the Clean Air Act as amended (42 USC 7410, 7601))

TAB C- List of External Comments Opposing or Endorsing the Proposed Standard

COMMENTS RECEIVED OPPOSING THE PROPOSED STANDARD
OF 1.5 µg/m^3 AS EXCESSIVELY STRINGENT

COMPANY	OPPOSED 1.5 µg/m^3, calendar month	ENDORSED 5.0 µg/m^3, calendar quarter (or other averaging period)
Amax Lead and Zinc, Inc.	X	X
American Mining Congress	X	X
American Petroleum Institute	X	
ASARCO	X	X
Associated Octel	X	X
Battery Council International	X	X
Bethlehem Steel	X	X
Bunker Hill Company	X	X
C & D Batteries	X	X
DuPont	X	X
ESA Laboratories	X	X
Ethyl	X	X
General Battery Corporation	X	X
General Motors Corporation		
Getty Refining and Marketing	X	
HECLA Mining Company	X	
Houston Chemical	X	X
Hunt Oil	X	
Kerr-McGee		
Lead Industries Association	X	X
Nalco Chemical	X	X
N L Industries	X	X
Prestolite Battery	X	X
Secondary Lead Smelters Association	X	X
Shell Oil	X	
St. Joe Minerals	X	X
Texaco, Inc.	X	X
United Machinery Group		
Vulcan Materials Company		

Summary: 45 comments received from 29 corporations or their representatives.

25 of the 29 firms opposed the proposed standard of 1.5 µg/m^3, calendar month average;

20 endorsed an alternative standard of 5.0 µg/m^3, calendar quarter average (or other averaging period).

COMMENTS RECEIVED OPPOSING PROPOSED LEAD AIR QUALITY
STANDARD OF 1.5 μg/m³, CALENDAR MONTH
IN FAVOR OF A MORE STRINGENT STANDARD

Natural Resources Defense Council

Sergio Piomelli, Pediatric Hematology, New York University Medical Center

Public Interest Campaign

University of Connecticut Health Center

COMMENTS RECEIVED ENDORSING PROPOSED LEAD AIR QUALITY
STANDARD OF 1.5 ug/m³, CALENDAR MONTH AVERAGE

State and Local Agencies

California Department of Health
Massachusetts Department of Public Health
New York State Department of Environmental Conservation
New York City Department of Environmental Protection
Tennessee Department of Public Health
Texas Air Control Board
Wisconsin Department of Natural Resources

Federal Agencies

Center for Disease Control, Public Health Service
Department of Transportation
Food and Drug Administration
Occupational Safety and Health Administration

Public Interest Groups and the Medical Community

Committee on Environmental Hazards, American Academy of Pediatrics
D.C. Committee for Lead Elimination in the District
League of Women Voters of the U.S.
National Urban League
Herbert Needleman, Boston Children's Hospital Medical Center
University of North Carolina School of Public Health

TAB D- Summary of Significant Comments and Agency Disposition

The comments received by EPA did not challenge three aspects of the proposed standard:

1. the basic structure of the rationale used by the Agency in deriving the level of the proposed standard.

2. the selection of young children as a population particularly at risk to lead exposure.

3. the Agency's estimate of 12 μg Pb/dl as an appropriate target for the mean population blood lead level attributable to non-air sources of lead exposure.

Significant comments were received, however, on a number of key areas relating to the standard:

1. the validity of using a subclinical effect, EP elevation, as the critical adverse health effect rather than clinically detectable anemia.

2. the appropriate blood lead threshold for elevated EP.

3. the incidence of health effects in populations residing in the vicinity of industrial sources of lead particulate emissions.

4. the appropriate causal relationship between micrograms of lead in the air and micrograms of lead in the blood.

5. the statistical form and period of the standard.

6. the appropriate margin of safety.

7. the importance of the respirable fraction of total air lead level.

8. the economic impact of the standard.

9. the State Implementation Plan regulations.

10. the Federal Reference Method for monitoring lead air quality.

11. the administrative procedures employed by EPA in the development of the standard and the provision for public participation.

A review of the comments received and their disposition has been placed in the rulemaking docket (OAQPS 77-1) for public inspection. The following paragraphs summarize the significant comments and present the Agency's findings.

The Health Significance of Erythrocyte Protoporphyrin Elevation

Ten commentors disagreed with EPA's conclusion that the impairment of heme synthesis associated with elevated erythrocyte protoporphyrin (EP) constituted an adverse health effect for the purposes of standard setting. Reasons for this disagreement included:

1. An elevated level of EP is not itself toxic to the cells in in blood or other tissues.

2. EP elevation, while indicating a change in the heme synthetic pathway, does not indicate an insufficient production of heme or hemoglobin.

3. EP elevation and the alteration of heme synthesis do not imply impairment of other mitochondrial functions.

4. EP elevation is not associated with impairment of the production of other heme proteins, particularly cytochrome P-450.

5. Elevated EP may be caused by conditions other than exposure to lead, particularly iron deficiency.

Five other commentors agreed with EPA's conclusions about the health significance of elevated EP citing the following arguments:

The Blood Lead Threshold for Elevated Erythrocyte Protooorphyrin

Comments provided by ten organizations challenged EPA's conclusion that the threshold for the elevation of EP occurs at a blood lead level in children of 15 μg/dl. Evidence offered for a higher threshold included:

1. the threshold accepted by EPA is based on a study in which an inappropriate statistical technique, probit analysis, was employed.

2. application of a more appropriate technique, segmented line analysis, results in a higher threshold.

3. the study in question excluded data on children with blood lead levels in excess of 30 μg/dl.

4. other investigators have reported higher thresholds.

Comments in support of the 15 ug/dl threshold maintained:

1. it is proper to exclude values considered abnormal if the intent of the analysis is to determine an unbiased effect threshold.

2. other studies have reported thresholds with error bands which include 15 μg/dl.

3. probit analysis is an appropriate technique and differs only slightly from the results obtained from segmented line analysis.

Agency Response

The threshold for EP elevation in children is primarily a statistical concept rather than a physical fact. Even at blood lead levels below 15 μg/dl some members of a population of children will exhibit elevated EP. The choice of an analytical technique is largely a matter of preference. In this regard, the Agency admits a preference for a segmented line analysis of the data which results in a statistical threshold of 16.7 μg/dl blood lead.

In the rationale for the proposed standard, EPA accepted a statistical estimate of the EP elevation threshold as a maximum safe population blood lead level. The basis for this choice was an awareness that because of individual variation, many children would have blood lead levels and, consequently, increased probability of EP elevation, in excess of the population mean blood lead level. Upon reflection, EPA concludes that an alternative method for deriving a safe population mean blood lead level consists of determining the level of concern for an individual member of the sensitive population and then calculating a mean target blood lead level for the population which will insure that a certain percentage of that population's members will not exceed the level of concern.

In the case of lead, the criteria document reports that blood lead levels in populations with fairly homogeneous exposure to lead are log normally distributed with a standard geometric deviation of 1.3 to 1.5. To insure that 99.5 percent of the sensitive population falls below a level of concern of 30 μg Pb/dl blood requires that the target mean for the population be 15 μg/dl. EPA concludes, therefore, that, based on a statistical estimate of the threshold for EP elevation as well as the protection of a reasonable percentage of the sensitive population from undue exposure, a target population mean blood lead level of 15 μg/dl is required.

The Incidence of Health Effects in Populations Residing in the Vicinity of Industrial Sources of Lead Particulate Emissions

Several comments cited situations in which proximity to significant point sources of airborne lead emissions appear to have little or no health impact on resident populations.

1. the interference of lead in a fundamental cellular function to the extent that there is accumulation of a substrate is physiological impairment even without the presence of clinical evidence of disease.

2. there are numerous instances in which it is prudent medical practice to intervene where subclinical indicators of physiological impairment are present.

3. the impairment of heme synthesis resulting from genetic or dietary factors places a child at enhanced risk to lead exposure.

4. there is evidence to suggest that impaired heme synthesis may have effects on other tissues as well as on red blood cells.

Agency Response

EPA agrees with the comments received that the onset of EP elevation as a result of exposure to lead may not connote a diseased state or a clinically detectable decrement in performance. It is equally reasonable that the extent of impairment of the heme synthetic pathway resulting from the presence of lead in an amount sufficient to move an individual child beyond the threshold for EP elevation does not create an intolerable metabolic condition. It is clear, however, that this impairment increases progressively with lead dose and leads to clinically observable symptoms (anemia).

The fact that other conditions, such as iron deficiency, may produce similar impairment, does not obviate the concern that lead in these circumstances is interfering with an essential biological function. The possibility of a nutritional imbalance is an additional stress to this system which may increase the sensitivity of a child to lead exposure.

Heme and heme-containing proteins play important roles in the oxygen fixation pathways in all cells. The effects of low-level lead exposure on the heme synthetic pathway in the red cell component of blood have been extensively studied in part because of the ease with which this tissue may be obtained. Other cellular metabolic systems utilizing heme are less well understood but may be similarly impaired. There is evidence that lead's interference with the transport of iron across the membranes of mitochondria (organelles common to all animal cells which perform many metabolic functions) may functionally impair brain enzyme and liver detoxification systems utilizing heme.

For these reasons, EPA concludes that the state of elevated EP· is potentially adverse to health. While the onset or a mild experience of this condition may be tolerated by an individual, as with other subclinical manisfestations of impaired function, it is prudent to exercise corrective action prior to the appearance of clinical symptoms. The criteria document reports that symptoms of anemia in children may occur at blood lead levels of 40 μg/dl. At 30 μg/dl, decreased hemoglobin production is not apparent, however, a significant proportion of the sensitive population exhibit varying levels of EP elevation. EPA therefore concludes, in accord with the position taken by the Center for Disease Control, that the elevation of EP associated with a blood lead level of 30 ug/dl is evidence of undue lead exposure in an individual member of the sensitive population.

Agency Response

EPA acknowledges the variability of the impact of exposure to air lead on the potential for adverse health consequences. It is clear that direct exposure to air lead is only one of many routes through which human exposure occurs. For this reason, the Agency has held, and continues to hold, that only a portion of the safe population mean blood lead level is attributable to air lead exposure. The presence or absence of health effects in an exposed population is influenced by a variety of factors including: meteorology, terrain characteristics, geological and anthropological history, personal and domestic hygiene, the occupations of the population members, and the food and non-food materials with which they come into contact. Taking into account such variability, it remains the Agency's belief that airborne lead directly and indirectly contributes to the risk of adverse health consequences, that sufficient clinical and epidemiological evidence is present to form a judgment as to the extent of this contribution, and that a national air standard for lead must be designed to be protective of the health of the entire population.

The Appropriate Causal Relationship Between Lead in Air and Lead in Blood

Several commentors questioned the Agency's conclusion that, for children, one microgram of lead per cubic meter air results in an increase of two micrograms lead per deciliter blood.

Agency Resolution:

EPA acknowledges that the air lead to blood lead relationship in children has been reported by some investigators as closer to 1:1. However, as the criteria document states:

"One assumption inherent in the calculation of the regression of
blood lead on air lead using standard least squares is that the air lead
values have been measured with no error. Obviously, the monitored air
lead values are not the exact values inhaled by the subjects in the
exposure area." "In general, the calculation regression coefficients are
underestimates of the true values." The use of personal dosimeters to
measure exposure reduces the measurement error. For this reason, EPA
regards the study of AZAR in adult males as an appropriate model for the
air lead/blood lead relationship. The grouping of data by an air lead level
indicates that the relation is curvilinear, that is, the ratio changes
with changing air and blood leads. In the range of the proposed air
standard, Azar's data indicate a ratio of 1:1.43 to 1:2.57. Because
children are known to have a greater net respiratory intake of lead as well
as greater net absorption and retention of this metal than adults, it
is reasonable to assume that the air lead to blood lead ratio for this
sensitive population, exposed to air lead levels in the range of the
proposed standard, is equal to if not greater than that for adults.
It is the conclusion of the Agency therefore, that an air lead to blood
lead ratio of 1:2 is not overly conservative.

The Statistical Form and Period of the Standard

One commenter expressed the view that, due to the log normal distribution
of air leads, a not to be exceeded standard of 1.5 $\mu g/m^3$ calendar month
average would require sources of air lead to achieve control of their
emissions to a geometric monthly mean of 0.41 $\mu g/m^3$ in order to prevent the
occurrence of a violation. Another individual expressed the opinion that, with
the continued operation of a six day sampling regimen, the number of samples

which could be collected in the course of a calendar month would not provide

a statistically valid estimate of the actual lead air quality for the period.

Comments by several individuals questioned the health basis for the

selection of the calendar month averaging period.

EPA Response

EPA accepts the consensus of comments received on the scientific and

technical difficulties presented by the selection of a calendar month averaging

period. The Agency believes that the key criterion for the averaging period is

the protection of health of the sensitive population. In proposing the 1.5 μg/m^3

standard, EPA concluded that this air level was safe for indefinite exposure

of young children. Critical to the determination of the averaging period is the

health significance of possible elevations of air lead above 1.5 ug/m^3 which

could be encountered without violation of the standard. In the proposed

standard, EPA chose a monthly averaging period on the basis of a study showing

an adjustment period of blood lead level with a change of exposure. Because of

the scientific and technical difficulties of the monthly standard, EPA

has reexamined this question and concludes that there is little reason to

expect that the slightly greater possibility of elevated air lead levels

sustainable by the quarterly standard is significant for health. This

conclusion is based on the following factors:

(1) from actual ambient measurements, there is evidence that the

distribution of air lead levels is such that there is little

possibility that there could be sustained periods greatly

above the average value.

(2) while it is difficult to relate the extent to which a monitoring

network actually represents the exposure situation for young

children, it seems likely that where elevated air lead levels

do occur, they will be close to point or mobile sources. Typically

young children will not encounter such levels for the full twenty-four hour period reported by the monitor.

(3) there is medical evidence indicating that blood lead levels reequili-brate slowly to changes in air exposure which serves to dampen the impact of a short-term period of exposure to elevated air lead.

(4) since direct exposure to air is only one of several routes of total exposure, a change in air lead would not impact proportionately on blood lead levels.

On balance, the Agency concludes that a requirement for the averaging of air quality data over calendar quarter will improve the validity of air quality data gathered without a significant reduction of the protectiveness of the standard.

The Appropriate Margin of Safety

Several comments received by the Agency criticized the proposed standard as incorporating an excessively large margin of safety. Conversely, some commentors were concerned that little or no safety margin had been applied.

EPA Resolution:

One approach to the satisfaction of the Clean Air Act requirement for an "adequate margin of safety" in ambient air quality standards has been the establishment of a threshold for adverse effects in the sensitive population with the selection of the final standard at some point below this level. The extent of the margin applied is largely dependent on the severity of the health effects documented and uncertainties associated with the scientific data base.

In the case of lead air pollution, the estimate of margin of safety is complicated by the multiple sources and media of lead exposure. EPA has elected to use margin of safety considerations in determinations of each of the intermediate factors rather than in a single final adjustment to the calculated air level. It is EPA's conclusion that the incorporation of conservative estimates of intermediate factors, where uncertainty exists, is a reasonable approach to margin of safety determination, and that the Agency's judgments have not been shown to be excessively or deficiently protective of human health.

The Importance of the Respirable Fraction of Total Air Lead Level

The Agency received a number of comments expressing concern that because the respirable fraction of airborne particulate lead is more readily absorbed into the blood stream, an air standard based on total air lead is unnecessarily protective of health.

Agency Response

EPA acknowledges the important role of respirable lead as a contributor to total lead body burden. It is not reasonable to conclude, however, that the presence of particles beyond this range do not represent an exposure condition. In addition to the indirect route of ingestion and absorption from the gastrointestinal tract, non-respirable lead in the environment may, at some point, become respirable through weathering or mechanical action. EPA concludes, therefore, that total airborne lead, both respirable and non-respirable fractions, is appropriate as a measure of total air exposure.

The Economic Impact of the Proposed Standard

In general, the comments received by the Agency were supportive of the draft Economic Impact Assessment. Commentors critical of the

assessment argued that the forecast underestimated the severity of the economic impact to certain lead industries.

Agency Response

The comments critical of the draft impact statement did not include data which would allow EPA to confirm the possibility of more severe economic impacts. Since the analytical methods employed were not brought into question, it is the Agency's judgment that the impact statement, with modifications necessitated by the change in averaging period, is a reasonable forecast of the economic consequences of implementation of the standard.

The Proposed State Implementation Plan (SIP) Regulations

A summary of comments and the Agency resolution is included in the preamble to the final regulations published elsewhere in this Federal Register.

The Federal Reference Method for Monitoring Lead Air Quality

A summary of comments and the Agency's resolution is included in the preamble to the final method published elsewhere in this Federal Register.

The Administrative Procedures Employed by EPA in the Development of the Proposed Standard and the Provision for Public Participation

Two commentors requested that cross examination of witnesses be allowed in the post-proposal public hearing on the proposed standard and implementation regulations. EPA also received a request to postpone the public hearing and to extend the comment period, citing the need to complete ongoing studies.

Agency Resolution:

Both the request for cross examination and for extension of the comment period were denied by the Agency. In the former case, it is

the Agency's view that cross examination would be counter to the informal rulemaking procedures followed by the Agency. Due to the extensive review opportunities available at all stages of regulatory development, an extension of the comment period was not felt to be sufficiently necessary to further delay the schedule for the preparation of the final rule.

TAB E- Summary and Comparison of Rationales Underlying the
Proposed and Final Standard

SUMMARY AND COMPARISON OF RATIONALES

Underlying the Proposed and Final Statement

Proposal/December 14, 1977

1. Selection of children, ages 1-5, as the sensitive population

   Rationale: Young children experience adverse effects at lower

   levels of exposure, and the effects may be more severe due to

   developing organic systems. Young children may be at a greater

   risk of exposure to environmental lead contamination.

2. Estimate of the maximum safe mean blood lead level for children.

   Rationale: accepting that the elevation of EP is the first effect

   which is adverse to health, the maximum safe blood lead level was

   taken to be the point where a correlation could be delicted between

   increasing blook lead and elevated EP. From extensive blood sampling

   in the population of New York City, children, analyzed by Piomelli,

   the threshold for this correlation was estimated to be at a mean

   blook lead of 15 µgPb/dl.

3. Estimate of non-air contribution to mean blood lead.

   Rationale: without this estimate the air standard would not be

   protective of public health. Based on mean blood lead levels in areas

   with very little air lead, and certain isotopic tracing studies,

   12 µgPb/dl as the maximum safe contribution for air exposure.

4. Estimate of air level contributing 3µgPb/dl to mean blood lead levels

in children.

   Rationale: epidemiological studies show a realtionship between lead

   in the air and lead in the blood. In the range of data available,

   1:2 was adopted as the best estimate of the impact 1 µgPb/m^3 on

   blood lead levels for children, and with many in safety considerations.

5. Calculation of the Standard.

Max safe mean blood lead		15 µgPb/dl
Non-air sources of lead	-	12 µgPb/dl
		3 µgPb/dl
air lead/blood lead relationship		1 µgPb/m /2 µgPb/dl
Proposed Standard		1.5 µgPb/m^3

FINAL STANDARD

1. Selection of Children as the sensitive population

   Rationale: same as for proposal

2. Estimate of Maximum Safe Blood lead level.

   Rationale: commentors pointed out that this critical factor could differ with use of different statistical techniques to estimate the threshold for correlation of EP with bolld leads. OAWM agrees with this point, but believes that 15 µgPb/dl should remain as the maximum safe mean blood lead for children for two reasons: 1) it is still in the range, although at the lower end. of estimates for this threshold, 2) because of population variation this population mean level is necessary to place most children below 30 µgPb/dl, the CDC guideline which OAWM adopts as the maximum safe blood lead for an individual child. OAWM further believes that any higher mean blood lead would reduce the health risk of the sensitive sub groups within the general population of children.

3. Estimate of non air contribution to mean blood lead.

   Rationale: same as for proposal

4. Estimate of air level contributing 3µgPb/dl to mean blood lead levels in children.

   Rationale: same as for proposal

5. Calculation of the Standard.

   Rationale: same as for proposal

TAB F- Table of Alternate Standards

Alternatives for the Level of the Final Lead Standard

Geometric standard deviation of measured blood lead values : 1.3

Non-Air Contribution to Mean blood lead : 12 ug Pb/dl

Air Lead/Blood lead Relationship 1:2

Health Effect Choice	% of Population	Estimated Mean Blood Level	Standard
Clinical anemia, threshold 40 ug PB/dl	99%	22	5.0
	99.9%	18	3.0
Subclinical impairment of heme synthesis indicated by elevated Erythrocyte Protoporplyrin, max. safe level 30 ug Pb/dl	99%	16	2.0
	99.5%	15	1.5
	99.9%	13	0.5

TAB G- Options for Dealing with Point Source Economic Impacts and
        Attainment Difficulties

DISCUSSION OF LEAD NONATTAINMENT PROBLEM

I.   STATEMENT OF PROBLEM

In the Economic Impact Assessment, OANR concludes that certain point sources of lead emissions may have severe technical or economic difficulty in attaining the standard, and that one primary lead smelter and many secondary lead smelters may face closure. These conclusions are based on rough estimates of emission factors for lead fugitive emissions, technical factors for hypothetical plants, and dispersion modeling. The actual impact of the standard will be more accurately known with the development of State implementation plans based on plant-specific data. Nevertheless, EPA is in the position of promulgating the standard with clear indications of severe impacts on nonferrous smelters, but without precise information on the extent of these impacts. In the following sections, OANR reviews the available analysis and possible alternatives and recommends an agency approach to dealing with this problem.

II. ANALYSIS RESULTS

A.   Mobile Sources

Even though mobile sources currently contribute about 90% of total lead emissions nationwide, the existing EPA regulations for the phase-down of lead in gasoline and the availability of lead-free gasoline will result in significant reductions in lead mobile source emissions. The OANR estimates that there will be only two AQCRs with mobile source violations in 1982, and further decline in mobile source emissions will eliminate mobile source violations by 1984.

B. Stationary Sources--Air Quality Analysis

At the level of the recommended standard of 1.5 μgPb/m^3, quarterly average, the principle economic impact of the standard will fall on primary copper smelters, primary lead smelters, secondary lead smelters, gray iron foundries, gasoline lead additive plants, and battery manufacturing plants. The EPA analysis was based on hypothetical sources, however, so in actuality other source categories may need to be controlled under certain conditions.

1. For primary lead smelters, the analysis predicts required control greater than 95 percent to meet the standard if the highest estimated fugitive emission rates are assumed. Best known control technology currently available might not be sufficient to attain the lead NAAQS around primary lead smelters with high fugitive emissions. Therefore, enforcement of the standard could cause closure of those smelters.

2. For secondary smelters, the analysis predicts required control greater than 95 percent to meet the standard if either the high or medium estimated fugitive emission rates were assumed. Again, best available control technology might not result in attainment around some secondary lead smelters, and some of these sources may have to be closed.

3. For the remaining four categories, the analysis predicts that attainment can be achieved with known technology.

C. Stationary Sources--Economic Analysis

Even if all known technology were applied to a particular source, regardless of whether the lead standard were attained near that source, the cost of installing that equipment alone may force some primary and secondary lead smelters and primary copper smelters to close. This conclusion was based on a range of assumptions concerning the degree of depreciation, tax rate, and minimally acceptable rate of return on investment for each plant.

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D. Stationary Sources--Summary of Extent and Impact

Table 1 presents a summary of the extent and impact of the lead nonattainment problem, giving the number of plants, the emission sources requiring control (fugitive or stack), and the potential closures for some plants.

III. FACTORS AFFECTING ACCURACY OF ANALYSIS

A. Lack of Representativeness of Hypothetical Sources

The economic analysis was based only on hypothetical plants. The hypothetical plants were based on actual plants, and the meteorological data used in the air quality model were taken from stations located in the vicinity of actual plants. This approach was taken rather than analysis of each facility because of the lack of data for individual facilities and because of the amount of time and resources required for analysis of each of the many individual sources of lead emissions.

B. Inadequate Fugitive Emission Factors

Fugitive emissions are difficult to quantify accurately since they are dependent on a wide range of site-specific parameters. The fugitive emission factors used in the analysis were derived from the few studies available and those studies were performed on only a few sources. A wide range of values was generally assumed.

C. Difficulty in Determining the Efficiency of Fugitive Control

Fugitive particulate emissions are generally uncontrolled; they can be controlled through hooding or enclosing of the operations that generate the emissions and venting the captured emissions to a fabric filter or other control device. OANR estimates that total operation enclosure and venting the emissions to a fabric filter will result in an overall capture and control efficiency of about 95 percent; the efficiency cannot be determined directly because fugitive emissions cannot normally be measured directly.

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TABLE I: STATIONARY SOURCE IMPACT ASSESSMENT SUMMARY

Source Category	No. of Plants in U.S.A.	Emission Sources Requiring Control	Potential Closures for Some Plants
Primary Lead Smelting	6	Fugitive	Yes
Secondary Lead Smelting	56	Fugitive	Yes
Primary Copper Smelting	16	Fugitive	Yes
Gray Iron Foundries	1500[a]	Fugitive	No
Gasoline Lead Additives	6	Stack	No
Lead Acid Battery Mfg.	191	Stack	No

[a]The gray iron foundry modeled had a cupola furnace. There are 841 foundries with cupola furnaces.

D.   Validity of Assumptions

1. The air quality analysis assumed that no background lead concentrations exist around the sources analyzed.

2. The analysis assumed that by 1982 all of the stationary sources of lead that require SIP control for particulate matter would be in compliance with the SIP particulate matter limitations. The more particulate matter control that actually occurs, the less the lead control needed, with the opposite situation being true. The particulate limitations applied primarily to stack emissions, however, while fugitive emissions, whose impact was far more significant, were assumed to be uncontrolled.

3. The model used does not account for deposition ("fall out") of large particles that may be present in the fugitive emissions. The analysis assumed that the particles were sufficiently small so that they behaved in a manner described by traditional Gaussian diffusion models. If particles deposit closer to the source than the model predicts, the concentrations downwind may be less than those actually calculated. The deposited emissions themselves, however, may become an independent source of emissions if the deposited dust is reentrained by wind or other mechanical disturbances.

E.   Economic Assumptions

The economic analysis assumed a range of values for factors such as the degree of depreciation of the plant, the tax structure under which the plant operates, and the minimally acceptable rate of return on investment for the plant. These factors in actuality vary significantly from facility to facility.

IV. OTHER CONSIDERATIONS

A. Primary Nonferrous Smelters

The forthcoming lead standard is only one more regulatory impact on the primary nonferrous smelters. In addition to lead, primary nonferrous smelters emit other fugitive emissions such as particulate matter, sulfur oxides, arsenic, cadmium, zinc, and manganese. Through revisions of current SIPs, fugitive particulate matter and sulfur oxides emissions will have to be controlled. Through development of other National Ambient Air Quality Standards under § 109 of the Clean Air Act, regulations for designated pollutants under § 111(d) of the Act, or National Emission Standards for Hazardous Air Pollutants under § 112 of the Act, fugitive emissions of arsenic, cadmium, zinc, and manganese might also have to be controlled. Complying with the forthcoming control requirements may not be possible on technical or economic grounds. Hence, even without a lead standard, primary nonferrous smelters could face compliance problems.

In the Clean Air Act Amendments of 1977, Section 119 recognizes the particular economic and feasibility problems of smelters in allowing certain relief measures to smelters in attaining the SO_2 standard.

B. Noncompliance Penalties

Section 120 of the Clean Air Act requires EPA to assess penalties against major stationary sources that are not in compliance with any emission limitation, emission standard, or compliance schedule under any applicable plan. The penalty is to be equal to the economic benefit that the source would experience from noncompliance.

Although primary nonferrous smelters that receive orders under Section 119 of the Act are exempt, OGC has indicated that the smelters are only exempt from limitations, standards, and schedules that

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pertain to SO_2 control. Thus, if a primary nonferrous smelter were not in compliance with a limitation, etc., for lead, EPA (or a State that has been delegated the appropriate authority) would have to assess a penalty against that source even if that smelter had received a primary nonferrous smelter order. The term "major stationary source" is defined by the Act to mean "any stationary facility or source of air pollutants which directly emits, or has the potential to emit, one hundred tons per year or more of any air pollutant (including any major emitting facility or source of fugitive emissions of any such pollutant, as determined by rule by the Administrator)." (Emphasis added.)

V. CONCEPTS FOR ALLEVIATING ANTICIPATED ECONOMIC IMPACTS

OANR has investigated a number of concepts for alleviating the anticipated economic impacts of setting and implementing a national ambient air quality standard for lead. The following discusses these concepts.

A. Two Year Extensions

Section 110(e) of the Clean Air Act allows EPA to grant an extension of up to two years for attainment of a primary standard if certain conditions are met. EPA could encourage States to request the two year extension if sources could not comply more quickly with the control measures needed.

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B. Supplemental Control Systems

Section 119 of the Clean Air Act allows the use of supplemental control systems (SCS) for primary nonferrous smelters, but only to meet an emission or air quality standard for SO_2. Furthermore, SCS is directed at reducing peak short-term concentrations to avoid violations of a short term standard. Since the lead standard is a longer term standard (i.e., 90 days), SCS does not appear to be appropriate to reduce violations.

C. Delayed Compliance Orders

Section 119 of the Clean Air Act authorizes delayed compliance orders (DCOs) for primary nonferrous smelters, but only to meet an emission or air quality standard for SO_2.

Under Section 113(d) of the Clean Air Act, both the States and EPA may issue a delayed compliance order which permits the owner or operator of a stationary source to delay compliance with provisions contained in a State Implementation Plan (SIP). To be eligible for a delayed compliance order, a source must be unable to comply with the SIP regulations to be covered by the order. In addition, the order must, among other requirements, establish interim emission limits which reflect the best practicable system of emissions reduction and a schedule which requires compliance as expeditiously as practicable.

The maximum delay that can be authorized by a Section 113(d)(1) order is three years after the date for final compliance required by the SIP regulation covered by the order. If the Administrator of EPA approves in 1979 SIP regulations designed to implement a national lead standard, the latest date (without an extension under § 110(e)) a SIP compliance schedule could establish for source compliance with emissions limitations designed to achieve the standard is 1982. This date is set under Section 110(a)(2)(A) of the Act, which provides that the attainment date for a national primary ambient air quality standard can extend up to three years from the time the Administrator approves provisions of the SIP designed to implement the standard. Thus, SIPs could contain compliance schedules with increments of progress which set 1982 as the date for compliance with lead emission regulations. If a SIP does set 1982 as the final compliance date, a delayed compliance order, if appropriate, could permit a source to delay compliance with the regulations up to 1985.

There are two instances where a delayed compliance order could permit a delay in compliance beyond 1985. Under Section 110(e) of the Act, the Administrator may extend an attainment date for two years if

certain conditions are met. If a two year extension is granted regarding attainment of a primary lead standard, a SIP compliance schedule could provide for compliance with the lead emission limiting regulations by 1984. If a SIP did set 1984 as the date for compliance, a Section 113(d)(1) order could, if appropriate, extend compliance up to 1987.

Compliance could also be delayed beyond 1985 if the source uses a "new means of emission limitation." If the new means is approved by the Administrator as satisfying certain conditions in the Act, the Administrator may issue a delayed compliance order under 113(d)(4) of the Act. The maximum delay in compliance that may be permitted by an order issued under this subsection is five years after the date for final compliance required by the SIP regulation covered by the order. If the SIP set a 1982 compliance date, a Section 113(d)(4) order could delay compliance up to 1987; if the SIP set a 1984 compliance date, the order could delay compliance up to 1989. A source granted a Section 113(d)(4) order is exempted by Section 120(a)(2)(B)(iii) of the Act from liability for noncompliance penalties based upon violation of the SIP regulation covered by the order.

D.   Research and Development Effort

A research and development effort is not expected to yield any new technologies in the near future better than those that exist for the control of fugitive emissions from primary and secondary lead smelters (i.e., enclosure of operations and venting of emissions to a fabric filter).

One kind of "R & D" effort that could be undertaken, however, is a set of demonstration fugitive emission control projects on one or more smelters that EPA would fund under section 103 of the Clean Air Act.

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These projects would actually result in some degree of control. Such an effort could be considered a veiled attempt at Federal subsidy for emission controls, and unless they were applied equitably from facility to facility, EPA could be accused of creating unfair advantages for a particular facility.

E. Definition of Ambient Air

Under this concept, EPA would continue to interpret attainment of the standard as being required only in areas to which the general public has access. If standards were violated on the fenced property of the existing source but not outside the property, the standard would be attained. EPA may consider accepting land acquisition and fencing by the emitting facility as a control strategy.

This concept of what constitutes the ambient air, however, is currently undergoing major reconsideration in EPA. There appears to be a strong argument for requiring the attainment of the national standards everywhere based on the wording of section 107(a) of the Clean Air Act, which states, "Each State shall have the primary responsibility for assuring air quality within the entire geographic area comprising such state. . ." (emphasis added). The Office of General Counsel argues, however, that this need not be applied literally and that some flexibility concerning the placement of monitors to measure the air concentrations can be assumed. OGC feels that the flexibility can be accomplished through revised EPA guidelines on monitoring that could preserve substantial discretion for the States and Regional Offices to decide not to require monitors too close to a source if the circumstances of the situation indicate a less stringent approach.

Land acquisition has several other problems also. The policy of land acquisition would probably not be applicable where the sources were not isolated; if doubt existed as to the actual source of the lead emissions that were causing a violation of an ambient standard, Source A could charge that emissions from Source B are the cause of the violations of the standard or even that Source B is causing violations on the property of Source A. Also, the lead emissions from stationary sources contain both large and small particles. Land acquisition may solve the problem of containing the large particles that deposit close to the source, but the small particles may be carried beyond any amount of land that could be economically acquired by the company.

F.   Deferring Decision on Options Until SIP Submission

Under this concept, EPA would require the "traditional" approach to developing a SIP, i.e., require each State to analyze the air quality impact of each source based upon available data, develop and evaluate control strategies where needed, select a control strategy that is adequate on paper, and submit the plan to EPA. At that time, it will be possible to determine whether--

1.   the plan requires all the control that is technologically feasible, the sources are eventually controlled to that level, and the NAAQS is still not being attained; or

2.   the level of control required would cause severe economic impacts and plant closures.

OANR believes that a more accurate estimate of economic impacts can be made on the basis of the SIP submissions, particularly if EPA works

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with the States and affected industries to develop accurate and plan-specific emissions data. As OAQPS reviews the SIP submissions, better judgments can be made about the possibility of compliance date extensions under sections 110, or 113, the allowance of land acquisition, or other steps that may mitigate the economic consequences of the control program. If at the time of SIP review severe impacts and possible closures are seen to be unavoidable, EPA should undertake to inform the affected congressional delegations and appropriate congressional committees of the projected impacts, and the restricted latitude available to EPA to balance public health objectives with economic goals.

G.   Biological Monitoring

This approach was suggested in public comments from representatives of primary lead smelters. Under this approach, sources that could not control emissions so that the lead standard will be met would be allowed to conduct a public health screening and hygiene program aimed at reducing the amount of lead that persons in the vicinity of the source take in and ensuring that safe blood lead levels are satisfactorily maintained.

There are legal, technical, and equity problems with this approach that render it unacceptable as a means of implementation of the national standard.

Concerning the legal problems, such a program assumes that the air quality standard will be violated, and presumably, the plan will not contain a demonstration that the air quality standard will be attained.

Under the Clean Air Act, EPA must disapprove a plan that does not contain a demonstration that the air quality standard will be attained by the mandatory attainment date. The Act provides for the protection of health through the standard setting, planning, and implementation processes; it does not allow for a surrogate procedure whereby public health may be protected even though the ambient standards are not met.

Concerning technical problems, the relationship between emissions from a source and blood lead levels is even not quantitatively certain. Even assuming a biological monitoring system were to be established, it is unclear what the source would have to do concerning its operation or emissions if the monitoring program revealed unacceptable blood lead levels. Even if a course of action were clear, the damage would have already been done, while the basic purpose of the standard setting and implementation process envisioned by § 110 of the Act is prevention of public health problems.

Concerning equity, the biological monitoring program would inconvenience the very people that are supposed to benefit from the Act. The Act envisioned that all people have an equal right to healthy air. The biological monitoring approach would imply that people who happen to live in areas with elevated air lead levels should not be accorded equal protection, but should be made to pay extra for their health through presumably continuous participation in a blood sampling program. If a person did not want to participate, it is doubtful whether he could be forced to, so therefore, his health could be placed in jeopardy.

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H.   Financial Assistance Programs

There are a number of financial assistance programs for air pollution control available through the Federal Government. These programs include the following:

--Industrial development bonds, which are sold by State and local governments to help companies obtain financing necessary to meet Federal pollution control requirements. The interest on such bonds are tax-free.

--Investment tax credits, which allow a firm to take 10 percent of the cost of certain capital investiments as a credit against its Federal tax liability. Investments in the purchase and installation of pollution control equipment are among the investments eligible for the tax credit.

--Rapid tax amortization of control equipment, which provides for a five-year amortization election for facilities that will prevent the creation or emission of pollutants when installed at the site of a plant or other property in existence before January 1, 1976; there are a number of conditions, however.

VI. CONCLUSIONS

A.   States will have difficulty in developing a SIP that demonstrates attainment of the proposed lead standard for the following reasons:

1.   States will have to use available fugitive emission factors, even though they are of questionable validity, or develop their own factors, to perform their air quality analyses in support of their SIPs.

2.   With limited resources and the nine-month period in which the plans must be developed, the States will not be able to develop emission factors for specific facilities.

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3. Any air quality model used to demonstrate the effect of a control strategy will only yield a theoretical impact and may not accurately represent the actual situation under study.

4. The efficiency of the fugitive emission control techniques has only been estimated, not verified.

B. Some sources might never achieve a level of control that will result in attainment of the proposed lead standard without ceasing operations. This is because of the suspected magnitude of the fugitive emissions from some sources and the suspected limitations on the degree of control that can be technologically achieved.

C. Even if EPA does not set a NAAQS for lead, other regulatory actions could still cause adverse economic consequences for the smelters.

D. Under the existing provisions in the Clean Air Act, there are no options for totally alleviating the severe economic impacts on some stationary sources of lead emissions that may arise. It should be emphasized that the severity of the impact is only an estimate, and may be more or less than estimated.

VII. RECOMMENDATIONS

OAWM recommends a combination of some of the concepts mentioned above. This combination of approaches would encompass the following:

A. The States would be required to develop their SIPs under a traditional approach (Concept F, above). That is, they would have to (1) analyze the air quality impact of all primary and secondary lead smelters and primary copper smelters (among other source categories) based upon available data and emission factors, (2) develop and evaluate control strategies where needed, (3) select a control strategy that is

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adequate on paper to attain and maintain the lead standard, and (4) submit the plan to EPA. States will request two-year extensions of the attainment dates under § 110(e) of the Act as needed.

B. In cooperation with EPA regions, State agencies, and affected plants, OAQPS will act to improve data on critical point sources (nonferrous smelters) to the extent possible in the SIP development review.

C. Sources will request extensions of compliance dates under § 113(d) of the Act.

D. OAQPS will provide guidance to the States on the applicability of land acquisitions as an acceptable control strategy.

E. OAQPS will re-assess economic impacts of the attainment program at the time of SIP review, and inform all interested groups about the results of this projection and what ameliorative steps EPA can take under the Act. This will include discussions with members of Congress, the executive branch, and affected industries.

F. EPA will issue an advance notice of proposed rulemaking on a requirement for air quality monitoring in the vicinity of primary and secondary lead smelters, and primary copper smelters. This would initiate a program for obtaining the air quality data that is essential to both a more accurate definition of the problem and the determination of the effect of control measures.

G. OAQPS will request ORD to obtain more representative information on fugitive lead emissions and will also make available reports that describe several techniques for estimating fugitive lead emissions.

H. OAQPS will request OPM to undertake a study of the impact of EPA regulations on the primary nonferrous smelters. The study would investigate which smelters will have difficulty meeting the various

environmental regulations, the magnitude of the nonattainment problem, the area of impact around the sources, the cost of control, and the various options available for alleviation of severe economic impacts.

TAB H- Comments from Other Federal Lead Regulatory Programs

Comments by other Federal Agencies

Comments on the proposed lead air quality standard were received from eight Federal agencies. Five of the agencies endorsed the air standard while three of the agencies commented on specific issues and neither endorsed nor opposed the standard. The Center for Disease Control and the U.S. Public Health Service voiced support for the proposed standard of 1.5 µg Pb/m^3 and urged basing the decision on the standard solely on considerations of the public health. CDC is fully satisfied that EP elevation does indeed represent a subclinical manifestation of lead toxicity and that young children are the population most at risk from lead exposure, while some subgroups of children are at special risk to lead because of conditions such as malnutrition, genetic factors, or iron deficiency.

The Consumer Product Safety Commission endorsed the approach and some of the judgments made in arriving at the air standard. CPSC concurs with the position that children are the population at enhanced risk to lead exposure, and that the goal of a mean population blood lead level for children of 15 µg Pb/dl is sufficiently low to be protective of the population at enhanced risk of exposure. CPSC views the selection of EP elevation as the adverse health effect of concern as open to challenge and suggests basing the standard on a more generally recognized severe health effect. CPSC concurs that the contribution of non-air sources to lead body burden must be evaluated in setting the air standard and suggests that a larger non-air contribution, such as 13.5 µg Pb/dl used in the California standard, might be considered.

The Food and Drug Administration commended EPA's proposal of an ambient air quality standard for lead. FDA agrees that children aged 1-5 years old comprise the most critically sensitive population. FDA concurs that 15 μg Pb/dl is a reasonable maximum blood lead level to use as an average national goal for children aged 1 to 5, although FDA suggests that for young children the margin of safety is disturbingly narrow. The division of the 15 μg Pb/dl into 12 μg Pb/dl for non-air sources and 3 μg Pb/dl for air sources was not unreasonable in FDA's view.

The Occupational Safety and Health Administration endorsed EPA's proposed standard for lead and agrees with EPA that 15 μg Pb/dl as an average national blood lead level goal for young children is reasonable. OSHA views their proposed standard of 100 μg Pb/m^3, 8-hour time weighted average, and their establishment of 40 μg Pb/dl as the threshold effect level for workers as consistent with the EPA proposed standard.

The Department of Transportation (DOT) endorsed the proposed standard of 1.5 μg Pb/m^3. Based on an analysis of the impact of the proposed standard on the highway program, DOT concluded that it is highly probable that transportation-related violations of the proposed standard would be limited to large urban areas.

In commenting on the proposed standard, the Department of the Interior (DOI) expressed concern that the burden for meeting the proposed standard will fall primarily on lead and copper smelters and battery manufacturers, and commented on the impact of lead dustfall on ground water quality. The Tennessee Valley Authority provided specific comments on the proposed State Implementation Plan Regulations and the proposed Federal Reference

Method. The Department of Commerce offered substantive comments on the environmental impact statement, pointing out that more consideration should be given to the potential impact of the standard on the petroleum industry.

The Occupational Safety and Health Administration proposed regulations in 1975 to limit occupational exposure to lead to 100 µg Pb/m^3, 8-hour time weighted average. The exposure limit was based on protecting against effects, clinical or subclinical, and the mild symptoms which may occur below 80 µg Pb/dl, providing an adequate margin of safety. The level of 100 µg Pb/m^3 anticipated to limit blood lead levels in workers to a mean 40 µg Pb/dl and a maximum of 60 µg Pb/dl. OSHA is presently reviewing the latest information on lead exposure and health effects in preparation for promulgation of the workplace standard for lead.

The Department of Housing and Urban Development (HUD) has requirements for reducing human exposure to lead through the prevention of lead poisoning from ingestion of paint from buildings, especially residential dwellings. Their activities include (1) prohibition of use of lead-based paints on structures constructed or rehabilitated through Federal funding and on all HUD-associated housing; (2) the eliminations of immediate lead based paint hazard; (3) notification of purchases of HUD-associated housing constructed prior to 1950 that such dwellings may contina lead-based paint; and (4) research activities to develop improved methods of detection and elimination of lead-based paint hazards, and the nature and extent of lead poisoning.

The Consumer Product Safety Commission (CPSC) promulgated regulations in September 1977 which ban:(1) paint and other surface coating materials containing more than 0.06 percent lead; (2) toys and other articles intended for use by children bearing paint or other similar surface coating

material containing more than 0.06 percent lead; and (3) furniture coated
with materials containing more than 0.06 percent lead. These regulations
are based on CPSC's conclusion that it is in the public interest to reduce
the risk of lead poisoning to young children from ingestion of paint
and other similar surface-coating materials.

The Food and Drug Administration adopted in 1974 a proposed tolerance
for lead of 0.3 ppm in evaporated milk and evaporated skim milk. This
tolerance is based on maintaining children's blood lead levels below
40 µg Pb/dl. FDA also has a proposed action level of 7 µg/ml for
leachable lead in pottery and enamelware, although the exact contribution
of such exposure to total human dietary intake has not been established.

The Center for Disease Control concluded in 1975 that undue or increased
lead absorption exists when a child has confirmed blood lead levels of
30-70 µg Pb/dl or an EP elevation of 60-189 µg Pb/dl except where the
elevated EP level is caused by iron deficiency. This guideline is presently
accepted by the scientific community but because of more recent data is
being reevaluated.

TAB I- Final Environmental Impact Statement

NATIONAL AMBIENT AIR QUALITY STANDARD FOR LEAD

FINAL DRAFT

ENVIRONMENTAL IMPACT STATEMENT

U.S. ENVIRONMENTAL PROTECTION AGENCY
Office of Air and Waste Management
Office of Air Quality Planning and Standards
Research Triangle Park, North Carolina 27711

July 1978

ABSTRACT

Under Section 109 of the Clean Air Act, the U.S. Environmental Protection Agency intends to promulgate a National Ambient Air Quality Standard for lead. In this report, the sources and 1975 ambient air concentrations of lead, trends in growth, and the existence and potential for lead emissions control are summarized. Emission control strategies have been developed and, under one, the nationwide environmental impacts are assessed for three alternative standards (1.0 $\mu g/m^3$, 1.5 $\mu g/m^3$ and 2.0 $\mu g/m^3$) and a quarterly averaging period.

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1.0 INTRODUCTION AND BACKGROUND

On May 7, 1974, the Administrator of EPA announced in the _Federal_ _Register_ that the Agency, although not required to do so by law, would prepare environmental impact statements on significant regulatory actions. Because the National Ambient Air Quality Standard (NAAQS) for lead, proposed under Section 109 of the Clean Air Act, meets the criteria for a significant action, the following impact analysis of standard implementation has been prepared.

The EIS employs actual and estimated air quality data, adjusted for growth, to predict areas of the country which may exceed a particular standard level by the date for attainment. Under the assumption that emissions of lead are proportional to lead air quality, the percentage reduction in emissions necessary to attain the standard in such areas is calculated. The extent of the required rollback is heavily influenced by the large emission reductions expected with the implementation of lead phasedown regulations for gasoline and the anticipated compliance of sources with state implementation plans for control of particulate matter. As a result, two categories of stationary sources of lead emissions, primary lead and copper smelters, are identified by the EIS as requiring additional lead emission control by the attainment date of 1982.

The Economic Impact Assessment (EIA), published separate from the EIS but incorporated by reference, utilizes a somewhat different methodology to estimate the economic consequences of standard implementation. Dispersion models are employed to estimate air quality resulting from lead emissions of plants representative of each source

category. Because this technique is more sensitive to point source impacts than the linear rollback model applied in the EIS to determine Air Quality Control Regions (AQCR's) with potential for violating alternative standard levels, the EIA identifies potential problems for the additional source categories of: Secondary lead smelters, lead-acid battery manufacturers, grey iron foundries, and lead additive manufacturers.

BACKGROUND: EVENTS LEADING TO THE LISTING OF LEAD UNDER SECTION 108

CLEAN AIR ACT AMENDMENTS OF 1970

In 1970, Congress adopted Amendments to the Clean Air Act. The Senate Committee on Public Works, in recommending the changes to the Act, made specific reference to lead as a contaminant of broad national impact, suggesting that air quality criteria for this pollutant be issued within 13 months of enactment of the amendments.

REGULATION OF LEAD AS A FUEL ADDITIVE UNDER SECTION 211

EPA analysis of the available data on atmospheric lead singled out mobile source emissions as the largest contributor to ambient lead levels. The use of lead additives to increase the octane rating of gasoline fuels was estimated by the Agency to account for approximately 90% of the air lead observed nationwide. In early 1971, EPA determined that the most effective means of reducing atmospheric lead concentrations

would be to remove or reduce the lead in gasoline and issued an Advanced Notice of Proposed Rulemaking on January 30, 1971.

Under Section 211 of the Clean Air Act, the Administrator of EPA is authorized to regulate any motor vehicle fuel additive which "causes, or contributes to, air pollution which may reasonably be anticipated to endanger the public health or welfare" or which "will impair to a significant degree the performance of any emission control device." [Section 211(C)(1)]. The January, 1971, notice outlined regulation of additive lead under both criteria; first, to gradually phase down the lead content of gasoline and, second, to establish and provide for the availability of a lead-free fuel which would not poison the catalytic convertors scheduled for installation in new model cars to reduce emissions of hydrocarbons and carbon monoxide.

In February, 1972, EPA proposed regulations requiring the availability of a grade of lead-free gasoline and a phased reduction of lead in gasoline over a four-year period (37 FR 3882). Following an extended comment period the Agency determined that the two regulations should be dealt with separately. On January 10, 1973, regulations requiring the availability of lead-free fuel by July 1, 1974 were promulgated (38 FR 1255).

Re-evaluation of the health effects analysis by EPA, based on comments received, led to reproposal of the phase-down regulations on January 10, 1973 (38 FR 1258) and promulgation on December 6 of the same year (38 FR 33734). These regulations provided for a phase-down

in the average lead content of gasoline to 0.5 grams per gallon over a period of four years, beginning January 1, 1975. The schedule was designed to ahcieve a 60-65 percent decrease in lead usage in gasoline. EPA determined that the phase-down schedule was reasonable with regard to protection of health and economically and technically feasible.

On December 20, 1974, the U. S. Court of Appeals for the District of Columbia Circuit set aside the phase-down regulations, following a petition by members of the additives industry. At that time, EPA suspended enforcement. On March 17, 1975, however, the Court vacated the prior judgment which served to reinstate the regulations. EPA continued to suspend enforcement until the June 14, 1976, decision by the U. S. Supreme Court upholding the regulations. A revised phase-down schedule was promulgated on September 28, 1976, which required that the pooled average of lead in gasoline be reduced to 0.5 grams/ gallon by October 1, 1979.

LITIGATION TO REQUIRE NAAQS FOR LEAD UNDER SECTION 109

During 1976, the Natural Resources Defense Council (NRDC) and others, brought suit against EPA for failing to list lead as a pollutant under Section 108 of the Clean Air Act and subsequently establish ambient air quality standards. NRDC argued that the statutory language, legislative history and purpose, and administrative interpretation of the Clean Air Act required that the EPA Administrator list pollutants under Section 108 if the pollutant is ubiquitous and "may cause or contribute to air pollution which may reasonably be anticipated to endanger public health or welfare." EPA argued that the listing of pollutants under Section 108 is at the discretion of the Administrator.

The Agency had determined that the most effective means of reducing ambinet lead levels was through reduction of the lead content of gasoline. Therefore, the pollutant need not be listed even though it met the criteria of Section 108.

In NRDC et. al. vs. Train, the U. S. District Court of the Southern District of New York ruled against EPA stating:

"There is no language anywhere in the statute which indicates that the Administrator has discretion to choose among the remedies which the Act provides. Rather, the language of Section 108 indicates that upon certain enumerated conditions, one factual and one judgmental, the Administrator "shall" list a pollutant which triggers the remedial provisions of Sections 108-110. The statute does not provide, as defendants (EPA) would have it, that the Administrator has authority to determine whether the statutory remedies which follow a Section 108 listing are appropriate for a given pollutant."

As of March 1, 1976, EPA was given thirty days to list lead under Section 108. The listing was signed on March 31, 1976, and announced in the Federal Register on April 8, 1976, pursuant to the Court's decision.

In July, 1976, EPA appealed the lower court's decision. Pending the decision of the appellate court, the one-year time-table for issuance of the air quality criteria and proposal of national ambient air quality standards for lead was stayed. On November 10, 1976, the U. S. Court of Appeals upheld the original decision. A period of nine months was

allowed for the issuance of criteria and proposal of the standard. The August 10, 1977, deadline was not met due to delays in finalizing the air quality criteria document for lead which, under the Section 109, must be issued at proposal. EPA reached agreement with the litigants to reschedule the standard proposal date to December 2, 1977.

On December 14, 1977, EPA proposed a level of 1.5 $\mu g/\text{m}^3$, calendar month average, as an ambient lead standard protective of public health with an adequate margin of safety. Following receipt and consideration of comments by the Agency, the averaging period for the final standard has been lengthened to a calendar quarter. This change is not anticipated to significantly reduce the protectiveness of the standard but will improve the validity of air quality data gathered and avoid placing an undue burden on state and local air pollution agency monitoring programs.

On the date of proposal a draft Environmental Impact Statement was issued. No significant comments were recieved on this draft.

ALTERNATIVES TO THE PROPOSED ACTION

As a result of the litigation previously described, there are no regulatory alternatives to establishing the lead NAAQS. The Agency is further limited by the language of the authorizing legislation which identifies the health and welfare implications of lead air pollution described in the Criteria Document as the only basis for the NAAQS. Costs of control and availability of control technology may not be taken into account in the decision-making process.

Both the EIS and the EIA evaluate the impacts of three possible standard levels, as required by Agency guidelines. Because under Section 109 of the Clean Air Act the standard must be based on health considerations. The analysis of alternative levels were not a factor in the decision on the level of the standard.

2.0 AIRBORNE LEAD IN THE ENVIRONMENT: SOURCES AND AMBIENT LEVELS

2.1 Sources of Lead in Ambient Air

Almost all airborne lead can be traced to man-made sources. That which is derived from natural origins (e.g., wind erosion of naturally lead-bearing soils or the stable end-product of radioactive radon gas releases) is believed to be negligible. Of the man-made sources, automotive emissions comprise the largest single source type (approximately 90 percent of all emissions, by weight). With regard to stationary sources, primary nonferrous smelters appear to be the most significant contributors.

2.1.1 Mobile Sources

For several decades, compounds containing lead have been added to automobile fuels to inhibit auto-ignition (engine knocking) (Lewis and Von Elbe, 1961). As automobile engine manufacturers sought to increase the compression ratio of gasoline engines (to maximize power and minimize fuel consumption), the tendency toward auto-ignition increased, requiring a higher concentration of anti-knock compounds in the fuel.

2.1.1.1 Source Types and Significance. Estimation of automotive lead emissions requires the evaluation of several factors regarding automotive vehicles and the fuels they use. These factors include (1) the distribution of the several types of vehicles--buses, trucks, cars, (2) the age distribution of automobiles, (3) the extent of which catalytic converters are in use, (4) vehicle miles traveled,

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(5) fuel economy (miles per gallon), (6) gasoline sales, and (7) the lead content of gasoline.

Distribution by Type of Vehicle. The Motor Vehicle Manufacturers Association reports three broad categories of motor vehicles registered in the United States: passenger cars, buses, and trucks. In 1975, passenger cars represented 80.3 percent of all motor vehicles registered in the United States, trucks represented 19.4 percent, and buses represented only 0.4 percent. Motorcycles are not considered as a major source of mobile lead emissions because of their relatively low gasoline consumption, wide spatial distribution, and substantial off-highway use.

Most passenger cars burn gasoline and of gasoline-burning cars, a substantial proportion consume leaded gasoline. However, most gasoline-burning cars manufactured in the United States in 1975 or later years are equipped with catalytic converters, designed to reduce carbon monoxide and hydrocarbon emissions, which preclude the use of leaded gasoline. Unleaded gasoline is also required for some non-catalyst vehicles. The age distribution of the automobile population is described in more detail below.

Buses are conveniently grouped into two categories: commercial buses and school buses. In 1975, approximately 80 percent of the buses were school buses and 20 percent were commercial buses. Of the total buses, 83.2 percent, including essentially all of the school buses, consumed gasoline, while the remaining 16.8 percent consumed diesel fuel (Motor Vehicle Manufacturers Association, 1976).

In 1975, approximately 92 percent of the trucks registered in the United States used gasoline, while the remaining eight percent used diesel fuel (Motor Vehicle Manufacturers Association, 1976). This corresponds closely with the 92.2 percent of all registered trucks which were under 26,000 pounds in weight. Therefore, it is not unreasonable to assume for computational purposes that all trucks under 26,000 pounds burn gasoline while all trucks over 26,000 pounds burn diesel fuel.

Age Distribution of Automobile Population. The age distribution of passenger cars registered in the United States is presented in Table 2-1 for five model years between 1964 and 1975. The pattern of age distribution of all cars registered during any of those five model years was quite similar, with over 90 percent of the cars being between 1 and 16 years of age and with approximately ten percent being older than 10 years of age (Motor Vehicle Manufacturers Association, 1976).

The Use of Catalytic Converters and Unleaded Gasoline. Most new cars manufactured in the United States subsequent to model year 1974 utilize a catalytic converter that is intended to reduce carbon monoxide and hydrocarbon emissions. Because these converters are susceptible to lead contamination, cars so equipped must use unleaded gasoline. Using retail passenger car sales data (see Table 2-2), it is estimated that approximately 3.3 percent of the 1975 car population

TABLE 2-1

AGE DISTRIBUTION OF PASSENGER CARS IN
THE UNITED STATES, 1964 THROUGH 1975

CAR AGE (YEARS)	PERCENT OF ALL CARS IN USE DURING MODEL YEAR:				
	1964	1969	1973	1974	1975
0-16+	100.0%	100.0%	100.0%	100.0%	100.0%
0-16	98.4	98.0	98.0	98.2	99.0
1-16	91.1	91.8	91.1	93.3	95.1
2-16	80.0	80.4	79.8	81.1	84.8
3-16	70.0	70.1	70.1	70.0	72.9
4-16	61.7	58.9	60.5	60.8	62.3
5-16	52.4	47.6	50.6	51.6	53.3
6-16	43.9	38.0	41.3	42.3	44.5
7-16	37.9	29.3	33.4	33.7	35.7
8-16	30.2	21.9	25.3	26.5	27.8
9-16	23.1	16.7	17.8	19.4	21.4
10-16	16.0	12.0	12.2	13.2	15.3
11-16	12.0	8.9	8.1	8.9	10.2
12-16	8.3	7.4	5.4	5.9	6.8
13-16	6.5	5.6	4.0	3.9	4.5
14-16	4.5	4.1	2.9	2.9	3.0
15-16	2.6	2.7	2.3	2.2	2.3
>16	1.6	2.0	2.0	1.8	1.0

Source: Motor Vehicle Manufacturers Association, 1976. Motor
Vehicle Facts and Figures, 1976.

TABLE 2-2

RETAIL PASSENGER CAR SALES IN THE UNITED STATES,
1964 THROUGH 1975

YEAR	DOMESTIC		IMPORT		TOTAL (thousands)
	NUMBER (thousands)	PERCENT OF TOTAL	NUMBER (thousands)	PERCENT OF TOTAL	
1964	7,617	94.0	484	6.0	8,101
1965	8,763	93.9	569	6.1	9,332
1966	8,377	92.8	651	7.2	9,028
1967	7,568	90.8	769	9.2	8,337
1968	8,625	89.3	1,031	10.7	9,656
1969	8,464	88.3	1,118	11.7	9,582
1970	7,120	84.8	1,280	15.2	8,400
1971	8,681	84.7	1,568	15.3	10,250
1972	9,327	85.2	1,622	14.8	10,949
1973	9,676	84.5	1,781	15.5	11,457
1974	7,454	84.0	1,417	16.0	8,871
1975	7,053	81.6	1,590	18.4	8,643

Source: Motor Vehicle Manufacturers Association. 1976. Motor
Vehicle Facts and Figures, 1976. Statistics Department,
Detroit, Michigan.

were so equipped and it follows that in subsequent years an increasing proportion of the passenger car population will use unleaded gasoline.

In addition to new cars requiring unleaded fuel, there has been limited voluntary use of unleaded gasoline for pre-1975 cars. In 1974, this use amounted to slightly more than one percent of total gasoline consumption (Federal Energy Administration, 1976a).

Vehicle Miles Traveled. Total vehicle miles traveled increased from 458.2 billion in 1950 to 1,307.7 billion in 1975. Of the total vehicle miles traveled in 1975, 78.6 percent were passenger car miles, 21.0 percent were truck miles, and only 0.4 percent were bus miles (Svercl, 1977).

Fuel Economy (miles per gallon). In general, average motor fuel mileage per gallon declined during the period from 1950 to 1973, and then improved in 1974 and 1975 as shown in Table 2-3. The recent improvement is due to several factors including lower speed limits, a growing population of smaller vehicles, and engineering design emphasis on fuel economy. This improvement is expected to continue. One study has indicated that the sales weighted average fuel economy in 1977 should be 18.6 mpg for all model year cars and vary from 31.8 mpg for cars in the 2,250 pound weight class to 12.7 mpg for cars in the 5,500 pound weight class (Murrell et al., 1976).

Gasoline Sales. With the exception of 1974, annual motor fuel consumption has risen steadily since 1950 (see Figure 2-1). In

TABLE 2-3

FUEL CONSUMPTION CHARACTERISTICS BY VEHICLE, 1950 THROUGH 1975

ITEM	1950	1955	1960	1965	1970	1971	1972	1973	1974	1975
AVERAGE GALLONS PER VEHICLE	728	759	777	775	830	838	859	851	788	790
CARS	603	644	661	656	722	723	730	736	676	712
BUSES	3,752	3,021	3,040	2,844	2,491	2,382	2,165	1,991	1,920	1,937
TRUCKS	1,257	1,278	1,330	1,347	1,365	1,368	1,446	1,361	1,269	1,227
AVERAGE MILEAGE PER GALLON	12.87	12.67	12.42	12.49	12.14	12.16	12.07	11.85	12.13	12.20
CARS	14.95	14.53	1.428	14.15	13.58	13.73	13.67	13.29	13.49	13.53
BUSES	5.57	5.85	5.26	5.35	5.34	5.38	5.80	5.86	5.90	5.75
TRUCKS	8.57	8.37	7.96	8.60	8.39	8.38	8.59	8.45	8.55	8.68

Source of 1975 Data: Svercl, Paul. March 8, 1977. Highway Engineer, Federal Highway Administration. Telephone conversation.

Source of 1950 through 1974 Data: Bureau of the Census. 1976b. Statistical Abstract of the United States: 1976. U.S. Department of Commerce.
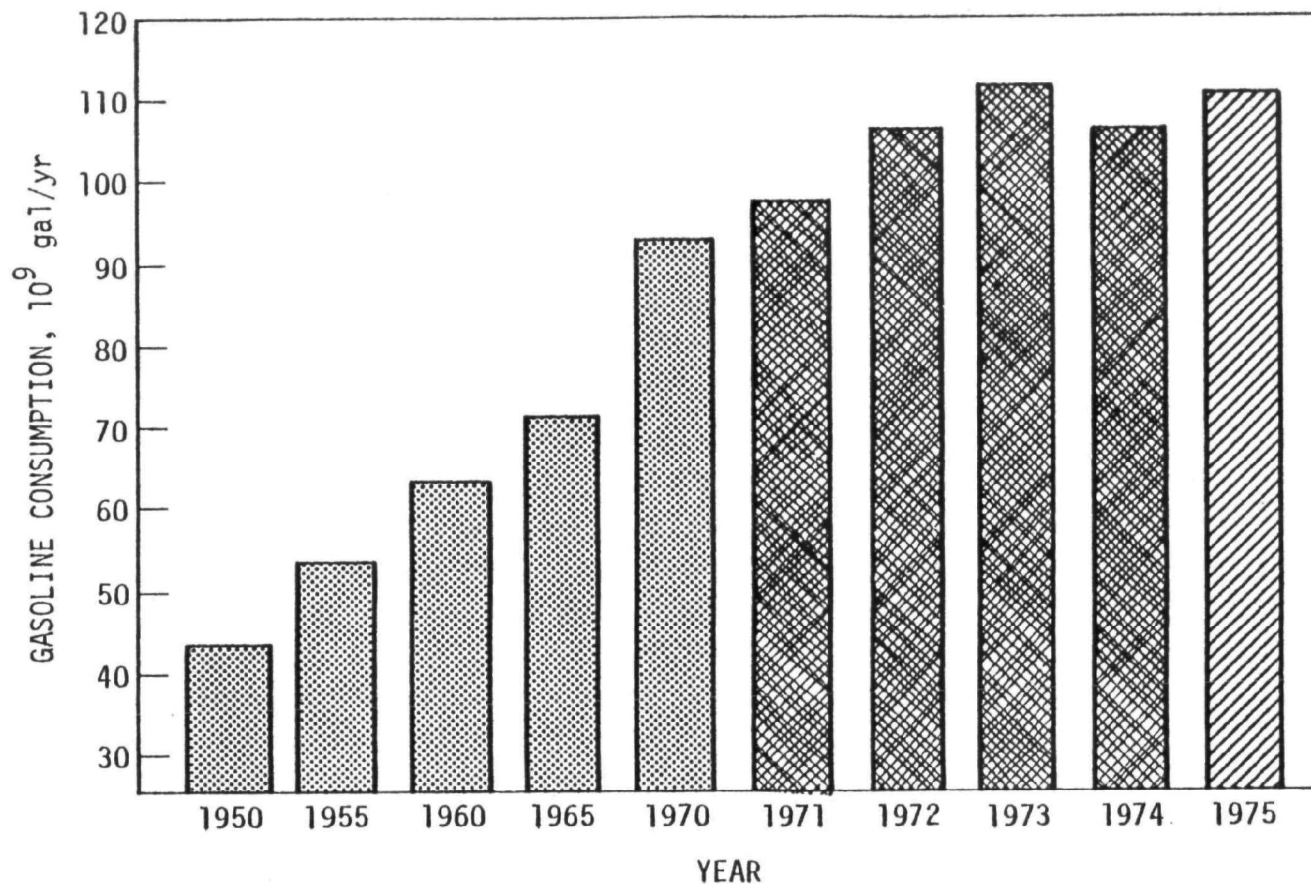
Note: Data for 1950, 1955 and 1960 include off-highway uses; data for other years are for highway uses only.

Bureau of the Census. 1976b. Statistical Abstract of the United States, 1976. U.S. Department of Commerce.

Motor Vehicle Manufacturers Association. 1975a. Automobile Facts and Figures, 1975. March 8, 1977.

Svercl, Paul. March 8, 1977. Highway Engineer, Federal Highway Administration. Telephone Conversation.

FIGURE 2-1
MOTOR FUEL CONSUMPTION IN THE UNITED STATES, 1950 THROUGH 1975

1973, total highway fuel consumption was 113 billion gallons, excluding fuel for military purposes. This included 104.5 billion gallons of gasoline of which 96.3 percent was used for highway transport while 3.7 percent was used for non-highway purposes. In 1974, there was a real drop in motor fuel consumption to 106.3 billion gallons (Bureau of the Census, 1976b).

Gasoline sales exhibit both a temporal and spatial distribution. During 1975, 57 percent of the gasoline sales took place in the six months from April through September. In the same year, the state with the highest gasoline consumption was California, where 10.22 billion gallons were consumed. California and nine other states (Texas, New York, Ohio, Illinois, Michigan, Pennsylvania, Florida, New Jersey and North Carolina) accounted for 51 percent of the total U.S. gasoline sales (National Petroleum News, 1975).

Lead Content of Gasoline. The average lead content of gasoline has declined since 1969 (see Figure 2-2). The summertime peaking trend is due to the additional tetraethyl lead (TEL) or tetramethyl lead (TML) added to increase the octane rating and compensate for the shorter distillation time required by increased product demand.

A decreasing trend in lead content combined with an increasing gasoline consumption resulted in an overall decrease of 25 percent in the amount of lead going into gasoline between 1972 and 1975. In addition to the manufacture of lower compression engines in the United States which would require less lead, many overseas outlets
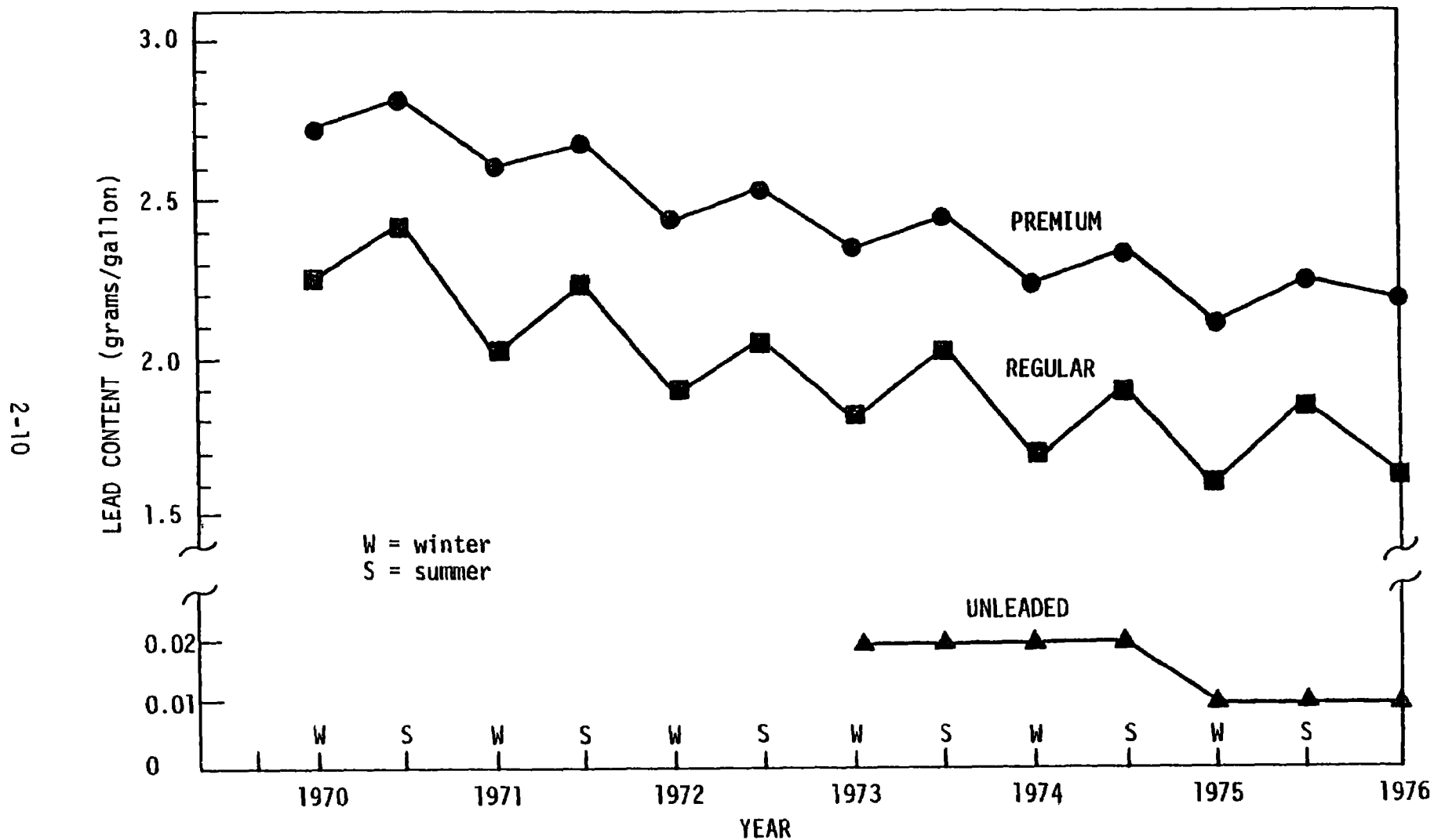
Source: Adapted from various semi-annual issues of Motor Gasolines. Ella Mae Shelton. Energy Research and Development Administration, Bartlesville, Oklahoma.

FIGURE 2-2
LEAD CONTENT OF GASOLINE--NATIONAL AVERAGES, 1970 THROUGH 1976

for TEL and THL are dwindling because of low-lead legislation in foreign countries (Edwards, 1973). The average lead content of all gasoline in 1970 was 2.3 grams per gallon, compared to 1.7 grams per gallon in 1975.

With the installation of lead-sensitive catalytic converters on most new cars manufactured in the United States since 1974, the proportions of gasoline sales represented by premium and regular grades have dropped significantly, while unleaded gasoline sales have risen correspondingly (see Table 2-4).

2.1.1.2 Current and Potential Control Technology. The following general control options may be applied to reduce lead emissions from mobile sources. They are:

(a) Mechanical devices added to exhaust systems (e.g., particulate lead traps);

(b) Transportation control plans;

(c) Fuel modification; and

(d) Automobile engine modifications.

Lead Traps. The removal of lead directly from the exhaust gases can theoretically be accomplished by means of particulate traps. To be effective, such traps must be able to collect a wide range of particle sizes. In addition, exhaust back pressure must be kept to a minimum to maintain engine efficiency.

At the present time, lead traps would be considered only for the decreasing population of vehicles burning leaded gasoline.

TABLE 2-4

PERCENTAGE OF GASOLINE SALES BY GRADE, 1970 THROUGH 1976

YEAR	PREMIUM SALES (1) (percent)	REGULAR SALES (2) (percent)	UNLEADED SALES (3) (percent)
1970	42.6	55.8	1.6
1971	41.1	57.3	1.6
1972	38.1	60.4	1.5
1973	32.4	66.2	1.4
1974	24.5	74.3	1.2
1975	19.2	72.9	7.9 (4)
1976	15.2	62.8	22.0 (4)

1. Source: National Petroleum News. Mid-May 1976. Factbook Issue. National Petroleum News.

2. Calculated by difference.

3. Calculated using data in: Federal Energy Administration. November 16, 1976b. Preliminary Findings and Views Concerning the Exemption of Motor Gasoline from the Mandatory Allocation and Price Regulations. Washington, D.C.

4. Numbers directly cited from: Federal Energy Administration. November 16, 1976b. Preliminary Findings and Views Concerning the Exemption of Motor Gasoline from the Mandatory Allocation Price Regulations. Washington, D.C.

The advent of a lead-tolerant catalyst could substantially increase this population, however, and the potential need for traps.

Transportation Control Plans. A well conceived and comprehensive transportation control plan may help to reduce lead emissions, particularly in urban areas, through the application of:

(a) Controls on traffice movements and routing;

(b) Incentives for car-pools and demand-responsive transit; and

(c) Improvements in mass transit systems.

Fuel Modification. Lead emissions from mobile sources may be reduced by restricting the lead content of gasoline by replacing lead additives with non-leaded substitutes, and through the use of substitute fuels. A program of lead phase-down has been initiated by EPA with the required availability of an unleaded gasoline grade as of July 1, 1974 and a stepped phase-down of the pooled average of lead in gasoline to 0.5 g/gallon by October 1, 1979.

High effectiveness and low production costs have favored the development of lead aklyl additives over unleaded substitutes. Other compounds with antiknock characteristics include ethers, alcohols, amines, and most metal alkyls. As commercial availability has been limited by a lack of cost-effectiveness versus the lead alkyls, they have not been commercially used as antiknock additives.

Recent interest in eliminating lead additives from gasoline has spurred the development of unleaded antiknock compounds, and

there are presently at least two metal-based additives which have been considered. A recently developed compound is Cerium (2,2,6,6-tetramethyl-3,5-heptanedionate)$_4$, or Ce(thd)$_4$. Preliminary tests, at a recommended concentration in gasoline of 0.5 g.Ce/gal have shown no health problems associated with its use.

Another potential substitute compound commercially available at this time is methylcyclopentadienyl manganese tricarbonyl (MMT), used in conjunction with moderately leaded gasoline to provide blending flexibility. MMT appears to be compatible with some catalysts (Bailie, 1976) but may contaminate others necessitating replacement (Consumers Union, 1977a, b). Because of the low toxicity of manganese* and the low concentrations that would be used in gasoline (Faggan et al., 1976; Ter Haar, 1975), the use of MMT is not expected to present a direct public health hazard. However, use of the additive has been associated with increased hydrocarbon emissions (Consumers Union, 1976b). As a result, the State of California has decided to ban MMT, effective September 7, 1977 (Sessa, 1977). Congress, thru the Clean Air Act has imposed a maximum concentration of MMT in gasoline cf 0.0625 g/gal., effective November 30, 1977, and a total removal of MMT unless manufacturers can document that the operation of catalytic converters is not impaired.

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*Manganese has a workroom threshold limit value, TLV, of 5,000 μg/m^3 compared to 200 μg/m^3 for lead (Occupational Safety and Health Administration, 1976).

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... ... included the use of natural

gas and hydrogen for more conventional vehicles and so-called fuel

cells for electric vehicles. Ethanol, and possibly methanol, hold

promise for near-term use in automobiles as substitute fuels. Though

the combustion of pure alcohol requires major engine modifications, a

blend of about 10 to 20 percent alcohol in gasoline could be utilized

with only minor engine modifications and a slight mileage penalty.

2.1.1.3 Emission Trends. Legislation. There are two Federal

regulations promulgated by the U.S. Environmental Protection Agency

and one public law that have direct bearing on lead emissions from

mobile sources. The regulations are: "EPA Regulations on Control

of Air Pollutants from Motor Vehicles and New Motor Vehicle Engines"

(40 CFR 85) and "EPA Regulations on Fuels and Fuel Additives" (40 CFR

80). The public law is the "Energy Policy and Conservation Act"

(PL 94-163).

The first regulation (40 CFR 85) establishes hydrocarbon, carbon

monoxide, and nitrogen oxide emissions standards for all new light-

duty vehicles (e.g., cars, station wagons, small passenger vans). To

achieve the standards with respect to hydrocarbons and carbon monoxide,

United States automobile manufacturers, beginning in 1975, have

installed catalytic converters on all gasoline-powered cars with

engine designs which would not otherwise meet emission limits. The

sensitivity of the catalysts employed requires the use of unleaded

gasoline. An upward trend in the proportion of sales represented by

unleaded fuel, with gradual turnover of the vehicle population, is expected to continue unless lead-tolerant catalytic converters are developed as an alternative emission control device.

The second regulation (40 CFR 80), promulgated in two parts, requires the availability of unleaded gasoline at all retail outlets, effective July 1, 1974, and provides for the phase down of the average lead content of gasoline to no more than 0.5 gram of lead per gallon by October 1, 1979.

In addition to these two Federal regulations, the "Energy Policy and Conservation Act" (PL 94-163) requires each manufacturer to obtain a progressively higher average fuel economy for all new car models to begin in 1978. The objective is to achieve an average of 18.0 mpg by 1978, 19.0 mpg by 1979, and 27.5 mpg by 1985. It should be noted that the average fuel economy of all 1977 model years cars is estimated to be 18.6 mpg (Murrell et al., 1976), placing the fuel economy performance at least one year ahead of the required schedule.

Average Emission Rate. One study of mixed urban and suburban driving has shown that 75 percent of the lead in gasoline is exhausted to the atmosphere. The remaining 25 percent is retained in either the crankcase oil or the engine and exhaust system, in approximately equal amounts (Hurn, 1968). In addition to the lead emitted from combustion, a small amount is lost through evaporative emissions from the fuel tank and carburetor.

During 1975, the average motor vehicle consumed 790 gallons of gasoline with an average lead content of 1.69 grams per gallon, emitting to the air approximately 1.0 kilogram (2.2 pounds) of lead. Estimated on-highway mobile source emission of lead from the combustion of gasoline can be calculated in three ways based on:

(a) Gasoline sales;

(b) Vehicles miles traveled; and

(c) Lead consumption at TEL plants.

Based on gasoline sales, the on-highway mobile source emissions for 1975 amounted to 140,200 tons. Using data on vehicles miles traveled, 136,200 tons of lead were emitted, while lead emissions based upon lead consumption at TEL plants amounted to 141,300 tons.

Projected Lead Emissions. The legislation cited in the previous section will serve to reduce mobile source lead emissions. Estimates of the resulting decrease of emissions have been calculated using the following assumptions:

(a) 75 percent of the lead in gasoline is emitted from the tailpipe over the lifetime of the vehicle (Hurn, 1968);

(b) Medium-duty trucks consume three percent of the total gasoline and they average ten miles/gallon (Motor Vehicle Manufacturers Association, 1977a; Commercial Car Journal, 1974);

(c) Leaded gasoline contains 2.0 g Pb/gallon and unleaded contains 0.05 g Pb/gallon (actual value for unleaded gasoline presently lower than this); the pooled average for future years is shown in Table 2-5;

(d) The percentage of pre-1975 automobiles will vary in future years as shown in Table 2-5;

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TABLE 2-5

SUMMARY OF AUTOMOTIVE FACTORS

YEAR	PERCENTAGE OF PRE-1975 CARS	AVERAGE FUEL ECONOMY (mi/gal)	POOLED AVERAGE, LEAD IN GASOLINE (g Pb/gal)
1974	100.0	12.4	2.0
1975	88.8	12.5	1.9
1976	74.5	--	1.6
1977	61.5	13.3	1.2
1978	49.4	14.0	1.0
1979	39.6	14.8	0.5 ①
1980	29.2	15.7	0.5
1981	21.3	16.8	0.47
1982	15.0	17.9	0.34
1983	10.3	19.1	0.25
1984	7.1	20.4	0.19
1985	5.2	21.7	0.15
1986	3.9	--	0.13
1987	2.8	--	0.11
1988	2.1	--	0.09
1989	1.7	--	0.08
1990	0.0	26.2	0.05
1995	0.0	27.4	0.05

1. Based on the gasoline additive phasedown regulation.

Source: Wilson, James. July 14, 1976a. U.S. Environmental Protection Agency. Personal correspondence.

(e) The average fuel economy for vehicles weighing less than 10,000 pounds will vary in future years as shown in Table 2-5;

(f) The total number of vehicles miles traveled annually is assumed to follow recent trends and increase each year by 31 billion miles (Motor Vehicle Manufacturers Association, 1975a); and

(g) Small refineries (<50,000 barrels per day), which are exempt, are assumed to constitute a negligible portion of the market.

Based on the automobile replacement rate reported by the Motor Vehicle Manufacturers Association, essentially all automobiles using leaded gasoline would be retired by 1990. Medium-duty trucks (greater than 10,000 pounds gross vehicle weight and less than 26,000 pounds*) and off-highway users may still require leaded fuel. These trucks consume three percent of total gasoline, while off-highway uses (gasoline powered tools, agricultural equipment, and snowmobiles) account for approximately four percent of the gasoline consumed. The off-highway sources have different emission characteristics than mobile sources, generally are not affected by mobile source control strategies, and are widely dispersed; therefore, they are not included in this discussion.

Based on the factors enumerated above, and the expected increase in fuel economy as specified in PL 94-163 (Energy Policy and Conservation Act), lead emissions from mobile sources in 1985 would be

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*Nearly all trucks with gross vehicle weights greater than 26,000 pounds use diesel fuel (which does not contain lead) and, therefore, would not affect the analysis and have been disregarded in this study.

approximately 11 percent of the 1975 estimated mobile lead emissions (or an 89 percent reduction) and in 1995 would be about 8 percent of the 1975 values (or a 92 percent reduction). Most of the emission reduction would occur in the ten years between 1975 and 1985 because during those years the majority of the cars using leaded gasoline would be replaced by models requiring unleaded fuel. Thereafter, the annual reduction would be smaller as the percentage of pre-1975 models shrink to five percent or less of the total vehicle population.

After 1990 (when essentially all replacement of pre-1975 cars is expected to be accomplished) no additional reduction of lead emissions by retirement of vehicles using leaded gasoline is antici- pated. Moreover, the improvement in average fuel economy resulting from the Energy Policy and Conservation Act will taper off after 1985, reaching a plateau by 1997. At the same time, however, the number of vehicle miles traveled should increase each year. The net effect of these conditions would be an incremental reduction in lead emissions between 1985 and 1995 of only three percent. Under the present regulation, no reduction in emissions from medium-duty trucks occurs and small quantities of lead are still expected to be emitted from vehicles using unleaded gasoline assumed to contain 0.05 g Pb/gallon. Thus, the reduction relative to 1975 lead mobile emissions can never reach 100 percent. The lead emissions for 1979, 1980, and 1981 would be fairly constant because the pooled averages for these years do not vary appreciably (as shown in Table 2-1).

2.1.2 Stationary Sources.

The annual supply of lead to U.S. industry is furnished by primary smelters, secondary smelters, ore and metal imports, industry, stocks; and government stockpile releases. In addition to these sources, lead is emitted to the air from a variety of industrial applications and uses.

Stationary source emissions of lead are classified as stack emissions and fugitive emissions. The former are released from on-site stacks ranging from tens to hundreds of feet in height and the subsequent behavior of the emitted material has been reasonably well studied and documented. Fugitive emissions, as the name implies, may occur throughout the facility and are more difficult to define, measure and control. Sources of fugitive emissions include leakages from process buildings, wind erosion of slag piles, and dust stirred up by automotive traffic, particularly on unsurfaced roads near major point sources.

2.1.2.1 Source Types and Significance. Twenty-three industries have been identified as being important emitters of airborne lead (U.S. Environmental Protection Agency, 1977a). Table 2-6 lists these industries along with their uncontrolled emission factors and 1975 emissions (after control). The industries listed contributed almost 90 percent of the 1975 nationwide stationary source lead emissions. For the purpose of analysis, 1975 has been adopted as the baseline

TABLE 2-6

LEAD EMISSIONS INVENTORY, 1975 NATIONWIDE VALUES

INDUSTRY	1975 PRODUCTION	EMISSION FACTOR		COMPLIANCE CONTROL FACTOR (percent)	CONTROLLED ③
		STACK	FUGITIVE		
FERROALLOY	$2,215 \times 10^6$ tons	①	--	89	84
BATTERY	48.3×10^6 batteries	27.69 lbs per 1,000 batteries	--	85	100
PRIMARY LEAD	642,000 tons	68.5 lbs/ton	7.3 lbs/ton	98.2 ④	2,734
SECONDARY LEAD	604,600 tons	56 lbs/ton	0.4 lb/ton	95 ④	954
PRIMARY COPPER	1.38×10^6 tons	20.9 lbs/ton	3.6 lbs/ton	92.6 ④	3,461
GASOLINE ADDITIVES	326,000 tons	5.2 lbs/ton (sludge pit, process vents); 41.3 lbs/ton (lead recovery)	--	92	1,333
CAST IRON FOUNDRIES	27.8×10^6 tons of lead processed	0.44 lb/ton	--	70	1,841
COAL-FIRED — UTILITIES	182,200 MWe	55.3 lbs/MWe	--	92	403 ②
OIL-FIRED UTILITIES	78,420 MWe	56.1 lbs/MWe	--	0	2,200 ②
MUNICIPAL INCINERATORS	11.67×10^6 tons	0.6 lb/ton	--	64	1,254 ②
IRON AND STEEL	①	①	--	①	1,227
ORE CRUSHING AND GRINDING	352×10^6 tons	0.012-0.3 lb/ton	--	25 to 27	544
PRIMARY ZINC	4 5,000 tons	20.85 lbs/ton	--	97.3	124
BRASS AND BRONZE	232,000 tons	22.75 lbs/ton	--	98	52

TABLE 2-6 (concluded)

LEAD EMISSIONS INVENTORY, 1975 NATIONWIDE VALUES

INDUSTRY	1975 PRODUCTION	EMISSION FACTOR		COMPLIANCE CONTROL FACTOR (percent)	CONTROLLED ③
		STACK	FUGITIVE		
LEAD OXIDE PRODUCTION	500,000 tons	0.44 lb/ton	--	0	110
PIGMENT PRODUCTION	73,000 tons	--	--	--	13
CABLE COVERING	500,000 tons of lead processed	0.5 lb/ton	--	0	125
CAN SOLDERING	134×10^6 base boxes	0.5 ton/10^6 base boxes	--	0	67
TYPE METAL CASTING	6.3×10^6 tons	0.25 lb/ton	--	50% of industry at 80%; 50% at 0%	480
METALLIC LEAD PRODUCTION	113,503 tons	1.5 lbs/ton	--	0	85
¯MENT PRODUCTION					
Wet	32.5×10^6 tons	0.10 lb/ton	--	93	137
Dry	39.5×10^6 tons	0.11 lb/ton	--		207
LEADED GLASS	492,000 tons	5 lbs/ton	--	95	62
AUTOMOBILE EMISSIONS	--	--	--	--	140,200

1. See Appendix V for discussion of 1975 emission calculation.

2. Includes crankcase oil combustion.

3. To the extent that the industry was controlled.

4. For stack emissions only, zero percent for fugitive emissions.

year as more recent information is not available on a consistent basis for all the industries listed.

Ferroalloy Producers. There are 48 ferroalloy plants in the United States which produced a total of 2.22×10^6 tons (2.01×10^6 metric tons) of ferroalloys in 1975. The majority of the plants are concentrated in Alabama, Pennsylvania, and Ohio with the remainder scattered in 13 other states. Most ferroalloy plants have capacities below 25,000 kilowatts electric (kWe) while ten plants have a capacity in the 25,000 to 75,000 kWe range, and ten have capacities over 75,000 kWe. Lead emissions in 1975 from this industry were 84.3 TPY, assuming a compliance control factor* of 89 percent.

Lead-Acid Battery Plants. There are 280 battery plants** in the United States, producing approximately 48,325,000 batteries in 1975. The plants are scattered fairly uniformly throughout the country, with some concentration occurring in New York, New Jersey, Pennsylvania, and California. Plant sizes range widely. Plants with a lead oxide (PbO) mill have a slightly larger emission factor

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*The degree of compliance for a given industry, expressed as a percentage, is a measure of the number of plants operating with the required SIP control devices. Numerically, this compliance factor is the ratio of the tons of airborne particulate matter controlled by the industry relative to the tons which would be emitted by the industry. Consider, for example, an industry where 80 percent of the plants have SIP control devices collecting 90 percent of the airborne particulate matter. The degree of compliance would theoretically be 72 percent. In actuality, the reported compliance factors, based on emissions, may be slightly different since not all plants may have achieved the identical level of control.

**With more than ten employees; producing lead-acid storage batteries.

than those without mills. Total 1975 lead emissions are estimated to be 100.4 tons based on a compliance control factor of 85 percent.

Primary Lead Smelter. There are six primary lead smelters in the United States, that is, smelters which use lead ore as the primary feedstock. These smelters accounted for the production of 642,000 tons (582,000 metric tons) of lead in 1975. The six smelters may be classified as relatively high emitters of lead (the older smelters in the western part of the United States) and relatively low emitters (the newer smelters located in Missouri). Emissions from each of these facilities were obtained from emission factors, plant production statistics and compliance control factors of 98.2 percent for stack emissions and zero percent for fugitive emissions. Total 1975 lead emissions from this industry are estimated to have been 2,374 tons (16 percent of the total emissions from stationary sources).

Secondary Lead Smelters. There are 93 secondary lead smelters in the United States, that is, smelters for which the feedstock is generally used lead products, primarily battery scrap and lead residues. These smelters produced 604,000 tons (548,000 metric tons) of lead in 1975. Plants are distributed more or less uniformly throughout the country. Total emissions of lead for this industry in 1975, including fugitive emissions, are estimated to be 973 tons based on a compliance factor of 95 percent for stack emissions and zero percent for fugitive emissions.

Primary Copper Smelters. There are 15 primary copper smelters in operation in the United States. They produced approximately 1.38 million tons (1.25 million metric tons) of copper in 1975. Individual plant capacities range from 15,000 to 300,000 tons per year (TPY). All plants are located in the western region of the United States near the ore deposits. Lead is contained in the input material to both the roasting and smelting processes and is emitted as part of the flue dust produced. Lead emissions from the copper smelting industry, including fugitive emissions, are estimated to be 3,460 TPY, based on a compliance control factor of 92.6 percent for stack emissions and zero percent for fugitive emissions.

Gasoline Additive Manufacturing (Lead Alkyl Production). There are six gasoline additive manufacturing plants in the United States, producing a total of 326,000 tons (296,000 metric tons) of lead additive in 1975. These plants are located in California, New Jersey, Louisiana and Texas. Based on emissions factors for the various industrial processes employed, production data and estimated compliance factors, lead emissions from this industry were estimated to be 1,330 tons (1,210 metric tons) in 1975. Particulate emissions originate only from the lead smelting furnace, alloy reactor and the lead recovery furnace. All other emission points exhaust lead in alkyl vapor form.

Gray Iron Foundries (Cast Iron). In 1975 there were 1,519 gray iron foundries in the United States, and together they produced 16.7

million tons (15.1 million metric tons) of castings. The presence of lead in the raw ores resulted in estimated emissions of 1,841 tons based on a compliance control factor of 70 percent and internal recycling due to a 40 percent rate of bad castings.

Combustion of Crankcase Oil. The quantity of waste automotive lubricating oil that is generated annually has been estimated to be between 400 and 730 million gallons (U.S. Environmental Protection Agency, 1974b; American Petroleum Institute, 1974; Weinstein, 1974a), and the total amount of waste crankcase oil burned as fuel in 1975 was 274 million gallons. Values for the lead content of waste crankcase oil range from 800 ppm to 11,200 ppm (Chansky et al., 1973); but a composite waste crankcase oil representing a nationwide, all-season sample had a lead content of 8,400 ppm (American Petroleum Institute, 1975).

While there are studies to indicate which type of facilities can burn waste crankcase oil (e.g., Chansky et al., 1974), there are no data indicating the amounts used by different facilities. It was assumed in this report that one-half of the oil would be used in oil-fired power plants, one-third in coal-fired utilities, and one-sixth in municipal incinerators. Although this breakdown is somewhat arbitrary, it does allow for a reasonable geographical distribution of lead emissions from crankcase oil combustion. Depending on the types of facilities assumed to burn waste crankcase oil, different emissions may differ since 50 percent and 80 percent

are used as emission factors when the crankcase oil is blended with utility oil and solid fuels (coal and trash) respectively. Assuming that crankcase oil is exclusively blended with utility oil, 4,300 tons of lead emissions would be expected from this industry in 1975. Using the mix of facilities described above--oil-fired and coal-fired power plants as well as municipal incinerators--would increase this figure to 5,600 tons.

Coal-Fired Power Plants. In 1975, there were 380 coal-fired power plants (above 25 megawatts electric equivalent) in the United States, consuming approximately 412 million tons (374 million metric tons) of coal as either a primary or auxiliary fuel. Based on an average lead content of coal of 8.3 ppm and assuming for the purpose of analysis that about 91.3 million gallons of waste crankcase oil were burnt at these power plants, emissions of lead from this industry were estimated to be 403 tons. This includes amounts contributed by waste crankcase oil usage based on a compliance control factor of 92 percent.

Oil-Fired Power Plants. In 1975, there were 260 oil-fired power plants (above 25 MWe equivalent) in the United States consuming 81.8 million bbl (13×10^6 m^3) of distillate and 554 million bbl ($881. \times 10^6$ m^3) of residual oil as either a primary or auxiliary fuel.

Since the lead emission factor for oil combustion is dependent on the lead content in the oil and as an individual plant breakout by type of oil used was not available, a weighted average of 0.9 ppm

of lead in oil was used. Assuming that 50 percent of the lead in oil is emitted (U.S. Environmental Protection Agency, 1977a) and that approximately 137 million gallons of waste crankcase oil were burnt in these power plants, lead emissions in 1975 were estimated to be 2,200 tons, mostly due to crankcase oil usage.

Municipal Incinerators. In 1975, 143 municipal incinerators in the United States burned 11,669,000 tons of refuse and are assumed to have used approximately 45.7 million gallons of waste crankcase oil as fuel. The vast majority of the installations are in the northeastern section of the country. Based on an emissions factor of 0.4 pound of lead per ton of refuse, the above assumed quantity of waste crankcase oil burnt and a compliance factor of 64 percent, nationwide lead emissions in 1975 from municipal incinerators were estimated to be 1,254 tons.

Iron and Steel Plants. There are six processes at iron and steel plants which are potential lead emitters due to the presence of lead as a trace metal in iron ore. These processes include sintering, coking, blast furnaces, basic oxygen furnaces, open hearth furnaces, and electric arc furnaces. In 1975, there were 160 iron and steel plants throughout the United States, and the nationwide emissions of lead from these plants were estimated to be 1,227 tons.

Ore Crushing and Grinding. Lead, zinc, and copper ore mining, crushing, and grinding operations, which are confined mostly to the western states, together contributed about 544 tons (493 metric tons)

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of lead to the nationwide total of lead emissions in 1975. The lead-containing ore mining operations are located almost exclusively in Missouri, Colorado and Idaho. Emissions are basically fugitive in nature, and because of the large particle sizes and high specific gravities of the dust, fallout occurs within a short distance from the source.

Primary Zinc Smelting. Estimated zinc production in 1975 was 445,000 tons (404 thousand metric tons). The zinc ore concentrates contain lead, varying from less than 1 percent up to 5 percent. The amount of lead released to the atmosphere is dependent on initial ore concentration. Lead emissions in 1975 were estimated to be 124 tons (112 metric tons) resulting from sintering and retorting operations.

Brass and Bronze Production. Production of brass and bronze alloys was estimated to be 232,000 tons (210 x 10^3 metric tons) in 1975, produced in reverberatory, rotary, crucible, or electric induction furnaces. Some of the alloys produced—leaded red brass, semi-red brass, high-leaded tin bronze, aluminum bronze, and leaded nickel bronze contain significant amounts of lead. The particulate emission factor is approximately 70 pounds/ton of charge with lead contents ranging from 7 to 58 percent. Estimated lead emissions from this source were at 52 tons (47 metric tons in 1975).

Lead Oxide Production. Approximately 500,000 tons (454,000 metric tons) of litharge (lead oxide) and black oxide were produced in the United States in 1975. Based on an average lead emission

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rate of 0.44 pounds/ton of product, national lead emissions from this industry were estimated to be 110 tons (100 metric tons) in 1975.

Pigment Production. Lead pigment production for 1975 was estimated to be 73,000 tons (66.1 x 10^3 metric tons), the majority of which was red lead and lead chromate. Lead emissions in 1975 after control were estimated to be 13 tons (11.8 metric tons).

Cable Covering Manufacturing. Consumption of lead by cable covering facilities was 50,000 tons (45,500 metric tons) in 1975. Based on a throughput to consumption ratio of ten to one, this implies that about 500,000 tons of lead were processed through internal recycling. Using an emission factor of 0.5 pound of lead/ton of lead processed, 1975 lead emissions were estimated to be 125 tons (113 metric tons).

Can Soldering. It has been estimated that metal can production in 1975 included 134 million base-boxes* of soldered steel cans. Lead emissions in 1975 from the soldering operation are estimated to be 67 tons (60 metric tons), based on an emission factor of 0.5 ton of lead per million boxes.

Type Metal Casting. Taking into account the metal ore cycle-to-replacement factor, it is estimated that of the 6.3 million tons of lead recycled approximately 16,200 tons (14,740 metric tons) of lead were consumed by type metal casting operations. Based on a

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* A base box is equivalent to 20.23 m^2 (218 ft^2) of surface area.

lead emission factor of 0.25 pound/ton recycled and a compliance of 40 percent, lead emissions in 1975 were estimated to be 480 tons (436 metric tons).

Metallic Lead Production. Approximately 200,000 tons (180 x 10³ metric tons) of lead were consumed in the manufacture of ammunition, bearing metals, weights and ballasts, and other products in 1975. Lead emissions from the 87,000 tons of lead processed for ammunition and bearing metal are negligible and the lead emissions from other processes are estimated to be 85 tons (77 metric tons) in 1975.

Cement Production. About 72 million tons (65 x 10⁶ metric tons) of cement were produced in 1975 by two methods described as dry and wet process. Production of cement by the dry process was estimated to be 39.5 million tons (35.8 million metric tons). Wet process production in 1975 was estimated to be 32.5 million tons (29.5 million metric tons). Lead is an incidental trace element in the raw materials of both processes. Emission factors for these processes are estimated to be 0.11 pound/ton and 0.10 pound/ton, respectively. Assuming an overall compliance factor of 93 percent, lead emissions in 1975 were estimated to be 207 tons (188 metric tons) from the dry process and 137 tons (124 metric tons) from the wet process.

Leaded Glass Production. Leaded glass production was estimated to be 492,000 tons (446 x 10³ metric tons) in 1975 and lead emissions were estimated to be 62 tons (50 metric tons) using an emission factor of 5.0 pounds/ton of glass and a compliance control factor of 95 percent.

2.1.2.2 Current Control Technology for Stationary Source
Emissions. Except for some gaseous emissions from the lead alkyl industry (i.e., gasoline additive manufacturing), lead is usually emitted in the form of particulates from industrial sources. Consequently, control devices for lead are usually the same as those used for total particulates, namely, baghouses or fabric filter (FF), wet scrubbers or collectors (WC), and electrostatic precipitators (ESP).

The collection efficiency of these three types of control devices drops with decreasing particle size, while it is evident that smaller diameter particulates have higher concentrations of lead (Natusch et al., 1974; Greensburg, 1976). Collection efficiency usually drops for particles around 1 micron in diameter, and been some "high efficiency" control devices (99.5 percent control) are only 90 percent effective at removing these small particles. On the other hand, many of the major lead sources emit fumes rather than particulates, and any effect due to surface area differential would be small. Additionally, the widespread use of baghouses, which are not as sensitive to differences in particle sizes as the other control devices, serves to reduce any control efficiency differences.

Fabric Filtration. Fabric filters, usually in the shape of a bag, are used to trap particulates through the mechanics of inertial impaction, diffusion, and direct interception. Collection efficiencies for well-designed baghouses exceed 99 percent, especially when

a cake builds up on the filter and sieving becomes an important factor in collection. The efficiency of fabric filters is, however, more sensitive to flow fluctuations and temperature than scrubbers or ESP's.

Electrostatic Preciptators. Electrostatic precipitation depends upon the collection of previously charged particles from an oppositely-charged collection plate. ESP's are usually not sensitive to flow fluctuations and they are capable of treating very large gas volumes at various gas temperatures.

Wet Scrubbers. Venturi scrubbers, which are the most common type of scrubbers used by those lead-emitting industries which use scrubbers only, have small space requirements and can accommodate flow variations. Water usage, water cleaning, and sludge generation are inherent limitations to the use of scrubbers, but when there are relatively low flow rates (<100,000 acfm) and high particulate con-centrations, the venturi scrubber is often specified.

2.1.2.3 Emission Trends. In order to develop emission trends for stationary sources, it is necessary to establish a baseline (in this case, for 1975) inventory. The tons of emissions are calculated by multiplying together three factors--(1) an emission factor, usually e, pressed as pound of lead emitted per ton of production and as taken from Control Techniques for Lead Air Emissions (U.S. Environ-mental Protection Agency, 1977a), (2) the production rate in tons per

year, and (3) a compliance control factor. This last factor is used
to account for the amount of control for total particulates (and,
hence, lead particulates) achieved by each industry by 1975 in
response to State Implementation Plans for control of total suspended
particulate matter (TSP). The degree of compliance, based on work
performed for the Divison of Stationary Source Enforcement (Massoglia,
1976a), is a measure of the number of plants which had installed the
necessary SIP controls by 1975. The compliance control factor,
presented in Table 2-6 is a combination of the degree of compliance
(i.e., number of plants) and the SIP control factor, and indicates
the percentage of tons of lead controlled in 1975 for an industry.
The 1975 lead emissions inventory can then be determined either as a
nationwide summation across individual industries or as a summation
of different industries within individual Air Quality Control Regions
(AQCR's).

For the 11 major stationary source categories, emissions inven-
tories for subsequent years--1982, 1985, and 1995--can be extrapo-
lated from the 1975 inventory using industrial growth rates, present
industrial capacity factors, and the applicable emissions control
factors. The growth rate is the percentage of annual production by
which an industry would be expected to grow for each subsequent year.
The capacity factor represents the 1975 production as a percentage of
the total-industry capacity. These two factors are used to determine
the year of full capacity, i.e., when the growth rate indicates that

present unused existing capacity would be filled. These factors are presented in Table 2-7.

It is necessary to predict the year in which full capacity will be achieved to assign the proper control factors to increased production related to industrial growth. For purposes of future lead emissions inventory development, it has been assumed that existing unused capacity would be utilized before any new production facilities are built. Thus, increased production until the estimated year of full capacity would be controlled according to factors associated with the State Implementation Plans (SIP) for total-particulate ambient air concentration standards, while production thereafter would be controlled to the extent provided by the New Source Performance Standards (NSPS) for particulate emissions at specific types of new facilities.

SIP Control. On November 25, 1971, EPA established national primary and secondary ambient air quality standards for particulate matter (40 CFR 50.6-50.7). The Clean air Act (Section 110) requires that each state develop "a plan which provides for implementation, maintenance and enforcement of such primary standards in each air quality control region (or portion thereof) within such State." The resulting SIP's required the control of particulates from a number of stationary sources, many of which have lead as constituent of the total particulate emission. SIP control factors were computed based on the average control efficiencies required by the states in

TABLE 2-7

FACTORS FOR PROJECTING FUTURE LEAD EMISSIONS

INDUSTRY	GROWTH RATE	1975 CAPACITY FACTOR	ESTIMATED YEAR OF FULL CAPACITY	SIP CONTROL FACTOR	NSPS CONTROL FACTOR
FERROALLOY	2	90	1981	99.5	99.5
STORAGE BATTERY	5	76	1981	85	85
PRIMARY LEAD SMELTER	1.5	83	1988	98.9	99.7
SECONDARY LEAD SMELTER	3.2	68	1988	97.5	99.3
PRIMARY COPPER SMELTER	3	73	1986	96.2	96.2
GAS ADDITIVE	-16	--	--	--	--
CAST IRON	2	93	1979	88.9	88.9
MUNICIPAL INCINERATOR	0	--	--	--	--
COAL-FIRED UTILITIES	5	100	1975	98	98.7
OIL-FIRED UTILITIES	2.5	100	1975	0	0
IRON AND STEEL	2.5	76.2	1987	--	--
Sintering	--	--	--	99.4	99.4
Coking	--	--	--	72.3	72.3
Blast Furnace	--	--	--	99.6	99.6
Open Hearth	--	--	--	90.2	90.2
Basic Oxygen Furnace	--	--	--	99.7	99.7
Electric Furnace	--	--	--	84.3	98.1

their SIP's and Appendix B of the Requirement for Preparation, Adoption, and Submittal of Implementation Plans (40 CFR 52). From Table 2-3 it can be seen that SIP control factors are generally $\geq$ 80 percent and often $\geq$ 90 percent.

In 1975 most of the major stationary lead emitters were in a fairly high degree of compliance (in terms of numbers of plants) as inferred by comparing the compliance control factors in Table 2-2 with the SIP control factors in Table 2-3 and by recalling that the compliance control factor is the product of the degree of compliance and the value of SIP control. Emission control techniques for total particulate (e.g., baghouse, scrubbers, and electrostatic precipitators) are the same as for control of lead emissions, and therefore the NAAQS for particulate matter has already and will continue to result in some control of lead. It is assumed that by 1982 all of the industries requiring SIP control would have a 100 percent degree of compliance and the compliance control factors would be identical to the SIP control factors. The improvement in compliance, then, would account for significant reductions in stack emissions in 1982 relative to 1975.

NSPS Control. Section 111 of the Clean Air Act provides the authority for the EPA Administrator to propose and promulgate regulations for a category of new stationary sources which "causes or contributes significantly to air pollution which may reasonably be anticipated to endanger public health or welfare." The first standards

of performance for new stationary sources (New Source Performance Standars, or NSPS) were promulgated in December 1971. By January 13, 1977, particulate standards had been promulgated for 13 source categories and had been proposed for two additional source categories.

No standards of performance have been promulgated or proposed specifically to regulate lead emissions. However, promulgation of additional new source performance standards is being considered, including promulgation of a lead regulation for process equipment operated at lead-acid storage battery plants. The scheduled date for proposing such a regulation is December 1977.

For 1982 and 1985, the effect of the NSPS control factor, with regard to lead emissions, is very small due to the fact that, in these years, industrial growth could be mostly accommodated by existing unused capacity. By 1995 the NSPS control would begin to have a slight effect, primarily due to the NSPS for electric furnaces in the iron and steel industry.

Fugitive Emissions. It should be noted that neither the SIP nor the NSPS control factors account for fugitive emissions. As seen in Table 2-6, fugitive emissions are only a fraction of the uncontrolled stack emissions. However, as SIP compliance on stack emissions is effected, fugitive emissions gain relative importance and begin to dominate.

Other Control. The phasedown of lead in gasoline not only directly relates to lead emissions from mobile sources, but also affects lead emissions from point sources which burn waste crankcase oil. As the lead content of gasoline is reduced, the lead content of waste crankcase oil will also decline and the resulting lead emissions from the stationary combustion of waste crankcase oil (i.e., in coal-fired power plants, oil-fired power plants, and municipal incinerators) would be expected to decrease proportionally.

2.2 Ambient Lead Concentrations

Current levels of airborne lead concentrations in the United States are important in determining the potential for air quality improvement required to meet a proposed ambient lead standard. The feasiblity of attaining and maintaining a given standard, and the impact of implementing that standard, depend on the required changes in air quality relative to present levels. Concentrations of airborne lead have been routinely monitored by a variety of Federal, state and local agencies in a number of Air Quality Control Regions (AQCR's) throughout the United States in recent years, although the reporting and monitoring procedures are not standardized and often result in inconsistent data (e.g., data based on nonuniform averaging times). This type of monitoring information is discussed in Section 2.2.1.

In addition to routine air quality monitoring conducted in an AQCR, a number of special monitoring studies have been undertaken

in the immediate vicinity of particular stationary lead emission sources. This information, presented in Section 2.2.2, is useful in analyzing the different types of point sources and determining the important factors that contribute to high ambient lead levels.

For those AQCR's in which there are not routine lead monitoring data available, estimates of air quality can be made based on air-borne lead emissions from existing typical point and mobile sources. Section 2.2.2 presents the results of this estimation process, where the highest expected lead concentrations are determined from maximum point source emission rates and highest traffic counts in the different AQCR's.

2.2.1 Network Monitoring Data

Ambient air lead concentration data are collected by a number of Federal, state, local and private agencies. In 1974, the National Air Surveillance Network (NASN) and the National Aerometric Data Bank (NADB) included lead monitoring data from 127 of the 247 AQCR's, and in 1975 there were 148 AQCR's represented in the data systems. In August 1976 a telephone survey was made to air monitoring agencies having responsibilities in the remaining AQCR's in the contiguous United States which were not represented in the NASN and NADB files (eight AQCR's in Alaska, Hawaii, American Samoa, Guam, and the U.S. Virgin Islands were not contacted). This survey found that lead monitoring in 33 additional AQCR's has been accomplished to date.

The total number of AQCR's with 1974 data was 144, while a total of 162 AQCR's had 1975 lead concentration data (including 2 with 1976 data). For all years combined (effectively 1974 and 1975) there were 170 AQCR's with reported monitoring data. Many of the monitoring agencies did not report their measured lead concentration data to the NASN or NADB systems due to a failure to understand the reporting procedures for lead, the relatively low values observed, or other undisclosed reasons.

The concentration data contained in the NASN and NADB systems were reported in terms of 24-hour measurements averaged over a calendar quarter, while other averaging times such as a year, were used as the basis for data reported by some state and local monitoring agencies. In order to compare concentration, all measurements were converted to quarterly averaging times. In some cases, quarterly averages were not reported in the NASN or NADB systems because the data were "insufficient"; that is, there were fewer than five 24-hour measurements during a quarter, or there was no more than one measurement during any two months of a quarter.

Quarterly averages were determined for all 170 AQCR's with reported lead concentrations, even those with "insufficient" data, data reported in terms of different averaging times, or data from years other than 1974 and 1975. In order to compare measured lead concentrations with an ambient standard based on a quarterly averaging

time, maximum concentrations for other averaging times were converted to maximum quarterly concentrations.

Table 2-8 indicates the maximum quarterly mean for all AQCR's with at least one value exceeding 1.0 $\mu g/m^3$. In all, 103 AQCR's (42 percent of all regions) are presented in the table. High ambient lead concentrations usually are restricted to the vicinity of a lead emitter; hence, an average concentration measurement for all monitors in an AQCR is less indicative of potential problems than maximum concentration values. However, the pervasiveness of high levels of airborne lead may be impossible to determine because of the distribution of monitoring sites. For example, there may be only one major emitter in an AQCR, and all monitoring sites are clustered around it, while the rest of the AQCR has very low levels of airborne lead. Nevertheless, an analysis of the ambient lead concentration summary given in Table 2-8 can give an indication of which AQCR's have potential problems due to high lead concentrations.

Of the 103 AQCR's represented in Table 2-8, 54 had quarterly mean lead concentrations of 1.5 $\mu g/m^3$ or above, 40 had concentrations of 2 $\mu g/m^3$ or above, 18 had at least one quarterly mean of 3 $\mu g/m^3$ or greater, and 8 had concentrations above 4 $\mu g/m^3$. There are a number of examples of the correlation between particular lead emitters and nearby elevated concentrations of lead, but it is extremely difficult to estimate the percent contributed from each emitter to a particular receptor. A review of the major sources of

TABLE 2-8

MAXIMUM QUARTERLY LEAD CONCENTRATIONS FOR SELECTED AQCR'S ①

AQCR NUMBER	LOCATION	MAXIMUM QUARTERLY MEAN	
		VALUE ($\mu g/m^3$)	YEAR
2	AL/GA	1.49	1974
3	E. AL	1.41	1975
4	W. AL	2.20	1975
5	FL/MS/AL	1.72	1974
7	TN/AL	1.11	1975
8	S. AK	1.30	1974
9	N. AK	2.02	1975
13	NV/AZ	2.34	1974
14	AZ/CO/NM/UT	4.07	1974
15	S. AZ	4.42	1974
16	CENT. AR	1.16	1974
18	AR/MS/TN	2.51	1975
24	S.W. CA	6.70	1974
28	N. CA	3.17	1974
29	S. CA	3.72	1975
30	W. CA	2.71	1975
31	CENT. CA	2.59	1975
36	CENT. CO	1.97	1975
42	CT/MA	2.72	1975
43	NJ/NY/CT	2.16	1974
45	DE/NJ/PA	2.08	1974
47	DC/MD/VA	1.52	1975
49	FL/GA	1.40	1975
50	S.E. FL	3.07	1974
52	W. FL	2.74	1974
54	CENT. GA	1.90	1974
55	GA/TN	1.24	1975
56	W. GA	2.20	1975
58	GA/SC	1.40	1975
62	ID/WA	31.94	1974
65	IL/IA	1.19	1975
67	IL/IN	3.45	1975
69	IL/IA	1.18	1975
70	IL/MO	1.58	1975
73	IL/WI	1.09	1974
76	E. IN	1.19	1975
78	KY/IN	1.33	1974
79	KY/IN/OH	1.03	1975

AQCR NUMBER	LOCATION	MAXIMUM QUARTERLY MEAN	
		VALUE ($\mu g/m^3$)	YEAR
80	CENT. IN	1.21	1974
82	IN/MI	1.39	1974
83	S. IN	5.33	1974
85	IA/NE	1.08	1975
88	N.E. IA	1.03	1975
92	S. IA	1.34	1975
94	MO/KS	1.46	1974
101	S.E. KY	2.17	1975
102	CENT. KY	1.27	1975
103	KY/OH/WV	2.08	1974
104	CENT. KY	3.07	1975
106	LA/TX	1.71	1974
115	N. MD	3.58	1975
116	S. MD	2.07	1974
119	E. MA	1.18	1975
120	MA/RI	1.38	1975
122	CENT. MI	1.27	1975
123	E. MI	1.87	1974
128	S.E. MN	1.46	1975
129	MN/WI	1.08	1974
131	CENT. MN	3.53	1975
136	N. NC	1.27	1975
139	S.W. MO	3.16	1974
142	S.W. MT	4.02	1972
148	W. NV	1.59	1975
151	PA/NJ	2.89	1974
152	CENT. NM	1.46	1974
153	NM/TX	2.65	1975
158	CENT. NY	1.38	1974
159	NY/VT	1.22	1974
160	CENT. NY	3.27	1975
161	E. NY	2.70	1974
162	W. NY	1.07	1975
166	N. NC	1.44	1975
167	NC/SC	1.28	1975
174	N. OH	1.33	1974
176	CENT. OH	1.19	1975
178	OH/PA	1.63	1974

TABLE 2-8 (concluded)

MAXIMUM QUARTERLY LEAD CONCENTRATIONS FOR SELECTED AQCR'S ①

AQCR NUMBER	LOCATION	MAXIMUM QUARTERLY MEAN	
		VALUE $(\mu g/m^3)$	YEAR
184	CENT. OK	2.71	1974
193	OR/WA	1.19	1974
195	CENT. PA	1.57	1974
196	S. PA	1.45	1974
197	S.W. PA	4.38	1974
200	CENT. SC	1.83	1974-1975
202	N.W. SC	1.81	1975
207	TN/VA	1.60	1975
208	CENT. TN	1.78	1974
209	W. TN	1.06	1975
211	N.W. TX	1.47	1975
214	S.E. TX	1.20	1975
215	N. TX	3.40	1975
216	E. TX	2.40	1975
217	S.W. TX	1.34	1974
218	W. TX	4.95	1974
220	W. UT	1.09	1975
221	E. VT	1.91	1974
222	S. VA	1.06	1975
223	S.E. VA	1.31	1975
225	CENT. VA	1.59	1974
226	N.W. VA	1.45	1974
229	CENT. WA	2.21	1974
234	W. WV	1.24	1975
239	S.E. WI	2.77	1974
240	S. WI	1.62	1974
244	PR	2.31	1974

1. Selected AQCR's are those with an estimated maximum quarterly concentration exceeding 1.0 $\mu g/m^3$.

Source: See Appendices S, T, and U.

lead emissions in the 8 AQCR's with maximum quarterly concentrations above 4 μg/m^3 reveals specific types of situations which can lead to relatively high ambient lead levels. Most of the quarterly values are estimates based on reported ambient concentrations for other averaging times.

The Eastern-Washington-Northern Idaho Interstate AQCR (No. 62) has the highest proportion of ambient concentrations above 4 μg/m^3 of all AQCR's (U.S. Environmental Protection Agency, 1974h, i; U.S. Environmental Protection Agency, 1975h, i). Near the monitoring sites is the Bunker Hill lead smelter in Kellogg, Idaho, which emits up to 83 tons per day of lead into the atmosphere (U.S. Environmental Protection Agency, 1974f: PEDCo-Environmental Specialists, Inc., 1976). The presence of this lead smelter, and possibly the presence of three cast iron foundries, contribute to the relatively high concentrations of airborne lead that were measured in AQCR 62.

Other types of major lead emission sources can also be cited as possible reasons for high values of airborne lead recorded in an AQCR. For exmaple, the presence of five primary copper smelters in Southern Arizona is probably a major cause of the elevated ambient lead concentrations in AQCR 15 (viz., a maximum quarterly mean of 4.4 μg/m^3). In addition to the copper smelters, seven-oil fired power plants, three cast iron foundries, and a battery plant represent other stationary sources of lead in the AQCR. The presence of high traffic volumes and the resulting lead emissions from car exhausts

is indicated by the fact that this area (Phoenix in particular) has a transportation plan to control vehicular emissions.

Primary lead and copper smelters also have contributed to elevated lead levels in AQCR 142 in Southwestern Montana, where maximum 24-hour measurements ranged up to 15 $\mu g/m^3$ (State Department of Health and Enviromental Sciences, Montana, 1972). Two cast iron foundries and a ferroalloy producer also may have had some impact on the observed values.

Cast iron foundries are the major sources of lead emissions in AQCR 218, Western Texas, where the maximum quarterly mean lead concentration was 4.9 $\mu g/m^3$. While vehicular emissions and small stationary sources contribute to the overall ambient lead concentrations, the four foundries are probably the major lead emitters in this AQCR.

In the Four Corners Region of Arizona, New Mexico, Utah, and Colorado (AQCR 14), the maximum quarterly mean concentration was over 4 $\mu g/m^3$. The major sources of lead emissions in this area are six coal-fired power plants. This is another example of an AQCR where lead concentrations are primarily caused by one type of source.

In contrast, the Los Angeles region in Southwestern California (AQCR 24) is an area where a number of different source types contribute to the high lead concentrations, which range up to a maximum quarterly value of 6.7 $\mu g/m^3$ (Air Resources Board, California,

1975). Emissions from a number of battery plants, secondary lead smelters, cast iron foundries, oil-fired power plants, in addition to the large number of mobile sources, combined to produce the measured airborne lead levels.

All other AQCR's with maximum quarterly means above 4 $\mu g/m^3$ have various types of major lead emitters which contribute to the potential airborne lead problem. Cast iron foundries and a coal-fired power plant are the major sources of airborne lead in Southern Indiana (AQCR 83), where the maximum quarterly concentration is 5.3 $\mu g/m^3$.

Cast iron foundries represent the largest number of stationary lead emission sources in Pittsburgh and Southwestern Pennsylvania (AQCR 197). In addition, there are ferroalloy producers, battery plants, coal-fired power plants, a secondary lead smelter, a municipal incinerator, and an oil-fired power plant in the AQCR, plus a relatively large number of mobile sources as evidenced by the fact that Pittsburgh has a transportation plan to control vehicular emissions. The maximum quarterly mean lead concentration in AQCR 197 was 4.4 $\mu g/m^3$.

Other ACQRs with maximum quarterly concentrations near 4 $\mu g/m^3$ include the following. The San Diego region (AQCR 29) is similar to the Los Angeles region, only on a smaller scale. Two battery plants, a similar number of cast iron foundries, and four oil-fired power plants helped contribute to the estimated maximum quarterly lead concentration of 3.7 $\mu g/m^3$.

The Chicago region (AQCR 67) includes a relatively large number of different lead emission sources, such as battery plants, secondary lead smelters, cast iron foundries, municipal incinerators, coal and oil-fired power plants, and mobile sources. The resulting estimated monthly level was 3.4 $\mu g/m^3$.

The other two AQCR's with concentrations near 4 $\mu g/m^3$ are located in Northern Maryland (AQCR 115, 3.6 $\mu g/m^3$ maximum monthly value), and in Central Minnesota (AQCR 131, 3.5 $\mu g/m^3$ estimated maximum quarterly concentrations). Each AQCR has a few battery plants, secondary lead smelters, and coal-fired power plants. In addition, AQCR 115 has six cast iron foundries, a municipal incinerator, and five oil-fired power plants, while AQCR 131 has 14 cast iron foundries. Each AQCR also has a mobile source plant to help control vehicular emissions.

Maximum quarterly lead concentrations in the 170 AQCR's for which monitoring data have been received indicate the extent of potential problems due to airborne lead, as defined by three different levels of airborne lead concentrations, 1.0, 1.5 and 2.0 $\mu g/m^3$ for maximum quarterly averages.

Figure 2-3 shows the number of AQCR's that have at least one maximum quarterly concentration above each of the indicated levels in 1974 and 1975. In a few instances, 1972 data were combined with 1974 results and 1976 data augments 1975 information. In all but one case (viz., quarterly values above 1.0 $\mu g/m^3$), the number of AQCR's with
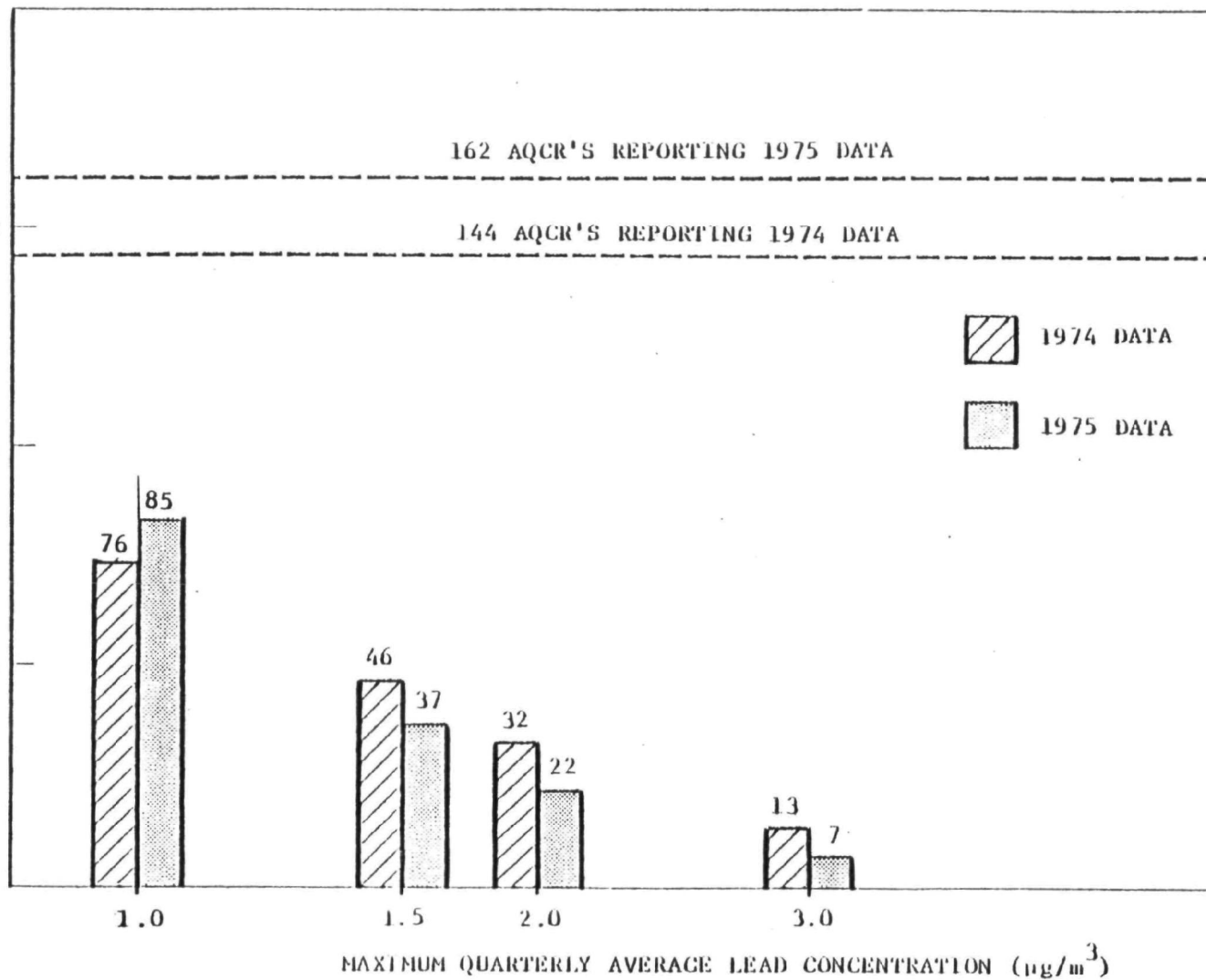
FIGURE 2-3
NUMBER OF AIR QUALITY CONTROL REGIONS (AQCR'S) WITH 1975 AMBIENT
LEAD CONCENTRATIONS EXCEEDING VARIOUS PROPOSED STANDARDS

maximum quarterly concentrations above a certain level decreased from 1974 to 1975. In all cases, however, the percentages of AQCR's with data that had quarterly concentrations above a given level declined from 1974 to 1975. Thus, while nine more AQCR's reported quarterly values above 1.0 $\mu g/m^3$ in 1975 than in 1974, there was a 0.2 percent decrease from 1974 to 1975 in the percentage of AQCR's that reported lead monitoring data and had monthly values above 1.0 $\mu g/m^3$. These declines appear to signify a relative improvement in air quality with respect to airborne lead from 1974 to 1975, due possibly to the reduction of the lead content in gasoline as well as the installation of particulate control devices on stationary sources over the years.

At a concentration of 1.0 $\mu g/m^3$, 103 of the 170 AQCRs with available data (61 percent) had estimated quarterly lead concentrations exceeding this value. The number of AQCRs decreases to 56 (33 percent of those reporting data) with quarterly levels above 1.5 $\mu g/m^3$, and to 38 (22 percent) that have at least one concentration 2 $\mu g/m^3$. Geographically, the 103 AQCRs which have maximum quarterly lead concentrations above 1.0 $\mu g/m^3$ comprise the majority of land area of the country and include the heavily populated areas.

Figure 3-1 shows the number of AQCR's which would have been out of compliance relative to different proposed standards based on reported ambient air concentrations for 1975 alone. Out of the 162 AQCR's with reported data, almost 80 percent reported ambient air

concentrations greater than 1.0 μg/m^3, while only 14 percent would

have been out of compliance for a standard of 2.0 μg/m^3. (Note that

Figure 3-1 includes estimated as well as reported data.)

2.2.2 Source Specific Data

Empirical studies have been conducted in order to investigate

the ambient air concentrations of airborne lead in the vicinity

of various stationary lead emission sources. However, because of

the number of different factors which can influence ambient lead

concentrations, the relationship between a particular lead emission

source and the resultant ambient lead levels can only be determined

in a general way. Influencing factors include meteorological vari-

ables such as wind speed and direction, stability class, and ambient

temperature; source-related factors such as stack height, fugitive

emissions, operating schedules (e.g., plant shutdowns), and source

type; terrain factors such as topography, local building sizes, and

nearby vegetation types, location factors such as downwind distance,

urban environmental, and other proximate emission source height, and

monitoring equipment condition. No single factor is responsible for

the concentrations observed at various downwind locations near an

emission source; hence, it is difficult to extrapolate the reported

data to ambient lead concentrations around other sources of airborne

lead. Nevertheless, empirical studies of ambient lead concentrations

near certain industries can provide insight into the general relation-

ships between lead emissions and downwind concentrations.

2.2.2.1 Specific Source Analysis - Primary Lead Smelters.

Ambient air quality measurements conducted in the vicinity of three primary lead smelters showed relatively high lead concentrations when compared to other lead emission sources. The American Smelting and Refining company (ASARCO) smelter in East Helena, Montana is the smallest of the three, producing an average of 170 tons of lead a day. The Bunker Hill smelter in Kellogg, Idaho is the largest, with a daily production of 350 tons of lead, while another ASARCO smelter in El Paso, Texas produces 200 tons of lead as well as 260 tons of copper a day (U.S. Environmental Protection Agency, 1975g).

The means of the monthly lead concentrations for ten receptors in the vicinity of the El Paso smelter range from 10.2 $\mu g/m^3$ at the closest receptor (0.2 mile away) to 0.9 $\mu g/m^3$ at the most distance receptor (3.7 miles away). Receptors located more than 1.1 miles (1.8 kilometers) from the smelter had no monthly lead concentrations greater than 5 $\mu g/m^3$, while the average of the monthly concentrations at any receptor was never more than 1.8 $\mu g/m^3$. Also, no monthly concentration exceeded 3 $\mu g/m^3$, and no average of the monthly concentrations exceeded 0.9 $\mu g/m^3$ for receptor sites more than three miles (4.8 kilometers) from the smelter.

The Bunker Hill lead smelter in Kellogg, Idaho processes 75 percent more lead per day than is processed by the ASARCO smelter

in El Paso. The maximum 24-hour lead concentration between March 1973 and June 1974 at a monitoring site 2,500 feet (760 meters) southeast of the mainstack was 45.5 $\mu g/m^3$, while the average 24-hour value was 12.5 $\mu g/m^3$. The distribution of daily concentrations at a receptor 0.4 mile from the Bunker Hill smelter shows a larger percentage of values above 5 $\mu g/m^3$ when compared with the concentration distribution at the closest receptor to the ASARCO-El Paso smelter (86 versus 61 percent, respectively), in spite of the fact that the downwind distance to the El Paso receptor is smaller (0.2 mile). The annual mean concentration at the receptor near the Bunker Hill smelter (12.5 $\mu g/m^3$) is also larger than at the El Paso receptor (10.2 $\mu g/m^3$). This is probably because the Kellogg plant emits more lead due to a number of factors, including a higher rate of lead processing, a higher concentration of lead in the ore, and slightly less efficient control devices.

Ambient lead concentrations have been monitored near the ASARCO lead smelter by the Environmental Protection Agency in 1975. Only maximum 24-hour values were reported, and these showed a general inverse relationship between concentration and distance from the source. The three receptors within one mile of the smelter averaged 12.1 $\mu g/m^3$ as a 24-hour maximum, while the two receptors 2.5 and 4.5 miles from the smelter had 2.5 and 7.0 $\mu g/m^3$ maximums, respectively.

Primary Copper Smelters. Primary copper smelters also produce lead as a byproduct, some of which is emitted to the effluent stream.

In general, lead concentrations in the vicinity of primary copper smelters are lower than those in the vicinity of lead smelters because of the lower uncontrolled lead emissions per ton of product from copper smelters.

Ambient lead levels around the Anaconda copper smelter in Anaconda, Montana were measured in 1973 and 1974. This is the largest of the copper smelters investigated, processing 500 tons of copper a day (U.S. Environmental Protection Agency, 1974f). The mean of the measured 24-hour lead concentration was 0.2 μg/m^3, with no values exceeding 0.6 μg/m^3. These concentrations were much lower than the ambient levels around the lead smelters described previously due to the lower lead emissions, the generally greater distance to the receptor, and the very tall stack (925 feet).

The Kennecott copper smelter in McGill, Nevada is smaller than the Anaconda plant, processing only 190 tons of copper per day (U.S. Environmental Protection Agency, 1974f). The average 24-hour ambient lead concentration 2.6 miles from the smelter was 0.3 μg/m^3, which was much lower than similar measurements observed near the three lead smelters described previously, even for receptors greater than 2.6 miles from their respective smelters.

The Magma copper smelter in San Manuel, Arizona processes 310 tons of copper per day. The mean 24-hour lead concentration of only 0.07 μg/m^3 is far less than the average values around the primary lead smelters described above, and no concentration exceeded 0.7

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$\mu g/m^3$. In spite of the fact that the quantity of copper processed at the San Manuel smelter is greater than the amount at the McGill smelter, and the receptor was closer (0.9 mile versus 2.6 miles), the airborne lead levels were lower. This was probably due in part to the taller stack and the high efficiency of the particulate control methods used at the San Manuel smelter.

The Phelps Dodge copper smelter in Ajo, Arizona processes 200 tons per day of copper (U.S. Environmental Protection Agency, 1974f), while the average 24-hour measured lead concentration near the smelter was 0.06 $\mu g/m^3$. Another Phelps Dodge copper smelter, in Douglas, Arizona, processes 370 tons of copper per day (U.S. Environmental Protection Agency, 1974f) with an average 24-hour concentration of 0.2 $\mu g/m^3$, and maximum concentration of 1.3 $\mu g/m^3$ at the receptors 3.1 miles from the smelter.

All receptors greater than 0.4 mile from the lead and copper smelters had 58 percent or more of their monthly lead concentrations below the level of 2 $\mu g/m^3$. If receptors near the El Paso and Kellogg smelters are excluded from the analysis, then over 94 percent of the 24-hour concentrations at all other receptors were less than 1 $\mu g/m^3$.

Lead Storage Battery Plants. Ambient lead monitoring has been conducted in the vicinity of five battery plants by Pennsylvania's Department of Environmental Resources. Four of the plants investigated combine grid manufacturing with secondary smelting of reclaimed

lead from used batteries. The secondary lead smelting facilities of
the General Battery plant in Hamburg, Pennsylvania were removed
in April 1971; ambient lead concentrations were monitored both before
and after the operational change.

The Marjol Battery Company plant in Throop, Pennsylvania pro-
cesses an average of 3.7 and a maximum of 3.8 tons of lead per hour.
Measured ambient concentrations ranged up to 4.9 $\mu g/m^3$ for an average
of all 24-hour values at one receptor, while at another receptor over
35 percent of the observations were above 5 $\mu g/m^3$, both receptors
being 330 yards from the plant. This fact probably results from the
relatively small stack height of the battery plant (20 feet) and the
proximity of the receptors (0.19 mile).

Lead emissions from the General Battery Company in Hamburg,
Pennsylvania are reported to average 1.1 pounds/hour with a maximum
of 1.6 pounds/hour for the grid casting operations without a rever-
beratory furnace. Existing control equipment includes a baghouse
with a 98 percent designed particulate removal efficiency and a
scrubber with a 96 percent design efficiency (Department of Environ-
mental Resources, Pennsylvania, 1976b). Prior to April 23, 1971,
when the reverberatory furnace at the plant was removed, ambient lead
concentrations near the plant were extremely high, with average
24-hour values up to 56.5 $\mu g/m^3$ at a distance of 50 yards (46
meters), and a maximum 24-hour value of 160 $\mu g/m^3$ at a receptor 275
yards (251 meters) away. Current lead concentrations at these same

two receptors are 2.5 μg/m^3 (average 24-hour value) and 2.9 μg/m^3 (maximum 24-hour value), respectively.

The General Battery Company plant in Laureldale, Pennsylvania, employs a total of eight smelting and casting operations, and emits an average of 4.9 pounds of lead per hour and up to a maximum of 7.3 pounds per hour. Average 24-hour lead concentrations measured in 1971 at three monitors within 250 yards (230 meters) of the plant were no greater than 1.5 μg/m^3, with no single 24-hour value exceeding 3.2 μg/m^3. However, in 1970 the average 24-hour lead concentrations at two monitors 150 yards from the plant were 15.2 and 33.2 μg/m^3 with maximum 24-hour values of 72 μg/m^3 and 140 μg/m^3, respectively (these higher values probably reflect increased lead emissions which were reduced by 1971). The reported concentrations at the Laureldale plant were measured prior to the addition of a lead reverberatory furnace that was moved from the Hamburg plant of the General Battery Corporation.

The Prestolite Battery Division of the Eltra Company in Temple, Pennsylvania emits a total of 9.7 pounds of lead per hour from 13 different processing operations. Average 24-hour ambient concentrations near the plant generally decline with increasing distance, from 8.2 to 1.3 μg/m^3 for receptors from 25 to 250 yards (23 to 230 meters) from the plant. However, the two closest monitoring sites are near a heavily traveled road where lead emissions from traffic may be important contributors to overall concentration levels.

Another receptor 1,330 yards (1,210 meters) away recorded an average concentration of 2.7 μg/m^3 in 1970, but this level was influenced by the lead emissions from the nearby General Battery plant in Laureldale.

The East Penn Battery Plant incorporates a blast furnace with potential lead emissions of 237 pounds/hour. The average 24-hour ambient lead concentrations, measured from 250 to 300 yards (230 to 270 meters) away, ranged from 3.1 to 3.9 μg/m^3.

Secondary Lead Smelters, Ferroalloy Producers, and Gray Iron Foundries. Ambient lead concentrations near the property line of secondary lead smelters, ferroalloy manufacturers, and gray iron foundries have been measured by the Texas Air Control Board. Sample 24-hour lead concentrations ranged from 3.3 to 111.6 μg/m^3 near two secondary lead smelters, from 2.5 to 4.2 μg/m^3 near a ferroalloy producer, and from zero to 50.9 μg/m^3 near seven gray iron foundries. Unfortunately, the relatively small number of reported samples and the lack of precise information concerning source emissions tend to reduce the significance of the data when compared to the ambient data presented for other source types.

A study was conducted between May and December 1973 by the Toronto Board of Health of lead concentrations near two secondary lead smelters (Roberts et al., 1974). It was found that fugitive emissions were more important than stack emissions in contributing to the nearby ambient lead levels, primarily because of the lower

emissions heights of fugitive sources. A comparison was made of ambient lead concentrations near the smelters with concentrations in an urban control area away from the smelters to see if there were any significant differences that could be attributed to lead emissions from the smelters. It was found that the geometric mean lead concentration in the smelter area was 3.0 $\mu g/m^3$ compared to a similar mean of 0.8 $\mu g/m^3$ in the urban control area (Roberts et al., 1974).

2.2.2.2 <u>General Considerations</u>. Ambient lead concentrations in the vicinity of certain industrial plants are the result of a number of variables. In general, the data demonstrate some important relationships such as the direct relationship between concentrations and the lead emission rate, and the inverse relationship between downwind distance and ambient levels of lead. Figures 2-4, 2-5, and 2-6 depict maximum 24-hour ambient lead concentrations as a function of distance from primary and secondary lead smelters (Figure 2-4), primary copper smelters and gray iron foundries (Figure 2-5), and battery plants (Figure 2-6). Lead concentrations near primary lead smelters (Figure 2-4) show most clearly the general decline of lead levels at increasing downwind distances from an emission source.

Table 2-9 indicates the percentage of monthly concentrations which exceeded five different concentration levels in the vicinity of the industrial plants investigated. In some cases, general conclusions concerning ambient lead concentrations near certain types of stationary emission sources may be drawn based on previous discussions.

2-61
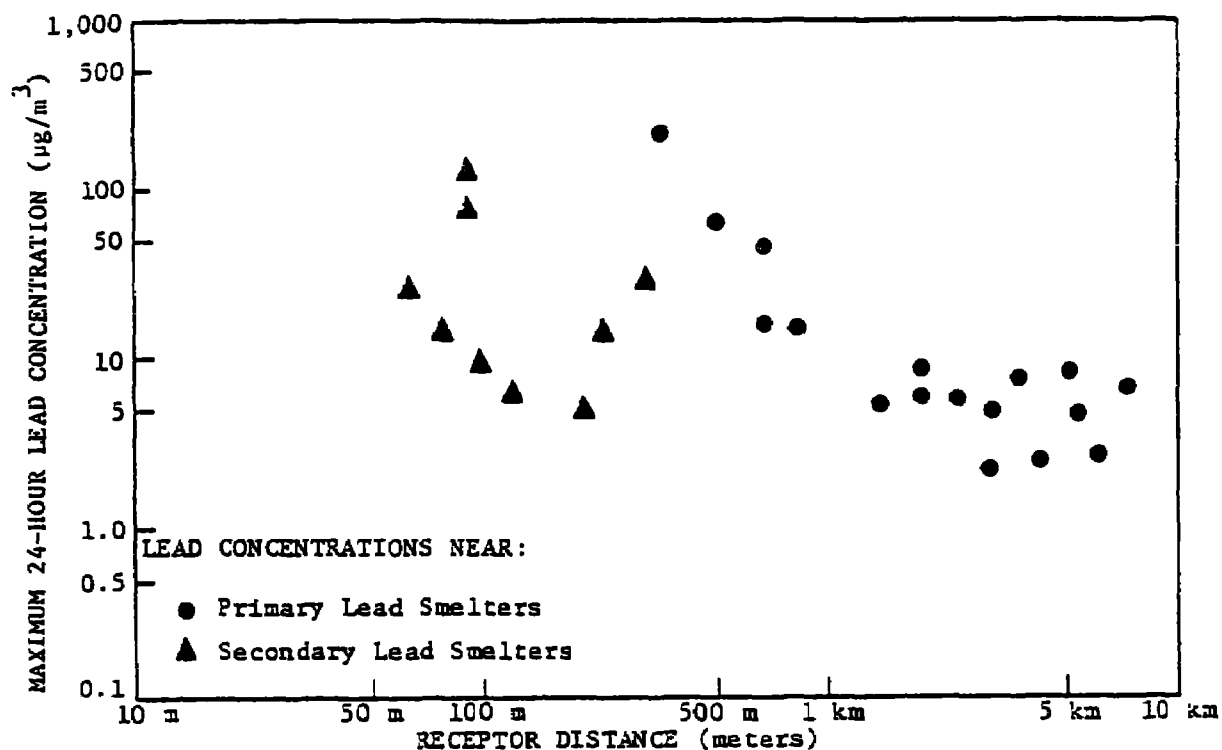
FIGURE 2-4
LEAD CONCENTRATIONS VERSUS DISTANCE FROM
PRIMARY AND SECONDARY LEAD SMELTERS
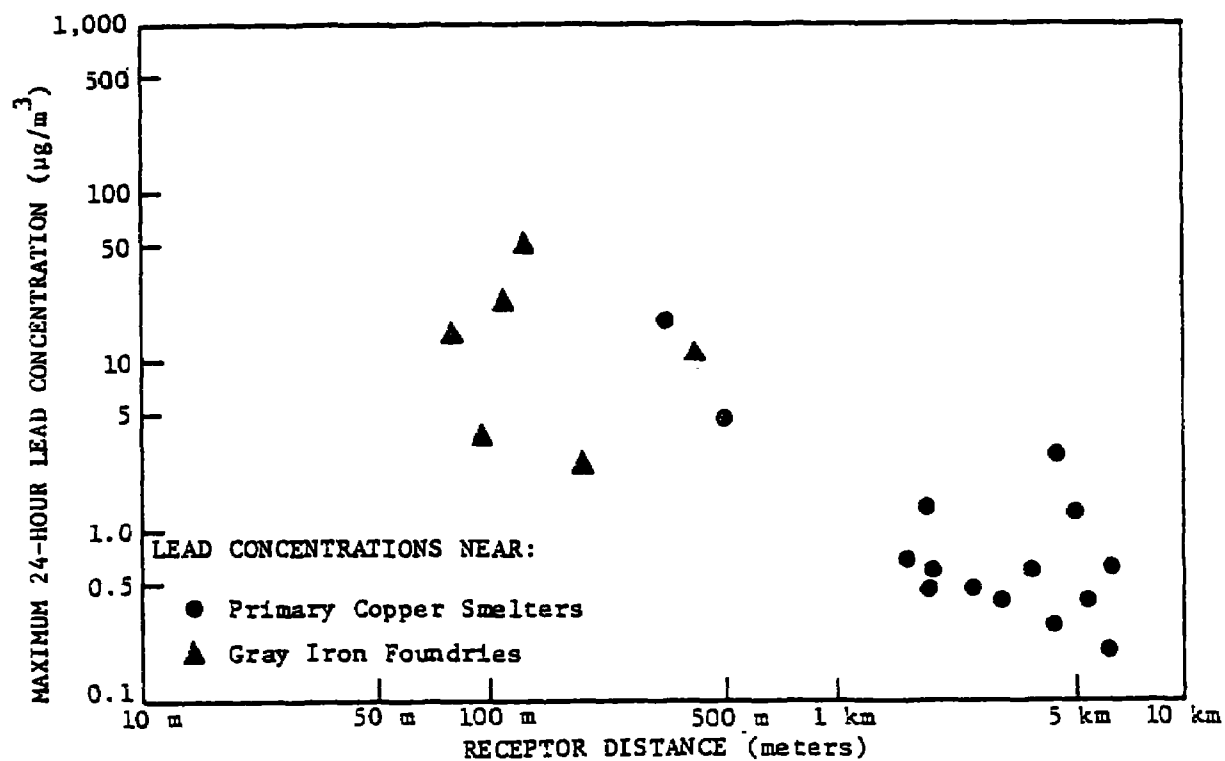
FIGURE 2-5
LEAD CONCENTRATIONS VERSUS DISTANCE FROM
PRIMARY COPPER SMELTERS AND GRAY IRON FOUNDRIES
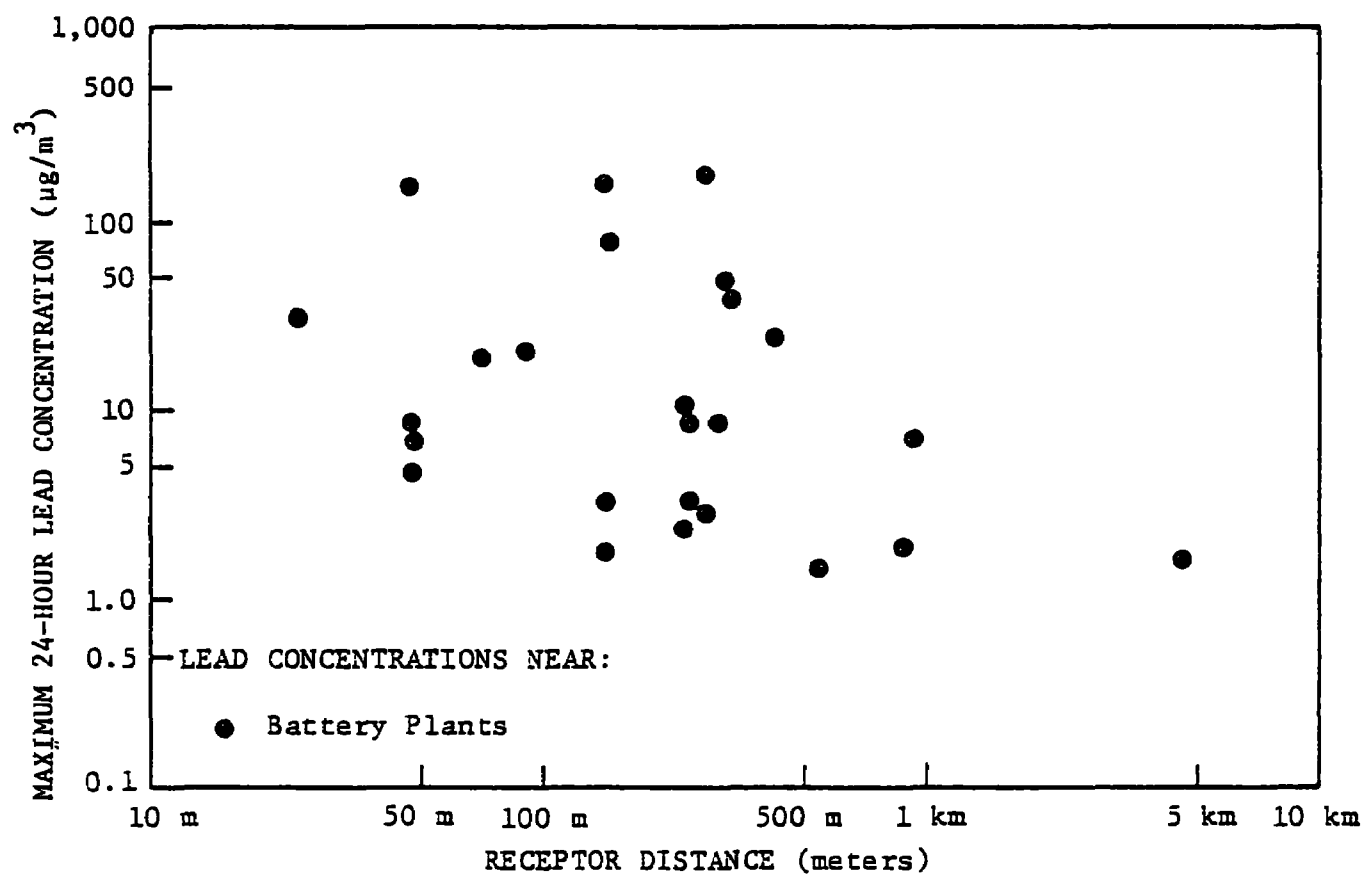
FIGURE 2-6
LEAD CONCENTRATIONS VERSUS DISTANCE FROM BATTERY PLANTS

TABLE 2-9

PROBABILITY OF EXCEEDING LEAD CONCENTRATION LEVELS NEAR SELECTED INDUSTRIES

INDUSTRY AND PLANT	PERCENTAGE OF MONTHLY AVERAGES EXCEEDING GIVEN LEVELS (g/m^3)					NUMBER OF MONTHLY AVERAGES
	0.5	1.5	2.0	3.0	5.0	
PRIMARY LEAD SMELTER						
ASARCO--El Paso, TX	96	49	35	20	13	379
Bunker Hill--Kellogg, ID	100	100	100	100	87	16
ASARCO--East Helena, MT	27	0	0	0	0	15
PRIMARY COPPER SMELTER						
ASARCO--El Paso, TX	96	49	35	20	13	379
Anaconda--Anaconda, MT	0	0	0	0	0	9
Kennecott--McGill, NV	7	0	0	0	0	14
Magma--San Manual, AZ	0	0	0	0	0	11
Phelps Dodge--Ajo, AZ	0	0	0	0	0	10
Phelps Dodge--Douglas, AZ	0	0	0	0	0	12
LEAD BATTERY MANUFACTURER						
Marjol Battery--Throop, PA	93	60	47	30	17	101
General Battery--Hamburg, PA	100	100	100	57	0	7
General Battery--Laureldale, PA	100	79	79	64	57	14
Prestolite Battery--Temple, PA	100	92	67	67	33	12
East Penn--Richmond Township, PA	100	100	100	100	0	3
SECONDARY LEAD SMELTER (a)						
Dixie Lead--Dallas, TX	100	100	100	100	100	1
NL Industries--Dallas, TX	100	100	100	100	100	1
FERROALLOY PRODUCER (a)						
Tenn-Tex Alloy--Houston, TX	100	100	100	100	0	1
GRAY IRON FOUNDRY (a)						
Oil City Iron Works--Corsicana, TX	0	0	0	0	0	1
Lufkin Industries--Lufkin, TX	100	100	100	100	100	1
Tyler Pipe--Tyler, TX	100	0	0	0	0	1
Trinity Valley Iron and Steel-- Fort Worth, TX	100	100	100	0	0	1
Green's Bayou Foundry--Houston, TX	100	100	100	100	100	1
McKinley Iron Works--Fort Worth, TX	100	100	100	100	100	1
American Darling Foundry--Beaumont, TX	100	100	100	100	100	1

Note: (a) Percentages are based on the one monthly average ambient air lead concentration value available for each plant listed.

Sources: U.S. Environmental Protection Agency. 1974g. Smelter Study, 1973-1974.

Department of Environmental Resources, Pennsylvania. 1976a. Hi-Vol Sampling Data.

Texas Air Control Board. April 1974a. A Report of Typical Element Emissions from Texas Smelters. Austin, Texas.

Texas Air Contral Board. April 1974b. A Report of Typical Element Emissions from Texas Foundries. Austin, Texas.

High ambient lead levels were observed in the vicinity of primary lead
smelters and battery plants, particularly those which include secondary
lead smelting facilities, and may be expected in the vicinity of other,
similar plants. These results are mainly due to the relatively large
lead emissions from the primary lead smelters, and the apparent lack
of atmospheric dispersion at the battery plants/secondary smelters
due to relatively small source-recep or distances and stack heights.
Concentrations in the vicinity of primary copper smelters were not as
high because of their comparatively large stack heights. However, in
some cases ambient lead concentrations could show elevated values
because of downwash or fumigation conditions from the stack, and the
amount of fugitive lead emissions from this type of facility. A
large percentage of the lead emissions from copper smelters is due to
fugitive emissions, which produce maximum downwind concentrations
relatively near the plant site and much closer than the monitoring
sites used for the reported air quality studies. If all monitoring
sites were located at the point of maximum downwind concentration
from each emission source, primary lead and copper smelters would
probably produce higher ambient lead concentrations than battery
plants or other types of sources.

2.2.3 Estimated Ambient Lead Levels for AQCR's Without Monitoring
Data

2.2.3.1 Introduction. For 73 of the 77 AQCR's where concen-
trations were not measured in 1975, estimates of the maximum
quarterly lead levels have been determined through mathematical

modeling of lead emissions and subsequent atmospheric diffu-
sion patterns (the four AQCR's omitted from the analysis were outside
the continental United States). Maximum lead emissions were estimated
from mobile sources at the location of the highest recorded daily
traffic volume within each AQCR. A line source diffusion model was
then applied to estimate the resulting ambient lead concentration ten
meters downwind from the road or street, given the observed traffic
speeds and road conditions. Emissions from stationary sources were
estimated by applying appropriate emission factors and control
efficiencies to each size and type of major lead source known to
exist in an AQCR. Maximum downwind concentrations were then esti-
mated for each source from diffusion equations, given appropriate
stack and fugitive emission parameters. The highest monthly lead
concentration from a stationary source was then superimposed on the
maximum concentration from mobile sources in each AQCR to derive the
expected upper limit for ambient lead levels. Because of the uncer-
tainties involved in estimating lead concentrations, the use of the
expected upper limit as a design value for determining emission
rollback requirements tends to minimize the probability of under-
estimating the impact of alternative lead standards.

2.2.3.2 Concentration Estimates from Mobile Sources. Each
AQCR within the continental United States which did not have reported
lead concentrations was contacted in order to determine the maximum
average daily traffic count (ADT) in that AQCR and the location of

that count. The type of road and its location were noted in order that the correct line source diffusion model classified according to one of four different roadway configurations could be applied.

The location and condition of each roadway where the maximum ADT was observed permitted a classif.cation according to one of the four following configurations.

(1) outside an urban area; limited access; free traffic flow (60 miles/hour average speed);

(2) within influence of an urban area; limited or non-limited access; somewhat restricted traffic flow (48 miles/hour average speed);

(3) within an urban area; limited or nonlimited access; moderately congested traffic flow (38 miles/hour average speed);

(4) within an urban central business district; nonlimited access; heavily congested traffic flow (16 miles/hour average speed).

The lead emissions rate per vehicle for each of these roadway configurations was based on the average lead content of gasoline and the average fuel economy considering traffic speeds. Lead content was assumed constant for all configurations, and equals 1.69 g Pb/gallon based on gasoline usage requirements in 1975 (see Section 2.1.1.3). The average fuel economy, determined from traffic speeds for the different configurations and the age distribution of vehicles in 1975, varied from 10.2 miles/gallon (mpg) for Configuration 4 to 21.4 mpg for Configuration 2. The emission rate, in g/m-sec, was determined from these variables plus the traffic count, and then

converted to a downwind concentration by use of a line source diffusion model. Table 2-10 shows the resulting maximum monthly ambient lead concentration for mobile sources in each of the indicated AQCR's.

2.2.3.3 Concentration Estimates from Stationary Sources. An inventory of the size and type of nine stationary sources of airborne lead was used to estimate lead emissions in those AQCR's without monitoring data. Appropriate emission factors and control requirements* were applied to the output levels of typical plants representing the different major industries with lead emissions. Each resulting lead emission rate, Q in (tons/year), was then related to a maximum quarterly lead concentration, χ(in $\mu g/m^3$), by use of an atmospheric diffusion model (Scruggs, 1977). The model was run for different industry types, and in some cases for different sizes, because of the varying stack parameters and other variables which affect pollutant diffusion. A separate factor, X/Q, was developed for each typical plant type and then multiplied by Q for the largest plant of each category in each of the pertinent AQCR's. The resulting monthly downwind concentrations, representing the maximum ambient lead levels in the vicinity of the different industry categories in each AQCR, are shown in Table 2-10.

The sum of the maximum expected concentration from the largest stationary contributor and the concentration near the roadway with the highest traffic count is used as an upper limit of the expected

*Due to SIP regulations for particulates.

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TABLE 2-10
ESTIMATED AIR QUALITY IN AQCR'S WITHOUT MONITORING DATA

AQCR	POTENTIAL QUARTERLY LEAD CONCENTRATION ($\mu g/m^3$)	LEAD CONCENTRATION NEAR MOBILE SOURCES ($\mu g/m^3$)	LEAD CONCENTRATION NEAR INDICATED STATIONARY SOURCES ($\mu g/m^3$) [1]								
			FERRO-ALLOY	BATTERY PLANTS	PRIMARY LEAD	SECONDARY LEAD	PRIMARY COPPER	GAS ADDITIVE	CAST IRON	COAL-FIRED POWER PLANTS	OIL-FIRED POWER PLANTS
1	1.23	1.07	<0.01	0.16	--	--	--	--	0.03	0.01	--
6	0.83	0.83	--	--	--	--	--	--	--	--	--
10	NAV [2]	--	--	--	--	--	--	--	--	--	--
11	NAV	--	--	--	--	--	--	--	--	--	--
19	1.17	1.09	--	--	--	--	--	--	<0.01	--	0.08
20	2.32	1.26	--	--	--	--	--	--	<0.01	--	1.05
23	0.56	0.56	--	--	--	--	--	--	--	--	--
34	0.85	0.85	--	--	--	--	--	--	--	--	--
35	0.54	0.53	--	--	--	--	--	--	<0.01	<0.01	--
37	1.25	1.25	--	--	--	--	--	--	--	--	--
38	1.10	1.03	--	--	--	--	--	--	<0.01	0.07	--
39	0.61	0.61	--	--	--	--	--	--	--	--	--
40	0.36	0.32	--	--	--	--	--		--	0.03	--
41	3.65	2.32	--	0.16	--	--	--	--	<0.01	--	1.33
44	0.61	0.61	--	--	--	--	--	--	<0.01	--	--
48	4.99	3.09	--	0.16	--	--	--	--	<0.01	--	1.90
51	2.56	1.26	--	--	--	--	--	--	--	--	1.30
63	0.35	0.35	--	--	--	--	--	--	--	--	--
66	1.13	1.10	--	--	--	--	--	--	0.03	0.03	--
71	0.94	0.88	--	--	--	--	--	--	--	0.06	--
72	1.00	0.67	0.06	--	--	--	--	--	<0.01	0.32	--
74	2.42	0.81	--	--	--	--	--	--	0.03	0.03	1.61
86	1.93	1.22	--	--	--	--	--	--	<0.01	0.72	--
89	1.49	1.46	--	0.03	--	--	--	--	0.03	--	--
90	1.09	1.09	--	--	--	--	--	--	--	--	--
91	2.10	2.10	--	--	--	--	--	--	<0.01	--	--
93	0.88	0.88	--	--	--	--	--	--	--	--	--
96	0.72	0.56	--	0.16	--	--	--	--	<0.01	--	--
97	0.25	0.25	--	--	--	--	--	--	<0.01	--	--
98	0.60	0.44	--	0.05	--	--	--	--	<0.01	0.16	0.08

TABLE 2-10 (continued)

ESTIMATED AIR QUALITY IN AQCR'S WITHOUT MONITORING DATA

AQCR	POTENTIAL QUARTERLY LEAD CONCENTRATION ($\mu g/m^3$)	LEAD CONCENTRATION NEAR MOBILE SOURCES ($\mu g/m^3$)	LEAD CONCENTRATION NEAR INDICATED STATIONARY SOURCES ($\mu g/m^3$) ①								
			FERRO-ALLOY	BATTERY PLANTS	PRIMARY LEAD	SECONDARY LEAD	PRIMARY COPPER	GAS ADDITIVE	CAST IRON	COAL-FIRED POWER PLANTS	OIL-FIRED POWER PLANTS
100	0.39	0.32	--	--	--	--	--	--	<0.01	--	0.68
108	1.08	1.08	--	--	--	--	--	--	--	--	--
111	0.36	0.36	--	--	--	--	--	--	--	--	--
117	0.66	0.66	--	--	--	--	--	--	--	--	--
134	3.32	1.51	--	--	--	--	--	--	--	--	1.82
135	1.48	1.44	--	0.05	--	--	--	--	<0.01	--	--
137	1.32	1.24	--	--	--	--	--	--	<0.01	0.08	--
138	12.04	1.08	--	--	11.0 ③	--	--	--	<0.01	0.12	--
144	1.60	1.60	--	--	--	--	--	--	--	--	--
149	0.87	0.47	--	--	--	--	--	--	--	--	--
150	2.06	1.89	--	--	--	--	--	<0.01	<0.07	0.17	--
154	0.86	0.86	--	--	--	--	--	--	--	--	--
155	0.54	0.54	--	--	--	--	--	--	--	--	--
156	1.17	1.17	--	--	--	--	--	--	--	--	--
157	0.59	0.59	--	--	--	--	--	--	--	--	--
165	1.55	1.19	--	--	--	--	--	--	<0.01	0.37	--
168	1.26	1.26	--	--	--	--	--	--	<0.01	--	--
169	1.51	1.47	--	--	--	--	--	--	<0.01	0.03	--
171	3.13	3.00	--	--	--	0.13	--	--	--	0.07	--
175	1.18	1.16	--	--	--	--	--	--	<0.01	0.02	--
177	0.82	0.79	--	0.05	--	--	--	--	0.03	<0.01	--
179	1.63	1.35	0.07	--	--	--	--	--	<0.01	0.28	--
180	0.60	0.53	--	0.05	--	--	--	--	0.03	<0.01	--
182	1.15	1.15	--	--	--	--	--	--	<0.01	--	--
183	1.75	1.59	0.06	0.16	--	--	--	--	0.03	0.15	--
187	0.66	0.66	--	--	--	--	--	--	--	--	--
190	0.98	0.96	0.02	--	T-	--	--	--	<0.01	--	--
191	0.34	0.34	--	--	--	--	--	--	--	--	--
192	0.38	0.38	--	--	--	--	--	--	--	--	--
194	1.09	1.09	<0.01	--	--	--	--	--	--	--	--

TABLE 2-10 (concluded)
ESTIMATED AIR QUALITY IN AQCR'S WITHOUT MONITORING DATA

AQCR	POTENTIAL QUARTERLY LEAD CONCENTRATION ($\mu g/m^3$)	LEAD CONCENTRATION NEAR MOBILE SOURCES ($\mu g/m^3$)	LEAD CONCENTRATION NEAR INDICATED STATIONARY SOURCES ($\mu g/m^3$) [1]								
			FERRO-ALLOY	BATTERY PLANTS	PRIMARY LEAD	SECONDARY LEAD	PRIMARY COPPER	GAS ADDITIVE	CAST IRON	COAL-FIRED POWER PLANTS	OIL-FIRED POWER PLANTS
198	1.09	0.83	--	--	--	--	--	--	<0.01	--	--
199	3.66	2.19	0.02	--	--	--	--	--	<0.01	0.07	1.47
201	0.80	0.76	--	--	--	--	--	--	--	0.03	--
203	0.58	0.58	--	--	--	--	--	--	<0.01	--	--
204	2.03	1.99	--	--	--	--	--	--	--	0.03	--
206	0.39	0.39	--	--	--	--	--	--	<0.01	--	--
219	0.97	0.93	--	0.05	--	--	--	--	--	0.02	--
224	2.07	2.03	--	--	--	--	--	--	<0.01	0.05	--
227	0.68	0.65	0.03	--	--	--	--	--	<0.01	--	--
228	0.86	0.86	--	--	--	--	--	--	<0.01	--	--
230	1.41	1.41	--	--	--	--	--	--	<0.01	--	--
231	0.45	0.45	--	--	--	--	--	--	0.01	--	--
232	0.85	0.85	--	--	--	--	--	--	--	--	--
233	0.91	0.91	--	--	--	--	--	--	--	--	--
235	0.89	0.64	<0.01	--	--	--	--	--	0.01	0.25	--
236	0.95	0.95	--	--	--	--	--	--	--	--	--
245	NAV [2]	--	--	--	--	--	--	--	--	--	--
246	NAV [2]	--	--	--	--	--	--	--	--	--	--

1. Data were not available for determining ambient lead concentrations from iron and steel plants and municipal incinerators (Scruggs, 1977).

2. NAV = not available; AQCR outside continental United States.

3. Stack emissions are assumed to be negligible. Fugitive emissions only are modeled.

    126,200 tons/year production   8.69 x 10^{-5} $\mu g/m^3$/ton product (Scruggs, 1977) = 11.0 $\mu g/m^3$.

ambient lead level in an AQCR, as given in Table 2-10. While it is not expected that the location of the two maximum concentrations would necessarily coincide, the analysis was designed to reduce greatly the probability of underestimating ambient lead concentrations in an AQCR.

Figure 2-7 shows the number of AQCR's which would have been out of compliance relative to different proposed standards based on estimated ambient air concentrations for 1975. Out of the 73 AQCR's with estimated data, almost 48 percent had estimated ambient concentrations greater than 1.0 $\mu g/m^3$ while only 11 percent would have been out of compliance for a standard of 2.0 $\mu g/m^3$.

The estimated maximum lead concentrations from 73 AQCR's without monitoring data are to be combined with the maximum observed concentrations from the 162 AQCR's with 1975 data (see Section 2.2.I) and eight AQCRs with only 1974 data. These data are to be used in determining required emissions rollbacks in order to meet possible ambient lead standards. The four AQCR's not included in the analysis (located in Guam, American Samoa and two in Alaska) were not considered to have major sources of lead emissions.
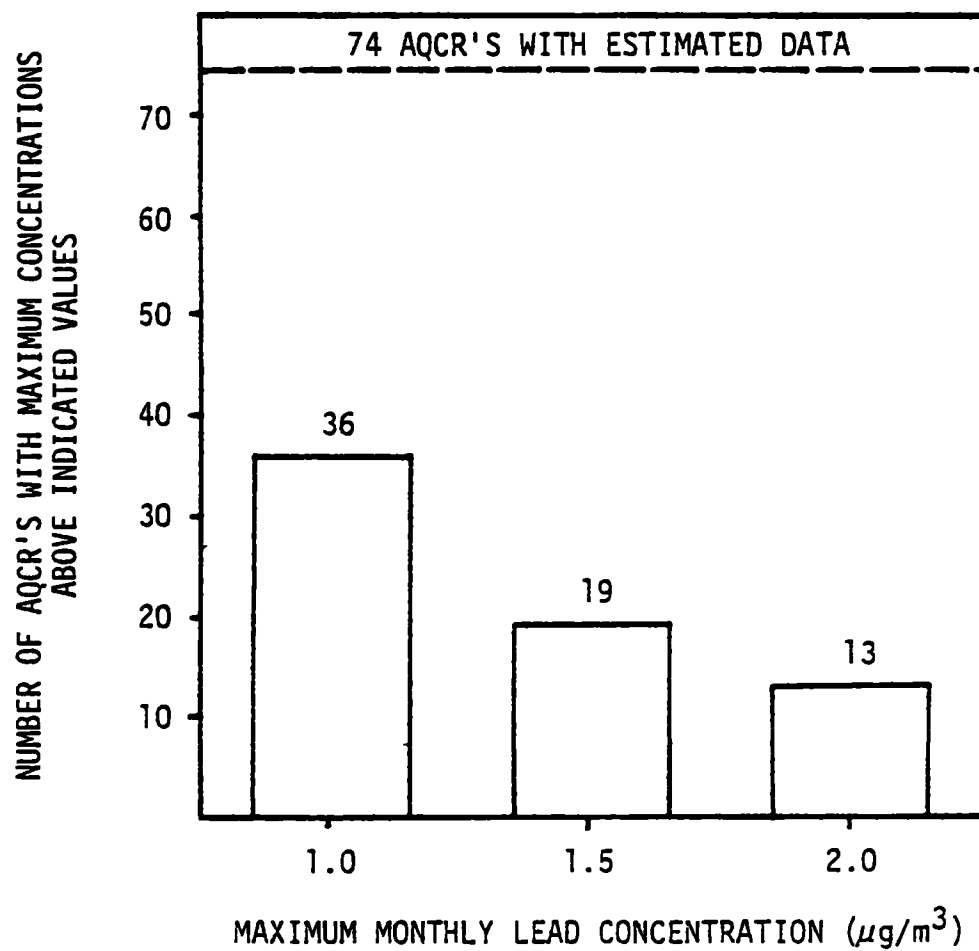
FIGURE 2-7
NUMBER OF AQCR'S WITH MAXIMUM ESTIMATED
LEAD CONCENTRATIONS ABOVE INDICATED VALUES

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REFERENCES

AIRBORNE LEAD IN THE ENVIRONMENT: SOURCES AND AMBIENT LEVELS

Air Resources Board, California. November 1975. Reconstruction of the California Ambient Air Quality Standard for Lead, Staff Report 75-21-1.

American Petroleum Institute. September 1974. Waste Oil Rounaup... No. 3. Publication No. 1587. Washington, D.C.

American Petroleum Institute. October 1975. Energy from Used Lubricating Oils. Publication No. 1588. Washington, D.C.

Bailie, J.D. March 1976. Economics of Manganese as an Antiknock in Unleaded Gasoline. Ethyl Corporation, Houston, Texas. Presented at the 1976 Annual Meeting, March 30, 1976, San Antonio, Texas.

Bureau of the Census. 1976b. Statistical Abstract of the United States: 1976. U.S. Department of Commerce.

Chansky, Steven, James Carroll, Benjamin Kincannon, James Sahagian, and Norman Surprenant. September 1974. Waste Automotive Lubricating Oil Reuse as a Fuel. Prepared for U.S. Environmental Protection Agency, Washington, D.C.

Commercial Car Journal. July 1974. "Industry Trends and Statistics," Commercial Car Journal.

Consumers Union. April 1977a. "Emissions Control: The Impossible Standards That Could Have Been Met," Consumer Reports. Consumers Union.

Consumers Union. August 1977b. "MMT: A Gasoline Additive That Should Be Subtracted," Consumer Reports.

Department of Environmental Resources, Pennsylvania. 1976a. Hi-Vol Sampling Data. Harrisburg, Pennsylvania.

Department of Environmental Resources, Pennsylvania. 1976b. Emissions Inventory. Harrisburg, Pennsylvania.

Edwards, H.W. December 31, 1973. "Colorado State University Research Program," Impact on Man of Environmental Contamination Caused by Lead, Interim Report prepared for the National Science Foundation. Colorado State University, Fort Collins, Colorado.

REFERENCES (Continued)

AIRBORNE LEAD IN THE ENVIRONMENT: SOURCES AND AMBIENT LEVELS

Faggan, J.E., J.D. Bailie, E.A. Desmond, and D.L. Lenane. October
      1975. An Evaluation of Manganese as an Antiknock in Unleaded
      Gasoline. Ethyl Corporation, Detroit, Michigan, and Houston,
      Texas. For presentation at the SAE Automobile Engineering
      Meeting, Detroit, Michigan, October 13-17, 1975.

Federal Energy Administration. November 16, 1976a. Preliminary
      Findings and Views Concerning the Exemption of Motor Gasoline
      from the Mandatory Allocation and Price Regulations. Washington,
      D.C.

Greenberg, Robert Russ. 1976. A Study of Trace Elements Emitted
      on Particles from Municipal Incinerators. University of
      Maryland.

Hurn, R.W. 1968. "Mobile Combustion Sources," Air Pollution,
      Vol. 3, edited by Arthur C. Stern. Academic Press, New York.

Lewis, Bernard and Guenther von Elbe. 1961. Combustion, Flames,
      and Explosions of Gases. Combustion and Explosives Research,
      Inc., Pittsburgh, Pennsylvania.

Massoglia, Martin F. August 1976a. Summary of Particulate and
      Sulfur Oxide Emission Reductions Achieved Nationwide for
      Selected Industrial Source Categories, 1970-1975: Volume I.
      Center for Technology Applications, Research Triangle
      Institute. Prepared for Environmental Protection Agency.

Motor Vehicle Manufacturers Association of the United States, Inc.
      1975a. 1975 Automobile Facts and Figures. Statistics
      Department, Detroit, Michigan.

Motor Vehicle Manufacturers Association of the United States, Inc.
      1976. Motor Vehicle Facts and Figures 1976. Statistics
      Department, Detroit, Michigan.

Murrell, J.D., R.G. Pace, G.R. Service, and D.M. Yaeger. October
      18-22, 1976. "Light Duty Automotive Fuel Economy Trends
      Through 1977," Paper No. 760795 presented at the Automotive
      Engineering Meeting. Society of Automotive Engineers,
      Dearborn, Michigan.

REFERENCES (Continued)

AIRBORNE LEAD IN THE ENVIRONMENT: SOURCES AND AMBIENT LEVELS

National Petroleum News. Mid-May 1976. Factbook Issue, National
     Petroleum News.

Natusch, D.F.S., J.R. Wallace, and C.A. Evans. January 18, 1974.
     "Toxic Trace Elements: Preferential Concentrations in
     Respirable Particles," Science, Vol. 183.

PEDCo-Environmental Specialists, Inc. June 1976. Interim
     Report on Control Techniques for Lead Emission Factors and
     1975 National Lead Emission Inventory. Cincinnati, Ohio.
     Prepared for U.S. Environmental Protection Agency.

Roberts, T.M., T.C. Hutchinson, J. Paciga, A. Chattopadhyay, R.E.
     Jervis, and J. VanLoon. December 20, 1974. "Lead Contamination
     around Secondary Smelters: Estimation of Dispersal and Accu-
     mulation by Humans," Science, Vol. 186 (4169), pp. 1120-1123.

Sessa, Bill. September 1, 1977. Public Information Officer,
     California Air Resources Board. Telephone conversation.

Shelton, Ella Mae. January 1972a. Motor Gasolines, Summer 1971.
     Bartlesville Energy Research Center, Bureau of Mines, U.S.
     Department of the Interior, Bartlesville, Oklahoma.

Shelton, Ella Mae. June 1972b. Motor Gasolines, Winter 1971-1972.
     Bartlesville Energy Research Center. Bureau of Mines, U.S.
     Department of the Interior, Bartlesville, Oklahoma.

Shelton, Ella Mae. January 1973a. Motor Gasolines, Summer 1972.
     Bartlesville Energy Research Center, Bureau of Mines, U.S.
     Department of the Interior, Bartlesville, Oklahoma.

Shelton, Ella Mae. June 1973b. Motor Gasolines, Winter 1972-1973.
     Bartlesville Energy Research Center, Bureau of Mines, U.S.
     Department of the Interior, Bartlesville, Oklahoma.

Shelton, Ella Mae. January 1974a. Motor Gasolines, Summer 1973.
     Bartlesville Energy Research Center, Bureau of Mines, U.S.
     Department of the Interior, Bartlesville, Oklahoma.

REFERENCES (Continued)

AIRBORNE LEAD IN THE ENVIRONMENT: SOURCES AND AMBIENT LEVELS

Shelton, Ella Mae. June 1974b. Motor Gasolines, Winter 1973-1974.
    Bartlesville Energy Research Center, Bureau of Mines, U.S.
    Department of the Interior, Bartlesville, Oklahoma.

Shelton, Ella Mae. January 1975a. Motor Gasolines, Summer 1974.
    Bartlesville Energy Research Center, Bureau of Mines, U.S.
    Department of the Interior, Bartlesville, Oklahoma.

Shelton, Ella Mae. June 1975b. Motor Gasolines, Winter 1974-75.
    Bartlesville Energy Research Center, Energy Research and
    Development Administration, Bartlesville, Oklahoma.

Shelton, Ella Mae. January 1976a. Motor Gasolines, Summer 1975.
    Bartlesville Energy Research Center, Energy Research and
    Development Administration, Bartlesville, Oklahoma.

Shelton, Ella Mae. June 1976b. Motor Gasolines, Winter 1975-76.
    Bartlesville Energy Research Center, Energy Research and
    Development Administration, Bartlesville, Oklahoma.

Shelton, Ella Mae. January 1977. Motor Gasolines, Summer 1976.
    Bartlesville Energy Research Center, Energy Research and
    Development Administration, Bartlesville, Oklahoma.

State Department of Health and Environmental Sciences, Montana.
    1972. Lead Concentration from High Volume Filters, Jan. 1972-
    Dec. 1972.

Svercl, Paul. March 8, 1977. Highway Engineer, Federal Highway
    Administration. Telephone conversation.

Ter Haar, G.L., M.E. Griffing, M. Brandt, D.G. Oberding, and
    M. Kapron. August 1975. "Methylcyclopentadienyl Manganese
    Tricarbonyl as an Antiknock: Composition and Fate of
    Manganese Exhaust Products," Journal of the Air Pollution
    Control Association, Vol. 25(8):858-860.

Texas Air Control Board. April 1974a. A Report of Typical Element
    Emissions from Texas Smelters. Austin, Texas.

Texas Air Control Board. April 1974b. A Report of Typical Element
    Emissions from Texas Foundries. Austin, Texas.

REFERENCES (Concluded)

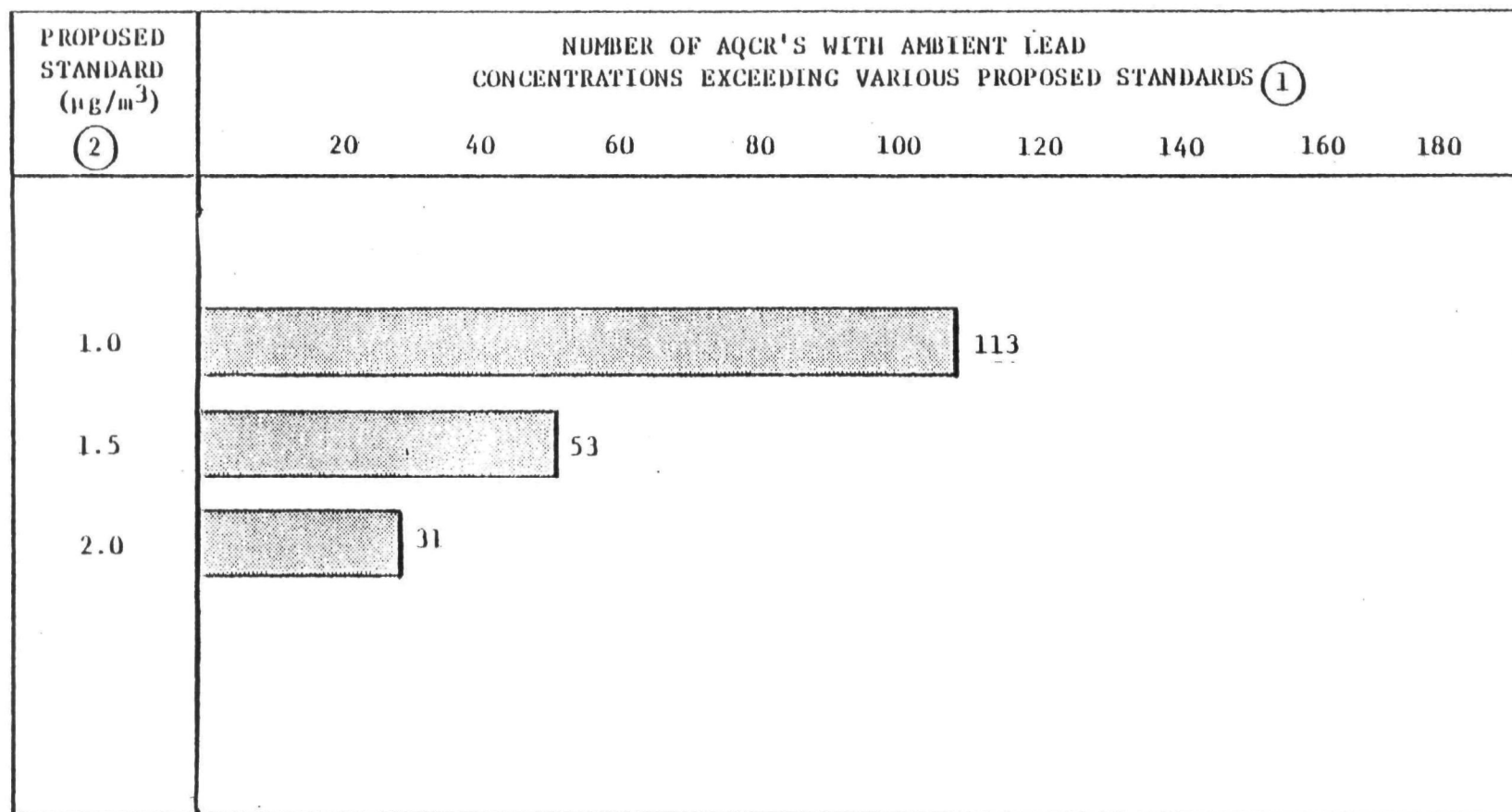AIRBORNE LEAD IN THE ENVIRONMENT: SOURCES AND AMBIENT LEVELS

U.S. Environmental Protection Agency. April 1974b. Report to
Congress, Waste Oil Study. Washington, D.C.

U.S. Environmental Protection Agency. October 1974f. Background
Information for New Source Performance Standards: Primary
Copper, Zinc, and Lead Smelters; Volume 1: Proposed Standards.
Office of Air Quality Planning and Standards, Research Triangle
Park, North Carolina. NTIS No. PB-237 832.

U.S. Environmental Protection Agency. 1974g. Smelter Study, 1973-
1974.

U.S. Environmental Protection Agency. 1974h. National Air Surveil-
lance Network--Ambient Air Quality Data, 1974. Computer
Printouts.

U.S. Environmental Protection Agency, 1974i. National Aerometric
Data Bank--Quarterly Frequency Distributions, 1974. Computer
Printouts.

U.S. Environmental Protection Agency, 1975g. Scientific and Technical
Assessment Report on Lead from Stationary Sources. EPA-60016-
75-00X. August 1975.

U.S. Environmental Protection Agency. 1975h. National Aerometic
Data Bank--Quarterly Frequency Distributions, 1975. Computer
Printouts.

U.S. Environmental Protection Agency. 1975i. National Air Surveil-
lance Network--Ambient Air Quality Data, 1975. Computer
Printouts.

U.S. Environmental Protection Agency. January 1977a. Draft Document:
Control Techniques for Lead Air Emissions. Office of Air Quality
Planning and Standards, North Carolina.

Weinstein, J. August 1974a. Waste Oil Recycling and Disposal.
Recon Systems. Inc., Princeton, New Jersey. Prepared for
Environmental Protection Agency. NTIS No. PB-236 148.

Wilson, James. July 14, 1976a. U.S. Environmental Protection Agency.
Personal communication.

3. ENVIRONMENTAL IMPACTS OF THE PROPOSED STANDARDS

3.1 DEVELOPMENT OF CONTROL STRATEGIES

The environmental impacts of a lead NAAQS are contingent upon the emission control philosophy and specific control strategies adopted by the states with the ultimate authority over those AQCR's whose ambient quality is projected to exceed the standard by the attainment date. In this section, sample control strategies are developed for the purpose of assessing the national impacts of the three possible standards (1.0, 1.5 and 2.0 $\mu g/m^3$, with attainment required by 1982. The probability of these sample control strategies being sufficient to bring the nation into compliance with the proposed standards is closely correlated with the accuracy of the ambient concentrations (both measured and predicted) on which the impact analysis is based. It is not to be inferred, however, that the control strategies developed are those which would necessarily be used by any given state.

Figure 3-1 shows the number of AQCR's with ambient air lead concentrations in the baseline year, 1975, in excess of alternative levels of the proposed standard. A large number of AQCR's (113 out of 243) would require additional control of lead emissions to meet an ambient lead standard of 1.0 $\mu g/m^3$ (quarterly average). To meet the less stringent candidate standards (1.5 $\mu g/m^3$ and 2.0 $\mu g/m^3$), 53 and 31 AQCR's respectively would require control. However, by 1982, the year in which the AQCR's must be in compliance with the lead NAAQS,

PROPOSED STANDARD ($\mu g/m^3$) (2)	NUMBER OF AQCR'S WITH AMBIENT LEAD CONCENTRATIONS EXCEEDING VARIOUS PROPOSED STANDARDS (1)								
	20	40	60	80	100	120	140	160	180
1.0						113			
1.5		53							
2.0	31								

1. Based on 243 AQCR's for which 1975 ambient conditions were estimated or reported (plus eight AQCR's for which 1974, or earlier, ambient data were reported).

2. Quarterly averaging time.

FIGURE 3-1
NUMBER OF AQCR'S WITH MAXIMUM QUARTERLY CONCENTRATIONS
ABOVE INDICATED VALUES

the number of AQCR's requiring control should be substantially reduced
due to existing EPA regulations which affect lead emissions to the
atmosphere (SIP and NSPS control for particulates and no-lead/phase-
down of lead in gasoline--see Sections 2.1.1.3 and 2.1.2.3).

To determine the amount of control which would be required in
1982. the rollback technique was used. When the 1975 ambient concen-
tration was greater than the proposed level of the standard, the per-
centage reduction of lead concentration in ambient air (rollback)
required to attain the standard was computed.* The rollback tech-
nique is based on the assumption that the percentage reduction in
the emissions of a pollutant is equal to the percentage reduction in
the ambient concentration of that pollutant. Thus, a 1975 emissions
inventory is necessary to determine the initial emissions rollback
required and a 1982 emissions inventory is needed for comparison to
determine how much additional control may be necessary relative to
the 1975 requirements.

Using the latest available data, a 1975 lead emissions inventory
was prepared which includes lead emissions from mobile sources and
from the 11 types of major point sources identified in Section 2.1,

---

*Percentage rollback =

$$\frac{\text{maximum lead concentration - proposed level of NAAQS}}{\text{maximum lead concentration - background lead concentration}} \times 100,$$

where natural background lead concentration is estimated at 0.005
$\mu g/m^3$ (National Academy of Sciences, 1972).

namely: ferroalloy production, lead acid battery production, primary lead smelting, secondary lead smelting, primary copper smelting, lead alkyl production, gray iron production, coal-fired power generation, oil-fired power generation, solid waste incineration, and iron and steel production. The resulting 1975 emission inventory and projected mobile and stationary source growth rates (see Sections 2.1.1.3 and 2.1.2.3) were the bases for estimating 1982 and later lead emissions inventories for each AQCR.

The percentage rollback of 1975 ambient lead concentrations required to meet the proposed standard was applied to the estimated tons of lead emitted in 1975. The resulting number of tons was compared to the estimated 1982 lead emissions to determine whether additional control of lead emissions would be required to meet the proposed level of the standard by 1982. The same technique was used to determine whether the standard would be maintained in 1982 and 1995, and was performed for the three different standards and 243 AQCR's involving approximately 2,900 plants in 11 industrial categories as well as mobile emissions for each AQCR (based on gasoline sales and lead content).

3.1.1 <u>Control Philosophy</u>

There are three basic schemes for the control of lead emissions--stationary source control, mobile source control, and combinations of stationary and mobile source control. Several alternatives are available for achieving each control scheme. The way in which these schemes

and options are applied depends on the prevailing levels of airborne

lead, the control philosophy followed, and the control strategy devised.

One possible philosophy is to require uniform control, i.e.,

that all sources of lead emissions in an AQCR apply the same degree

of control. By following such a philosophy, all sources would share

the burden of meeting the proposed standard. However, if an AQCR

had one or two emitters of large quantities of lead to the atmosphere,

the reduction in lead emissions which small sources could achieve

(even if they ceased operating) would be insignificant in terms of

bringing the AQCR into compliance and in relation to the reductions

achievable by larger emitters. The lead emissions inventory (pre-

sented in Chapter 2) shows that there is, in fact, a wide range in

the quantities of lead emitted by various sources. This large vari-

ation may, therefore, render such a philosophy impractical.

Another alternative is to apply selective control, i.e., to

require only the larger emitters to control their operations, since

their emissions are more likely to be the cause of the maximum lead

concentrations. Under this philosophy, the source of the largest

proportion of the total quantity would be controlled first, followed

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*For purposes of analysis, control options refer to the many indivi-
dual measures available (e.g., baghouses, scrubbers, and electro-
static precipitators for point sources; car pools, mass transit,
bicycles, alternative engine designs, alcohol blends, alternative
octane boosters, and particulate traps for mobile sources). Con-
trol philosophy implies a broader outlook--whether to apply controls
uniformly on all emitters, large and small, or to select certain
emitters preferentially. If the latter course is followed, one
develops control strategies consisting of selected options.

by the next largest source and so on until the standard is achievable. This latter philosophy has, generally, been followed in the development of the control strategies presented in this section.

3.1.2 Overall Control Strategies

A sample control strategy has been developed for each AQCR expected to be out of compliance under each of the three standards under consideration. Each strategy was developed by applying the best available control technology (BACT) to the type of source from which the largest proportion of the total quantity of lead is emitted. If the resulting rollback was not sufficient, then BACT was applied to the next higher class of emitters, with one exception.* In this instance, a smaller source of emissions was selected, as the residual rollback required was relatively small.

As a result of applying the selective control philosophy, two candidates for additional control are primary lead and primary copper smelters and automotive vehicles. The specific control strategies developed are summarized in Table 3-1. It should be noted that stack and fugitive emissions from the smelters were treated as separate items for control strategy development. It should also be noted that, in one instance, pre-1975 automobiles and other automotive vehicles (i.e., medium-size trucks) were treated as separate source types.

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*For one AQCR, the strategy included control of mobile sources rather than the second highest class of emitters as residual reduction in emissions required (after requiring control of the highest class of emitters) was of a small magnitude.

TABLE 3-1

NUMBER OF AQCR'S PROJECTED TO REQUIRE CONTROL
OF LEAD EMISSIONS TO COMPLY WITH PROPOSED LEAD NAAQS

SUGGESTED AMBIENT AIR QUALITY STANDARD AND CONTROL STRATEGY	YEAR			
	1982	1983	1985	1995
1.0 ug/m³				
Number of AQCR's Requiring Additional Control for				
● Pre-1975 automobiles only	1	-	-	-
● Primary copper smelters - fugitive emissions only	1	1	1	1
● Primary lead smelters - fugitive emissions only	1	1	1	1
● Primary lead smelters - fugitive and stack emissions plus mobile sources	2	2	2	2
Total AQCR's Requiring Control Measures	5	4	4	4
.5 µg/m³				
Number of AQCR's Requiring Additional Control for				
● Primary copper smelters - fugitive emissions only	1	1	1	1
● Primary lead smelters - fugitive emissions only	1	2	2	1
● Primary lead smelters - fugitive emissions plus mobile sources	2	1	-	-
● Primary lead smelters - fugitive and stack emissions plus mobile sources	-	-	1	2
Total AQCR's Requiring Control Measures	4	4	4	4
2.0 µg/m³				
Number of AQCR's Requiring Additional Control for				
● Primary copper smelters - fugitive emissions only	1	1	1	1
● Primary lead smelters - fugitive emissions only	1	1	1	1
● Primary lead smelters - fugitive emissions only plus mobile sources	1	1	1	-
● Primary lead smelters - fugitive and stack emissions plus mobile sources	-	-	-	1
Total AQCR's Requiring Control Measures	3	3	3	3

Control of combinations of sources other than those shown would not, generally, result in the AQCR's achieving compliance. This is not the case in one AQCR; however, the application of the selective control philosophy led to the control strategy developed.

The control strategies indicated in Table 3-1 for 1982 are those which are suggested for attaining the standards. The strategies specified for 1983, 1985 and 1995 are those which may serve to maintain the proposed levels of the standard. For each AQCR requiring control of lead emitters in 1982, the control strategy in subsequent years is the same or pertains to a subset of the controlled sources.* This implies that after the standards are attained in these AQCR's, the maintenance of ambient standards would not require control of additional source types or the introduction of new control strategies, although a higher degree of control may be required within particular source categories.

As noted in Table 3-1, five AQCR's would require additional control in 1982 for the most stringent standard proposed, 1.0 $\mu g/m^3$. Four AQCR's would require additional control in 1983. For a standard of 1.5 $\mu g/m^3$, the number of AQCR's expected to be out of compliance would be four by the years 1982 and 1983. For a standard of 2.0 $\mu g/m^3$, AQCR's out of compliance would be three for the years 1982 and 1983. It should also be noted that mobile-only controls would be needed in one AQCR in 1982 only if the 1.5 $\mu g/m^3$ standard were imposed; for

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*With the exception of a primary copper smelter in one AQCR which may present a small problem in 1995, but not earlier.

any less stringent standard, mobile-only controls would be unneces-
sary. In subsequent years, for a given standard, there is a shift
from more complex strategies to simpler ones (e.g., fugitive-plus
stack-plus-mobile to fugitive-plus-stack to fugitive emissions alone).

3.1.3 Stationary Source Control Strategies

Some AQCR's are expected to require control strategies only for
stationary sources. The types of stationary sources requiring control
are projected to be primary lead and primary copper smelters. These
smelters have already adopted measures or are in the process of adopt-
ing measures to control their stack emissions in order to comply with
total-particulate regulations. These control measures have resulted
in some control of lead. In most cases, further control of lead emis-
sions only from stacks could not provide the additional reduction in
lead emissions, according to the rollback technique, necessary to
bring the AQCR's into compliance with the proposed NAAQS for lead.
It should be noted that the analysis is sensitive to the amount of
total-particulate stack control in existence in 1975 (i.e., the com-
pliance control factor). Since this value is not known for many
individual smelters, a nationwide average was employed and the amount
of further stack control is not precisely tailored to site-specific
conditions.

The lead emissions inventory indicates that by 1982 an important
source of lead emissions is fugitive emissions from primary lead and

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primary copper smelters. In at least one case, the reduction of these emissions would be sufficient to bring the AQCR into compliance.

To control fugitive emissions at primary smelters, it is necessary to provide a building evacuation system to a fabric filter (BEFF). Such a system consists of hoods, ducts, fans, and fabric filters and is believed to be capable of achieving up to a 99 percent collection efficiency. It is projected that 10 to 22 such systems, depending on the standard adopted, will be required. For the purpose of making this projection, it was assumed that each building requiring control within the smelter would be provided with a separate control system. However, this assumption does not significantly affect the projected environmental impacts.

For some AQCR's it would also be necessary to apply mobile source controls, which are discussed later, or even stack emissions controls. Typically, fabric filters and scrubbers are applied for control of primary lead smelter stack emissions, while electrostatic precipitators are employed for the control of primary copper smelter stack emissions.

Further stack control implies techniques above and beyond the best available control technology already (by 1982) on the stacks in response to requirements for the total-particulate NAAQS. Such additional control would require the development of new technology (beyond present BACT) and could prove to be highly unattractive economically with the result that the smelter operators so affected may decide to

terminate operations. Before such a drastic measure is taken, how-
ever, careful monitoring analyses near these smelters should be per-
formed. Although the present study was based on the best available
monitoring data, the information was limited in many cases. Further-
more, it is not the intent of this report to present detailed site-
specific information, rather a generalized nationwide overview.

Thus, for purposes of developing strategies and their environ-
mental consequences, it is assumed that BEFF control of fugitive
emissions from primary lead and/or primary copper smelters would
clean up sufficient amounts of the anticipated point source emis-
sions.

3.1.4 Combined Stationary and Mobile Source Control Strategies

In some instances, the rollback analysis showed that control of
both stationary and mobile sources may be necessary to meet the pro-
posed levels of the lead NAAQS. Review of the emission inventories
for these areas reveals that elimination of lead emissions from either
source category would not be sufficient to bring the AQCR into com-
liance. Primary lead and/or primary copper semlters are operated
in all of the AQCR's requiring a combined point and mobile source
control strategy. Quantities of lead emitted by other point sources
in these regions are estimated to be less than one ton per year or
three orders of magnitude less than the quantities of lead emitted
by the primary smelters. The control strategy suggested for these
cases is to apply the maximum amount of reasonably available control

to the fugitive emissions at primary smelters, and to apply mobile source controls (particulate traps) to achieve the remainder of the reduction required. Thus, some AQCR's would require installation of particulate traps as part of their control strategies. The total numbers of vehicles requiring particulate traps in order for alternative levels of the standard to be met are shown in Table 3-2. Traps on medium-size trucks and replacement traps have been accounted for in these totals. It should be noted that the installation of particulate traps in model-year medium-size trucks would be required in years between those shown in the table to maintain compliance with the NAAQS proposed.

3.1.5 Mobile Source Control Strategies

In addition to the control of primary copper and lead smelters alone or in combination with mobile source control, it is expected that one AQCR would require some control of mobile sources in 1982 to achieve compliance with a standard of 1.0 $\mu g/m^3$. It should be noted, though, that these controls would not be needed by 1985 due to the no-lead/phasedown of lead in gasoline already required under current EPA regulations. Nevertheless, the AQCR would be required to undertake some form of action to reduce mobile emissions, and, since the elimination of the small quantities of lead emitted by point sources would not bring the region into compliance with the standard, a strategy of controlling only mobile sources is proposed for this AQCR. Naturally, states may elect to propose a combination point

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TABLE 3-2

NUMBER OF VEHICLES WHICH MAY REQUIRE LEAD PARTICULATE TRAPS
AS A FUNCTION OF ALTERNATIVE STANDARD AND TIME

PROPOSED STANDARD (quarterly average, $\mu g/m^3$)	YEAR		
	1982	1985 ①	1995 ②
1.0	1,265,300	49,100	8,800
1.5	106,500	26,900	4,900
2.0	58,000	26,900	0

1. Pre-1975 autos and medium-size trucks obtaining their second particulate trap plus model-year medium-size trucks.

2. Medium-size trucks of various ages obtaining another particulate trap plus model-year medium-size trucks.

and mobile source strategy as they are in no way bound to apply the mobile-only strategy used here.

Only one option, the use of particulate lead traps on pre-1975 automobiles, appears capable of providing the necessary 25 to 30 percent reduction in emissions. Although these traps are not expected to be generally available until 1982, the inclusion of this option in State Implementation Plans may provide an incentive to hasten the development and marketing of traps, at least on a limited geographical basis. For this reason, the installation of particulate lead traps is considered a feasible control strategy, and is used in the impact analysis for the AQCR discussed here.

3.2 PRIMARY IMPACTS

3.2.1 Air Quality

Primary impacts are those which can be attributed directly to the action being assessed--setting and enforcing the NAAQS for lead. The two primary impacts which are expected to result from this action are: (a) a decrease in the quantity of lead emitted to the atmosphere, and (b) a decrease in ambient air lead concentrations. Of the three levels of the standard considered (1.0, 1.5, and 2.0 $\mu g/m^3$, monthly average), the most stringent level (1.0 $\mu g/m^3$) applied in 1982 would result in these two primary impacts occurring most often-- in 5 out of 243* AQCR's. Thus, the primary impacts (i.e., changes

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*Four AQCR's (Guam, American Samoa, and two in Alaska) have been excluded from the analysis.

in lead emissions and air concentrations) resulting from the setting
of the NAAQS for lead are seen to be limited to a few locations and
are discussed in the following sections.

3.2.1.1 Lead Emissions

A direct impact of setting and enforcing the NAAQS for lead is
a reduction in the number of tons of lead emitted annually to the
atmosphere. Calculation of the reduction was based on the measured
and estimated ambient air quality concentrations presented in Section
2.2 and the rollback philosophy used in developing control strategies
in Section 3.1. The reductions required in individual AQCR's were
summed to determine the total national reduction which would be re-
quired to attain and maintain the proposed lead NAAQS in future years.

Table 3-3 summarizes the nationwide reductions of lead emissions
which may result from the various proposed levels of the standard.
For the most stringent standard analyzed, 1.0 μg/m^3 quarterly average,
a 30 percent rollback of nationwide tonnage, relative to 1975 condi-
tions would be implied. As the level of the standard becomes less
stringent, the percentage rollback required decreases. For a stan-
dard of 1.5 μg/m^3, a 15 percent reduction would be implied, and for
a standard of 2.0 μg/m^3, a 10 percent reduction is indicated. The
reduction required changes from year to year since the total number
of tons emitted varies due to (1) industry growth (or decline), (2)
elimination of lead in gasoline, and (3) additional compliance with
total particulate regulations.

TABLE 3-3

NATIONWIDE ESTIMATE OF REDUCTION IN TONS OF LEAD
EMITTED TO THE ATMOSPHERE TO MEET PROPOSED STANDARDS

STANDARD ($\mu g/m^3$)	PERCENTAGE ROLLBACK, RELATIVE TO 1975	ADDITIONAL REDUCTIONS BY YEAR, STATIONARY AND MOBILE SOURCES (tons of lead)			
		1982	1983	1985	1995
1.0	30	2,562	2,274	2,275	2,901
1.5	15	1,736	1,658	1,659	2,286
2.0	10	1,233	1,170	1,174	1,710

Standards based on quarterly averaging time.

The trend in the reduction for any standard between 1982 and 1995 is a function of these factors and is independent of the level of the standard. In 1985, the rollback required is less than in 1982, primarily because the reduction in mobile emissions (due to gasoline additive and fuel economy regulations) is greater than any increases resulting from more vehicle miles traveled and/or growth in the industrial point source category. But by 1995, the diminishing effect of gasoline additive and fuel economy regulations is not great enough to offset the increases in point source emissions. More specifically, anticipated increases in primary lead production would yield increased lead emissions to the atmosphere, thereby resulting in the need for additional reduction in lead emissions in 1995 relative to 1985.

The reductions in Table 3-3 represent nationwide values for both mobile and stationary sources. The control of fugitive lead emissions from primary lead and copper smelters as well as the control of mobile sources is estimated to account for most of the required reductions. For example, for the most stringent standard, 1.0 $\mu g/m^3$ in 1982, the fugitive and mobile control strategies are designed to effect approximately 98 percent of the total emissions reduction required.* The remainder is attributable to the stack emissions from

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*In this case, fugitive control should eliminate 2,349 tons of lead emissions while mobile control measures should reduce 387 tons compared to a required reduction of 2,754 tons (see Table 3-3).

primary lead or primary copper smelters. It should be noted, however, that these stacks already have (by 1982) BACT* systems. Thus, for purposes of a nationwide assessment, it appears that the indicated strategies--fugitive dust and mobile emissions control--represent a reasonable and comprehensive approach. Of course, the states have the option and the responsibility to develop strategies to suit their individual needs.

3.2.1.2 Ambient Concentrations

As presented earlier, Figure 3-1 shows how many AQCR's had either reported or estimated 1975 ambient air lead concentrations that would exceed the proposed levels of the standard. The cumulative influence of regulations (other than the lead NAAQS) which directly control lead emissions to the atmosphere (SIP and NSPS control of particulates as well as no-lead in gasoline--see Sections 2.1.1.3 and 2.1.2.3) are themselves expected to reduce (1) lead emissions by 1982, (2) ambient air lead concentrations, and (3) the numbers of AQCR's (relative to 1975) expected to exceed the proposed levels of the standards. For a standard of 1.0 ug/m^3, quarterly averrage, 113 AQCR's would have exceeded the standard in 1975, while in 1982 only five AQCR's are expected to exceed the same level. It is these five AQCR's whose ambient air lead concentrations would have to be reduced further and thereby be affected by a lead NAAQS of 1.0

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*Best available control technology.

$\mu g/m^3$. Other AQCR's may also experience reduced lead concentrations because of other regulatory actions, but not as a direct result of the lead NAAQS. Any new facilities, constructed in areas where the lead NAAOS is not exceeded, would have to be designed so their lead emissions during operation would not result in ambient lead levels exceeding the standard.

For a standard of 1.5 $\mu g/m^3$, quarterly average, ambient lead concentrations would need to be reduced in four AQCR's in 1982, while three AQCR's would require reductions in the same year if the 2.0 $\mu g/m^3$ standard were adopted. It should also be noted, though, that four AQCR's would need lead controls in 1995 using the 2.0 $\mu g/m^3$ standard, because of growth in the primary lead smelting industry.

3.2.2 Human Health and Welfare

The protection of human health and welfare is the purpose of a national ambient air quality standard for lead. The effects of lead on human health and welfare are addressed in the Air Quality Criteria for Lead issued by EPA at proposal. The level of the standard is based solely on health and welfare considerations. The proposed rulemaking preamble contains a statement of basis and purpose which explains the Agency's standard rationale.

3.3 OTHER ENVIRONMENTAL IMPACTS

Using the control strategies specified in the previous section, the cumulative, nationwide secondary impacts likely to result from promulgating a lead NAAQS can be determined. The major secondary impacts which may occur include changes in energy consumption, noise levels, land acreage, other pollutant emissions, ecological implications and costs to industries and state governments.

Assessment of these impacts with respect to stationary sources has been based on the following assumptions:

(a) Control of fugitive emissions from primary lead and primary copper smelters would be achieved through the construction and operation of building evacuation system to fabric filter (BEFF) facilities;*

(b) Such facilities would be located adjacent to the smelting facilities on property already owned and developed by the smelting companies;

(c) Lead emitted from fugitive sources and captured by the BEFF facilities would not be recovered, i.e., the worst case, and therefore landfill operations would be needed to dispose of the material collected; and

(d) Landfills would be located a few miles from the smelters in areas which are presently undeveloped.

When the exact locations of all facilities being constructed as a result of the lead NAAQS can be positively identified, site specific impacts can be evaluated.

The secondary impacts related to the mobile source strategy (the application of lead particulate traps) are based on the assumption that the particulate traps can be manufactured in existing muffler-producing facilities.

It is assumed that the operation of BEFF facilities at stationary sources would be ongoing actions for many years. On the other hand, with regard to the particulate traps, there would be a large initial demand under conditions of the 1.0 $\mu g/m^3$ standard--approximately 1.3 million units, by 1982--with a sharp falloff in production

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*Includes hoods, ducts, fans, and baghouses.

in subsequent years (see Table 3-2). For years later than 1982 and/ or for standards greater than 1.0 ug/m^3, the demand for particulate traps would be relatively small.

3.3.1 Energy Consumption

Considerations of energy consumption involve the construction and operation of the BEFF's at each of the primary lead and primary copper smelters required to control fugitive emissions as well as the fabrication and operation of particulate traps for reducing automotive emissions. Energy consumption is typically characterized by capital and operating energy demands. Capital energy is defined as the energy required to produce various materials (e.g., structural steel, sheet metal, raw chemicals) and assemble the materials into finished products. Operating energy consists of the energy to run the BEFF fans, to dispose of the collected particulate matter, and to operate automobiles with particulate traps.

3.3.1.1 Capital Energy

Based on (1) the amount of structural steel and other materials used at the ASARCO smelter in El Paso, (2) the ratio of total particulate to lead particulate, (3) the capacity of the BEFF at El Paso, and (4) the tons of lead to be collected at the affected primary copper and lead smelters, the nationwide capital energy costs in 1982 for a standard of 1.5 µg/m^3 are expected to be 3.12 x 10^{12} and 1.74

$x\ 10^{12}$ BTU(th)* for primary copper and primary lead smelters, respectively. The capital energy costs in 1982 associated with the alternative standards are shown in Table 3-4. The table also lists equivalent barrels of oil. A comparison with either the nationwide domestic demand of oil at 17.7×10^6 barrels per day in 1976 (Federal Energy Administration, 1977) or the 1975 operating energy for the primary lead and copper industries of 30×10^6 barrels of oil (based on 1975 production rates and energy factors derived from Bureau of the Census, 1967) indicates that the capital energy costs for retrofitting all the primary copper and lead smelters are relatively small.

The capital energy for the automotive control strategy is considered to be the energy to manufacture the particulate traps. Since the particulate traps would likely be manufactured by muffler manufacturers at existing plants, no new major facilities would have to be constructed and the capital energy is considered to be that which would be expended to provide and fabricate the necessary sheet metal. Under the most widespread application of the most stringent standard, 1.3 million particulate traps** would be required. The capital energy required to produce this number of mufflers is estimated to be the equivalent of 477,000 barrels of oil. The corresponding energy to produce the same number of particulate traps, containing slightly

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*BTU(th) = British thermal unit (thermal)

**Required for the mobile source strategy relating to a standard of 1.0 $\mu g/m^3$ in 1982.

TABLE 3-4

NATIONWIDE ENERGY COSTS ASSOCIATED WITH FUGITIVE LEAD EMISSIONS CONTROL
AT PRIMARY COPPER AND LEAD SMELTERS, 1982

LEVEL OF STANDARD ($\mu g/m^3$)	CAPITAL ENERGY		OPERATING ENERGY	
	10^{12} BTU	EQUIVALENT BARRELS OF OIL ($x\ 10^6$)	10^{12} BTU/yr	EQUIVALENT BARRELS OF OIL PER YEAR ($x\ 10^6$)
1.0	6.7	1.15	1.44	0.25
1.5	4.9	0.84	1.06	0.18
2.0	3.0	0.51	0.67	0.12

more steel and/or aluminum, would be 542,000 barrels of oil. In some cases the particulate traps would be installed on vehicles requiring new mufflers, so the capital energy would be expected to lie somewhere between the two energy values mentioned above. It is important to note that these capital energy requirements for the two devices, mufflers and particulate traps, are fairly similar with the exception of possible retooling, required for particulate trap production, which is unknown but considered to be of a low order of magnitude.

The need for particulate traps for less stringent alternative standards or for later years is generally two orders of magnitude less than for the 1982 case involving the 1.0 $\mu g/m^3$ standard presented above.

3.3.1.2 Operating Energy

The operating energy for point source control is associated with the power to drive the fans in the BEFF and with the fuel to transport and bury the collected particulate matter. Based on a study of the BEFF facility for the ASARCO smelter at El Paso, Texas (Nelson, 1977), it is estimated that the nationwide energy consumption rates for 1982 at a standard of 1.5 $\mu g/m^3$ are 0.63 x 10^{12} and 0.43 x 10^{12} BTU(th) for the primary copper and lead smelter BEFF's, respectively.

If it is assumed that the collected material is transported to landfills several miles away, the fuel energy requirements for 1982 at a standard of 1.5 $\mu g/m^3$ are computed to be less than 1 x 10^9

BTU(th). Even if the energy to operate the bulldozers at the land-
fill sites were of the same magnitude, the energy for hauling and
burial is negligible compared to that for the BEFF fans and is not
considered further in the analysis. Thus, the operating energies
reported in Table 3-4 represent, for the different standards, the
energy to power the BEFF fans. The energy values (for fans at the
required BEFF's) are small (less than one percent) in comparison to
the annual energy input to the primary copper and primary lead smelt-
ing industries. Based on 1975 production values (see Appendices C
and E) and energy-per-ton factors for both industries (Bureau of the
Census, 1967), the total energy input to both industries is estimated
to be 172×10^{12} BTU(th) for 1975.

The operating energy associated with the use of particulate
traps refers to the power which is needed to force the spent gases
through the exhaust system. With the present design of particulate
traps there is no appreciable difference in the pressure drop across
a standard acoustical muffler and a particulate trap and, therefore,
in operating energy required.

3.3.2 Noise Levels

Most of the noise generated by the operation of BEFF's occurs
within the structure housing the system where Occupational Safety
and Health Administration (OSHA) standards specify that noise expo-
sure levels are not to exceed 90 dBA for an eight-hour workday.
Individual pieces of equipment, such as fans which typically generate

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noise levels ranging from 76 to 102 dBA at five feet (Goodfriend and Kessler, 1973), may not meet these specifications. Therefore, the entire control system including fans, ductwork, and piping should be designed using those acoustical measures necessary to insure that the OSHA noise standards are met. It should be noted that the exposure levels can be increased by 5 dBA for each halving of the exposure time. The U.S. Environmental Protection Agency (EPA) has proposed to OSHA that a maximum eight-hour occupational exposure level of 85 dBA be established within three years of the OSHA regulation and ultimately an eight-hour exposure level of 80 dBA (U.S. Environmental Protection Agency, 1974). Furthermore, EPA proposed that the exposure level can be increased by only 3 dBA for each halving of the exposure time.

Assuming that the OSHA permissible noise exposure levels are met, the exterior sound pressure levels would be less than 90 dBA due to noise attenuation caused by the building walls, ambient air, and nearby structures. Maximum noise levels computed based only on attenuation related to distance, are 70 dBA at 50 feet and 58 dBA at 200 feet. Assuming that the BEFF's are to be at least 200 feet from the property line, noise levels are not expected to exceed typical local noise ordinances (e.g., New Jersey, 1974).

The particulate traps are expected to have acoustical properties similar to those of a standard muffler and any changes in noise levels in the vicinity of roads and highways are not anticipated to be perceivable.

3.3.3 Land Use Parameters

The use of a BEFF system to control fugitive emissions requires space not only to house the system but for the disposal of the particulate matter collected in a landfill area. It should be noted that the space requirements for the BEFF housing represent a one-time allocation, while the requirements for landfill are on an annual basis. The manufacture of particulate traps is expected to occur at existing facilities.

3.3.3.1 Space Requirements for BEFF Facilities

The area* occupied by the baghouse facility consists of the baghouse proper, a transformer substation, ducting, a loading area, and an approach road. The baghouse itself is assumed to vary in size according to the amount of lead particulate to be collected, but the area for the other items is assumed to remain constant regardless of output. Based on the BEFF at the ASARCO smelter in El Paso, Texas (Nelson, 1977), the BEFF area (for additional structures) for the affected smelters (primary copper and primary lead) is estimated to be 4.2 acres for a standard of 1.5 $\mu g/m^3$. This acreage and the acreages according to the other levels of a lead standard are presented in Table 3-5. Relative to the area occupied by a single smelter (e.g., the ASARCO smelter at El Paso itself occupies over 700 acres of land), the space requirements for BEFF's are quite small.

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*External to the existing smelter.

TABLE 3-5

NATIONWIDE LAND USE PARAMETERS ASSOCIATED WITH FUGITIVE
LEAD EMISSIONS CONTROL AT PRIMARY COPPER AND LEAD SMELTERS, 1982

LEVEL OF STANDARD (μg/m^3)	AREA FOR ADDITIONAL STRUCTURES (acres)	VOLUME FOR DISPOSAL (acre-feet)
1.0	6.7	21.6
1.5	4.2	16.0
2.0	3.3	10.1

3.3.3.2 Landfill Considerations

For a standard of 1.5 $\mu g/m^3$, the nationwide amounts of total particulate fugitive dust to be disposed of would be 9.5 acre-feet and 6.5 acre-feet for primary copper and primary lead smelters, respectively in 1982. Landfill factors resulting from the promulgating of the alternative standards are presented in Table 3-5. Volumes (in acre-feet) are listed instead of acreages since the number of acres would vary from site to site according to the thickness of the land-filling operations. Even with a conservative estimate of two feet for the proposed thickness of the landfill layer of disposed dust, the nationwide annual acreage requirements under the most stringent of the standards proposed (1.0 $\mu g/m^3$) would be very small—on the order of ten acres.

3.3.3.3 Mobile Strategy Considerations

Not all of the 1.3 million particulate traps which would have to be installed by 1982 represent new production capacity. In 1972 the annual muffler production in the United States was over 54 million units of which 32.5 million units were replacement mufflers, up from 26.5 million units in 1967 (Bureau of the Census, 1977). Thus, the annual production rate by 1982 may be extrapolated to at least 40 million units. Since approximately one-third of the 1.3 million pre-1975 cars would need a replacement muffler in the 1981 to 1982 time period, by virtue of normal wear, the production of 0.4 million particulate traps would merely take the place of a similar number of

mufflers. Production of the other 0.9 million traps would be for cars not needing replacement mufflers at the time and thus represents an additional production capacity of one to two percent if all the traps were produced in one year. The percentage increase would be even smaller if the particulate traps were also manufactured in years prior to 1982 in an effort to build up a stockpile. Any plant expansion of this magnitude could occur on property already owned by muffler manufacturers.

3.3.4 Other Air Pollutants

Control devices installed to reduce fugitive lead emissions from primary lead and copper smelters are also expected to control emissions of other trace contaminants. In order to estimate the magnitude of this impact, the uncontrolled emissions were computed for several pollutants. Fugitive emission factors for trace metals from primary lead and primary copper smelters have not yet been developed. Estimates for the magnitude of trace element emissions were derived from concentrations of the elements found in stack particulates from one smelter (Statnick, 1974) and from particulate fugitive emission factors (U.S. Environmental Protection Agency, 1974a). The remaining estimates (except mercury) were derived from typical concentrations of trace elements in the ores (U.S. Environmental Protection Agency, 1974f), particulate fugitive emission factors, and the assumption that 50 percent of the concentration of the elements

in the ores is found in the fugitive particulates. Mercury emissions
were computed from a materials balance (Van Horn, 1975).

Table 3-6 represents the estimated fugitive emissions for seven
pollutants from both primary lead and primary copper smelters. While
the estimates for some pollutants in the table may appear small when
considered on a nationwide basis, it must be remembered that there
were only a few primary copper and primary lead smelters operating
in the United States in 1975. If, on the other hand, for a given
AQCR, the primary smelters constitute the major source of the trace
elements in question, particulate control at the smelters (fugitive
emissions control to provide compliance with the lead NAAQS) would
reduce the emissions of the trace elements as much as 99 percent in
the vicinity of the smelters. The predicted reduction in arsenic
would be significant when compared to the estimated nationwide arse-
nic emissions of 4,890 tons/year from all types of sources.

The use of lead particulate traps is not expected to alter the
exhaust emission characteristics except, of course, for lead (Summers,
1977).

3.3.5 Hydrology

The impact on hydrology likely to result from the lead NAAQS is
a change in the lead concentrations of both ground waters and surface
waters. The reduction of airborne lead concentrations expected from
the enforcement of the lead NAAQS would result in lower lead concen-
trations for bodies of water by limiting the amount of lead entering

TABLE 3-6

TRACE METALS--ESTIMATED FUGITIVE EMISSIONS AND THEIR REDUCTIONS

TRACE ELEMENT	1975 UNCONTROLLED NATIONWIDE EMISSIONS (TPY)			1982 EMISSIONS REDUCED AT SMELTERS (TPY)		
	PRIMARY COPPER SMELTERS	PRIMARY LEAD SMELTERS	TOTAL SMELTERS	STANDARD (μg/m^3)		
				1.0	1.5	2.0
Arsenic	2,990	70	3,060	970	590	130
Cadmium	265	520	783	310	280	260
Chromium	6	1	7	2.3	1.6	0.7
Mercury	50	5	55	18	11	4
Zinc	1,900	330	2,230	740	500	220
Beryllium	1	0.2	1.2	0.4	0.3	0.1
Antimony	23	4	27	9	6	3

Source of 1975 Arsenic Data: U.S. Environmental Protection Agency.   July 1976.   Air Pollutant Assessment Report on Arsenic.

the surface water by direct deposition and/or runoff. Lead concentrations of surface water as well as ground water may increase unless the solid waste collected at the BEFF's is disposed of at carefully sited and well designed landfills. Leachate is a highly mineralized fluid containing such constituents as chloride, iron, lead, copper, sodium, nitrate, and a variety of organic chemicals (U.S. Environmental Protection Agency, 1977c). In confined, slow moving, or relatively low-volume surface waters, leachate has killed vegetation and fish, eliminated spawning areas, and precluded the use of existing and planned recreational areas (U.S. Environmental Protection Agency, 1977c).

Solid waste land disposal sites can be sources of groundwater contamination because of the generation of leachate caused by water percolating through the bodies of refuse and waste materials. Disposal sites located in areas where the water table is close to land surface can produce leachate and subsequent groundwater contamination. In some places, such as low lying coastal areas, the water table is so high that all disposal sites constructed without sufficient natural or artificial barriers would contaminate ground water. Leachate contamination of supply wells can result in adverse health effects as a result of chronic exposure, and can cause severe economic hardships, distresses, inconveniences, and inequities to owners of damaged lands.

Because primary lead and primary copper smelters are located in western states, their disposal sites would probably not be located in areas highly susceptible to groundwater contamination (e.g., low lying coastal areas, wetlands). Under Section 1424(e) of the Safe Drinking Water Act of 1974, only one aquifer, the Edwards Underground Reservoir, San Antonio, Texas has been designated for special protection and there are no smelters in that area whose solid waste disposal would have an impact on that aquifer.

Although small quantities of water would be required for the construction (e.g., in concrete) of the new control facilities, no increase in water consumption is anticipated during the operation of the BEFF's. Moreover, there are no liquid effluents directly associated with the operation of BEFF's.

The use of particulate traps is not expected to have any adverse impact on water use or water quality. Fewer lead emissions onto and near roads imply less lead in any runoff to streams. The disposal of the traps would be either as units removed from the auto or as part of the auto when junked. Some of this metal would be recycled while the rest would be disposed of at landfill sites and junk yards. It is not possible to quantify the impacts due to potential leaching at these unspecified sites.

3.3.6 Topographic, Geologic, and Soil Characteristics

Decreased quantities of lead in the air would cause less lead to settle out onto all types of surfaces including soils. Thus, the

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lead NAAQS would result in lead accumulation in the soil at a slower rate than if the standard were not established.

Slight changes in topographic, geologic, and soil characteristics of the immediate construction areas may result from grading, trenching, filling, and compacting operations occurring while building the BEFF's. A nationwide total of less than seven acres was estimated for construction of the BEFF's needed to meet the most stringent of the proposed standards (see Section 3.3.3). Because the BEFF's would probably be located adjacent to the smelting facilities on property already developed and owned by the smelting companies and the construction would not involve major excavation for these essentially above-ground facilities, occupying relatively small acreages, no significant impacts on topographic, geologic, and soil characteristics are anticipated.

Even though the landfill operations would result in alterations of topographic and soil characteristics during the excavation and backfilling stages--some topsoil would be lost and/or replaced by subsoil and the local topography would be slightly changed--the extent is anticipated to be small. On the basis of approximately 20 acre-feet of material to be buried (see Table 3-5), and assuming a conservative layer thickness of two feet, the nationwide area involved would be no more than ten acres annually for the affected primary copper and lead smelters. The depth of the landfills is not expected to be great enough to affect geologic considerations.

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The manufacture and installation of lead particulate traps should not appreciably affect topographic, geologic, or soil characteristics since existing facilities, with possible minor expansion, would be used.

3.3.7 Historical and Archaeological Sites

Those baghouses which are bu'lt as a result of the proposed lead standard will probably be located adjacent to the smelting facilities on property already developed and owned by the companies. Therefore, it is unlikely that any historical or archaeological sites would be affected by the construction of additional baghouses. On the other hand, land used for landfill operations may be located at a distance from the facilities and may be presently undeveloped. When the specific locations of the new landfill sites are identified, it can be determined whether they would involve historical and archaeological sites by contacting local historical societies and references including the National Register of Historic Places and the National Registry of Natural Landmarks.

Any plant expansions to produce lead particulate traps at existing muffler facilities are likely to occur adjacent to the main complex and no historical or archaeological site disturbances are anticipated.

3.3.8 Aesthetics

The addition of a BEFF to an existing smelter would alter the appearance of the complex but the magnitude of this change in an

already industrial area is expected to be small since the BEFF would occupy only a small fraction of the area of the complex, would be immediately adjacent to the smelter, and would have a lower profile than the smelter itself. Moreover, the design of a BEFF (general industrial) would be in keeping with the rest of the complex. However, locations designated for new landfills may be located in presently undeveloped areas and the changes in appearance, although temporary and involving only small acreages, may be more obtrusive as vegetation and topsoil are removed.

For the manufacture of lead particulate traps, any plant expansions, if necessary, would likely have the same general appearance as the original building and no adverse impacts regarding aesthetics are anticipated.

3.3.9 Ecological Impacts

Ambient lead concentrations in natural environments should be reduced in the future by the promulgation of the NAAQS for lead. The major overall effect of this action, in conjunction with other lead control programs would be to reverse the present trend of accumulation of lead in natural ecosystems, principally in soils and sediments. Other heavy metals would be controlled to some extent by these programs, particularly at smelters, so that the overall effect of an NAAQS for lead would be a reduction in the environmental burden of several heavy metals.

3.3.9.1 Terrestrial Environments

The establishment of an NAAQS for lead is only one of several factors that would be responsible for reducing the input of lead to terrestrial ecosystems. Roadside areas would be affected primarily by the gradual elimination of lead in gasoline. By 1985 lead emissions from vehicles to roadside environments should be about 11 percent of 1975 levels (see Section 3.1). Because medium-duty trucks may continue to utilize leaded gasoline, lead emissions along highways may never be completely eliminated but would be small in quantity.

Reductions of lead inputs to terrestrial environments due to the control of particulate emissions from stationary sources is expected to be site specific. Under the proposed strategy, fugitive sources within some AQCR's may not be controlled (specifically for lead) if the proposed ambient air standards for lead can be achieved by the phasedown of lead in gasoline and/or ambient and emissions standards for total particulate matter. Since some fugitive emissions may not be controlled, local areas affected primarily by a point source may not experience a reduction in lead input.

Where the lead input to a terrestrial system would be reduced, the presently observed increase in lead concentrations in soils is expected to be retarded. However, the fate of lead already stored in soils is not as straightforward. Because of its relative immobility in soils, existing lead would probably be slowly (over geological time) covered by new soil or carried to streams through normal erosion

processes. Lead still would be available to vegetation and the food web as long as the present storage remained in the biologically active surface layers.

Surface deposition of lead on leaves would decline rapidly. This deposition is not believed to be a major source of lead to vegetation itself, rather to those organisms feeding directly on the leaves. Thus, this route would be considerably reduced as a means of transmitting lead to higher species in the food web.

3.3.9.2 Aquatic Environments

Most of the actions that would reduce the input of lead to terrestrial environments would also reduce lead inputs both directly and indirectly to aquatic environments. In addition, effluent limitation guidelines established under the Federal Water Pollution Control Act Amendments of 1972 (PL 92-500) would.be important in reducing lead in various liquid point source discharges.

As with terrestrial sites, actual reductions in lead in particular aquatic environments are expected to be site specific, depending on the mix of lead sources. For example, coastal ocean water would experience a reduction in lead input from the phasedown of lead in gasoline and the control of point source emissions to the air because these are the dominant lead sources for that environment (see Appendix X). An aquatic environment dominated by the inflow of domestic sewage wastes may experience no change in lead inputs because present legislation sets no lead standards for this type of source.

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Despite expected overall decreases in air and waterborne lead concentrations, aquatic ecosystems would continue to receive some lead from terrestrial ecosystems in normal erosion and runoff because of the present large storage of lead that has accumulated in surficial terrestrial soils. Because of this, aquatic environments would not exhibit as rapid a decline in overall lead concentrations as would terrestrial environments. Lead stored in sediments in eroding streams would be transported slowly downstream. High concentrations of lead in sediments in depositional areas such as lakes would be covered by sediments containing less lead as lead control measures become instituted and the storage of lead presently in terrestrial soils slowly depletes by erosion. Lead concentrations throughout the aquatic food web would decline as lead in the water decreases and lead in sediments becomes slowly buried beneath the biologically active surface layers.

3.3.10 Demography

The total labor force required for construction of a BEFF is expected to be met by using local construction workers. The operation of a BEFF would probably require a smelter company to hire two additional people, one for operation and one for maintenance (Nelson, 1977). Even under the most stringent of the standards proposed, only 20 to 22 BEFF's would be required. Consequently no widespread population shifts are anticipated--and none of the related impacts are likely to occur. These would include such community services as

housing, medical facilities, educational institutions, public utilities, and public safety organizations (fire and police).

Since the exact nature of the particulate trap production process has not yet been specified, the size and qualifications of the labor force required to operate the facilities cannot be precisely evaluated. If the traps were simply to serve as replacements for the usual attrition of mufflers, it might be possible for those workers presently manufacturing mufflers to be reassigned the tasks necessary for trap production. A majority of the traps, however, would likely be placed on cars not needing new mufflers at the time and an additional work force would have to be hired for a one or two-year period. It does not appear that particularly skilled operators would be needed and most industrial areas have enough unemployment so that unskilled workers could be found locally.

3.4 RELATIONSHIP BETWEEN LOCAL SHORT-TERM USES OF MAN'S ENVIRONMENT AND THE MAINTENANCE AND ENHANCEMENT OF LONG-TERM PRODUCTIVITY

The promulgation of an NAAQS for lead involves having to accept some short-term environmental concessions for anticipated long-term benefits. The latter are most importantly reflected in the expected reduction of airborne lead and the subsequent improvement in public health and welfare, while the former involve several short-term commitments of and undesirable effects upon man's environment.

Many of the short-term adverse impacts are expected to occur during the construction stages of such projects as (1) the installation

of BEFF systems to control fugitive emissions at smelters, and (2) the creation of landfill areas to accommodate solid wastes. Other short-term adverse impacts would occur if the additive effect of OSHA standards and the lead emission control strategy should dictate the extreme measure of plant closure of all or part of its operations. In this case a notable short-term adverse impact would be the loss of jobs.

The taking of land for construction involves some long-term loss of habitat but in the case of the land used for BEFF operations, this area would be generally adjacent to the smelter within the property lines and relatively uninhabitable. Moreover, the acreage requirments are small (on the order of a few acres total for all smelters). The total acreage needed annually for landfill (to bury dust collected during the BEFF operations) is less than 25 acres and the land is expected to undergo only short-term disruption since the sites can be rehabilitated through revegetation. It should be noted that this short-term disruption will reoccur periodically as new waste is collected for disposal.

A major irony of the mobile portion of the control strategy is that the need for particulate traps is short-lived. Only for the case of the most stringent standard (1.0 $\mu g/m^3$) are these control options needed to any large extent, and even then only for a limited time period. Due to the effectiveness of the Federal phasedown program, the need for this control option is expected to drop

dramatically within a few years.

The short-term implications of such a situation could involve the drastic choice of decommissioning these facilities once phase-down becomes effective enough. Alternative actions include a gradual production and stockpiling of traps before 1982 to minimize the size of the additional production facilities needed.

The use of energy represents both a short-term and a long-term commitment of resources. The former relates primarily to the capital energy expended to construct the necessary BEFF systems, while the latter derives from the operational stages, i.e., collecting fugitive dust at smelters. While the manufacturing of traps represents the use of operating energy, whether this use would become long-term depends upon how soon these facilities may be decommissioned. It is not clear how useful the further production of particulate traps would be. Based on the reduction of lead in air, it would appear that the particulate trap program is a temporary option.

While it is difficult to make direct comparisons between the adverse impacts of the proposed action and the benefits which would result, the improvement of human health constitutes the overriding factor behind the promulgation of an NAAQS for lead. The benefit

to be achieved is a reduction of adverse health effects which might

otherwise occur as a result of prolonged community exposure to lead.

3.5 MITIGATING MEASURES AND UNAVOIDABLE ADVERSE IMPACTS

Among the environmental impacts identified in this analysis are

several which can be classified as adverse impacts. These include

the consumption of more energy, changes in land use patterns, water

pollution, and the production of a large number of particulate traps

in a short time. In addition, certain economic impacts discussed in a

separate statement can be expected, such as increased costs to car

owners, to state and local governments, and to consumers of copper and

lead and their products. Measures can be taken to reduce or eliminate

some of these impacts. Those impacts which cannot be mitigated are con-

sidered to be unavoidable adverse impacts.

3.5.1 Mitigating Measures

Careful siting and design of the landfill sites which would be

used for disposal of lead from BEFF's can eliminate or reduce the

potential for these sites to pollute surface and/or ground waters.

To minimize the aesthetic impact of new landfill sites on surround-

ing areas, topsoil could be used to cover the disposal site and veg-

etation reestablished. It may also be possible to dispose of the

solid waste from the BEFF's in abandoned mines which may be owned by

the primary lead and primary copper smelting companies. To reduce

the possibility of lead leaching from the disposal sites, new land-

fills can be designed such that they would be lined with impermeable

membranes. In addition, a monitoring system should be a part of a design to identify failures or accidents at the landfill which result in leaching. Designing the BEFF's such that the lead dust collected could be recycled in the smelting process or buried in the lead mines would minimize the need for additional solid waste disposal sites and their related impacts. Acoustical devices can be incorporated in the design of the BEFF's to minimize their operating noise levels.

With stockpiling, the particulate traps could be manufactured over several years to reduce the impacts of trying to quickly produce large numbers of these essentially one-time-use devices. Particulate trap production facilities are expected to be located at existing muffler plants and, therefore, should blend with the surroundings, having no impact on aesthetics.

3.5.2 Unavoidable Adverse Impacts

Of the impacts identified in Sections 3.2 and 3.3, measures are not available to mitigate some of the adverse impacts. The expense of adding control devices to automobiles and primary lead and primary copper smelters cannot be avoided. The additional energy consumed to manufacture and operate these devices is another unavoidable adverse impact which may be attributed to the setting and enforcing of the NAAQS for lead. Either the state, local, or Federal government would have to pay for the implementation plan development, ambient air monitoring, and standard enforcement, as these are unavoidable costs. Measures to mitigate the increased costs of producing

lead and copper and their end products are not available. The magnitude of these impacts varies for alternative levels of the proposed standard, but at none of the levels analyzed are these impacts expected to be of major consequence.

3.6 IRREVERSIBLE IMPACTS

This section identifies the resources which are irreversibly or irretrievably committed as a result of the proposed action, i.e., the establishment of an NAAQS for lead.

Resources are considered irreversibly committed if, as a result of the proposed action, they

(a) Are consumed,

(b) Cannot be recovered and reused, or

(c) Are permanently damaged.

The proposed strategy for the implementation of the lead standard is the control of both stationary and mobile sources of lead emissions. The control strategy (described in Section 3.1) involves

(a) The use of labor and materials in the manufacturing of control systems (BEFF's and lead traps);

(b) The use of labor, materials, and land for plant modification (primary lead and copper smelters);

(c) The use of labor for the installation of control equipment;

(d) The use of labor, equipment, and land for the disposal of dust collected by the BEFF's; and

(e) The use of energy in connection with all the above activities.

From among the above resources, labor and energy should be regarded as irreversibly committed. On the other hand, materials used in the above activities would be largely recoverable for reuse, with the exception of reinforced concrete used in plant construction. Similarly, any equipment would be reusable either as is or through recovery in the form of scrap materials.

It is not anticipated that there would be permanent impacts on the land used; however, depending on use, as a result of the proposed action, land would be temporarily unavailable, e.g., land used for disposal sites. No permanent hydrological or ecological impacts are anticipated nor is there any anticipation of permanent effects on topographical, geological, or soil characteristics.

REFERENCES

ENVIRONMENTAL IMPACTS OF THE PROPOSED STANDARD

Bureau of the Census. 1967. Census of Manufacturers, 1967: Summary and Subject Statistics, Vol. 1, pp. 6-235 through 239. U.S. Department of Commerce.

Bureau of the Census. 1977. Information Officer, Industry Division, Department of Commerce. Telephone conversation.

Federal Energy Administration. April 1977. Monthly Energy Review. National Energy Information Center, Federal Energy Administration.

Goodfriend, L.S. and F.M. Kessler. 1973. "Industrial Noise Pollution," Pollution Engineering and Scientific Solution. Proceedings of the First International Meeting of the Society of Engineering Science Held in Tel Aviv, Israel June 12-17, 1972. Plenum Press, New York-London, 1973.

Nelson, K.W. January 11, 1972. American Smelter and Refinery Company, Incorporated. Written correspondence to John M. Pratapas, U.S. Environmental Protection Agency.

Statnick, Robert M. October 1974. Measurement of Sulfur Dioxide, Particulate, and Trace Elements in Copper Smelter Converter and Roaster/Reverberatory Gas Streams. National Environmental Research Center. Research Triangle Park, North Carolina.

Summers, Joseph. March 16, 1977. U.S. Environmental Protection Agency, Michigan. Telephone conversation.

U.S. Environmental Protection Agency. January 1974. Lead and Air Pollution: A Bibliography With Abstracts. Air Pollution Technical Information Center, Office of Air and Water Programs, Office of Air Quality Planning and Standards, Research Triangle Park, North Carolina.

U.S. Environmental Protection Agency. December 18, 1974j. "Occupational Noise Exposure Regulation," Federal Register, Vol. 39, No. 244.

U.S. Environmental Protection Agency. October 1974f. Background Information for New Source Performance Standards: Primary Copper, Zinc, and Lead Smelters; Volume 1: Proposed Standards. Office of Air Quality Planning and Standards, Research Triangle Park, North Carolina. NTIS No. PB-237 832.

REFERENCES (Concluded)

ENVIRONMENTAL IMPACTS OF THE PROPOSED STANDARD

U.S. Environmental Protection Agency. July 1976l. Air Pollutant Assessment Report on Arsenic.

U.S. Environmental Protection Agency. January 1977c. The Report to Congress on Waste Disposal Practices and Their Effects on Ground Water: Report January 1977. Office of Water Supply.

Van Horn, William. October 1975. Materials Balance and Technology Assessment of Mercury and Its Compounds on National and Regional Bases. Prepared for U.S. Environmental Protection Agency by URS Research Company. NTIS PB-247 000.

TAB J- Final Economic Impact Assessment

ESTIMATED RESOURCES REQUIRED BY STATE AND LOCAL CONTROL AGENCIES FOR IMPLEMENTATION OF A 1.5 $\mu g/m^3$ STANDARD
(SUMMARIZED BY EPA REGION)

EPA REGION	PRIMARY LEAD SMELTERS	PRIMARY COPPER SMELTERS	SECONDARY LEAD SMELTERS	LEAD STORAGE BATTERY MANUF.	TOTAL* SOURCES AFFECTED	FIRST YEAR REQUIREMENTS			ON-GOING REQUIREMENTS		
						MAN YEARS	TOTAL COST (IN THOUSANDS)	CAPITAL COST (IN THOUSANDS)	MAN YEARS	TOTAL COST (IN THOUSANDS)	OPERATING COST
I			1	15	118	1.4	31.8	22.7	4.2	95.8	3.3
II			5	11	156	1.8	41.5	36.2	5.5	125.6	4.6
III			10	18	241	2.6	60.0	44.2	8.0	184.2	7.1
IV		1	10	25	268	5.1	117.3	100.0	14.1	324.0	14.1
V		1	16	37	643	12.4	283.1	61.8	22.8	523.4	9.0
VI	1	3	7	14	138	4.5	103.7	65.4	10.2	233.3	9.9
VII	3		1	14	125	1.7	38.2	36.2	5.1	118.0	4.6
VIII	1	2	1	4	37	2.2	50.8	19.6	3.6	83.4	2.3
IX		8	4	40	129	6.2	141.1	78.9	12.2	279.7	11.3
X	1	1	1	12	55	2.4	54.5	21.1	4.3	97.6	2.8
SUBTOTALS	6	16	56	190	1910	40.3	922	486.0	90	2065	69
TOTALS					1910	40.3		1408	90		2225

*Includes grey iron foundries, primary lead smelters, primary copper smelters, battery manufacturers, secondary lead smelters, & gasoline additive plants.

ECONOMIC IMPACT ASSESSMENT FOR THE
NATIONAL AMBIENT AIR QUALITY STANDARD FOR LEAD

and

THE ECONOMIC IMPLICATIONS OF A QUARTERLY MEAN AVERAGING TIME
FOR THE LEAD NATIONAL AMBIENT AIR QUALITY STANDARD

Office of Air Quality Planning and Standards
Office of Air and Waste Management
U.S. Environmental Protection Agency

June 28, 1978

Preface

The "Economic Impact Assessment for the National Ambient Air Quality Standard for Lead" (EIA) was issued when the Agency proposed a 1.5 µg/m^3 monthly average standard. Subsequent to proposal the Agency received several public comments on the EIA. Most were generally supportive of the EIA in terms of the industries affected by the standard. In some instances however the commentors forecast more severe impact. Because the commentors' supporting documents did not allow verification of the assumptions underlying the forecasts, the EIA was not altered.

The Agency also received comments on the proposed standard itself. In view of those comments, the Agency intends to promulgate a 1.5 µg/m^3 quarterly average standard. The EIA issued at proposal did not analyze the economic impact of that standard. Hence, the EIA issued at proposal is supplemented by an analysis of the 1.5 µg/m^3 quarterly average standard. This analysis is found after page 56 of the EIA issued at proposal and is entitled "The Economic Implications of a Quarterly Mean Averaging Time for the Lead National Ambient Air Quality Standard".

ECONOMIC IMPACT ASSESSMENT FOR THE

NATIONAL AMBIENT AIR QUALITY STANDARD FOR LEAD

Office of Air Quality Planning and Standards
Office of Air and Waste Management
U.S. Environmental Protection Agency

November 22, 1977

ECONOMIC IMPACT ASSESSMENT

1.0 SUMMARY AND INTRODUCTION

1.1 <u>Summary</u>

The purpose of this analysis is to estimate the economic impact which can be expected from a constant air quality for lead. This analysis examines three levels which are deemed to fall within the likely range of the final standard. It should be noted, however, that this economic assessment is not a basis for selecting the standard since the Clean Air Act requires that the standard be based solely on health and welfare criteria. This assessment considers three possible standards: 1.0, 1.5, and 2.0 $\mu g/m^3$ (monthly average). The economic impact assessment emphasizes the impacts upon stationary source lead emitters but also discusses the impacts upon mobile source lead emitters and state and local control agencies charged with implementing the standard.

Dispersion models indicate that plants in at least six industries may be required to install control devices to meet the alternative standards under consideration. These control devices would be in addition to those control systems required by typical state regulations for control of particulate or other emissions. The six industries under consideration are primary lead smelting, secondary lead smelting, primary copper smelting, grey iron foundries, gasoline lead additive manufacturing, and lead-acid storage battery manufacturing.

The economic impact assessment is based primarily upon the use of model plants and estimated emission factors. The model plant emissions were used in a meteorological dispersion model that predicts maximum ambient lead concentrations. The dispersion modeling results were then used to estimate which emission sources needed additional control to meet the alternative ambient standards and the extent of control required. The resulting control requirement then determined the type of control equipment needed and the cost of the equipment. Control costs to meet alternative standards were

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then factored into a discounted cash flow model that served as the basis for evaluating potential plant closures.

As expected, the results of the economic impact analysis indicate that model plants of the six industries mentioned above will be affected in varying degrees by the alternative standards under consideration. As shown in Table 1-1, annualized compliance costs expressed as a percent of model plant revenues range from zero to over 7 percent depending upon the level of the standard and the type of model plant being analyzed.

It is possible that some plants, facing control costs of the magnitude shown in Table 1-1, may choose to close rather than comply with emission regulations required to achieve a given ambient lead standard. An analysis of this issue shows that, for lead air quality standards of either 1.5 or 2.0 $\mu g/m^3$, potential plant closures may be possible in the primary lead industry, the secondary lead industry, and the primary copper industry. In addition, at an ambient standard of 1.0 $\mu g/m^3$ plant closures may be possible for some grey iron foundries. Plant closures are not projected for gasoline lead additive plants or lead-acid battery plants for any of the alternative standards under consideration.

The economic impacts described above are based upon a number of factors such as emission rates, plant profit margins, and terrain and weather conditions in the vicinity of the source. Since these variables are difficult to quantify with any reasonable degree of precision, it must be borne in mind that impacts at any one specific source may vary considerably from the impacts described here. It should be noted that a rollback analysis (an analysis that assumes a linear relationship between the percent of air quality improvement and emission reductions) indicated that only two industries-- primary lead smelting and

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Table 1-1. RELATIVE COSTS OF ALTERNATIVE AMBIENT LEAD STANDARDS - MODEL
PLANT ANNUALIZED COSTS AS A PERCENT OF ANNUAL REVENUE

Model Plant Type	Alternative Ambient Standards (μg/m^3 monthly average)		
	2.0	1.5	1.0
Primary Lead	0.9% to 7.7%*	1.2% to 7.7%*	1.8% to 7.7%*
Secondary Lead	7.4%**	7.4%**	7.4%**
Primary Copper	0.0% to 3.3%	0.0% to 4.3%	0.0% to 5.2%
Grey Iron	0.0% to 2.0%	0.0% to 3.8%	0.0% to 6.2%
Gasoline Lead Additives	0.2%	0.2%	0.2%
Lead Acid Batteries	0.0% to 0.1%	0.0% to 0.1%	0.0% to 0.1%

*The control efficiency of the costed system is assumed to be 95%. At this level of efficiency the model primary lead smelter with high fugitive emissions could only attain an air quality standard of 3.9 μg/m^3.

**The model secondary lead smelter with low fugitive emissions could meet a standard of 2.0 μg/m^3 with an expenditure of 7.4% using the 95% control system referred to above. A model secondary lead smelter with high fugitive emissions, however, could only meet an air quality level of 3.7 μg/m^3 with the same system.

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primary copper smelting--would need to install control devices to meet the alternative standards. This result is at variance with the dispersion analysis upon which the stationary source economic impact assessment was based that indicated six industries would need to install control devices. This fact emphasizes the effect of various modeling assumptions upon the results of the economic impact analysis as well as the general problem of the variability of the results depending upon various input assumptions.

An analysis of potential impacts to mobile source lead emitters for the ambient lead standards under consideration has also been developed. This analysis indicates that mobile sources in portions of one to four Air Quality Control Regions, or a possible total of 58,000 to 1,300,000 vehicles, may have to be controlled, assuming the ambient lead standard must be achieved in 1982. However, because of lead phasedown regulations and the increased use of lead free gasoline for catalyst equipped vehicles, the total number of mobile source lead emitters is expected to decrease after 1982. One control device that may be feasible for mobile sources is a lead trap muffler. Other means of control include reducing vehicle miles traveled and further reducing the lead content of gasoline.

State and local air pollution control agencies will also incur costs to develop and implement plans to achieve an ambient air quality standard for lead. Total first year costs for all state and local agencies are estimated to range from $1.0 - $1.7 million, or 0.6 - 1.0 percent of current expenditures. Recurring costs are estimated to be $1.4 - $2.8 million, or 0.9 - 1.8 percent of current expenditures. Man-year requirements, both first-year and recurring, are similarly estimated to be less than 2 percent of current levels.

1.2 INTRODUCTION

This report assesses the cost and economic impact of alternative ambient lead standards. The stationary sources covered in the assessment are model primary lead smelters, secondary lead smelters, gasoline lead additive manufacturing plants, lead-acid battery manufacturing plants, primary copper smelters, and grey iron foundries. In addition, the potential costs of mobile source emission control and of requisite state and local control agency information, administration, and enforcement activities for alternative standards are also estimated. The alternative standards considered are 2.0, 1.5, and 1.0 $\mu g/m^3$, monthly average. The detailed methodology and documentation of the analysis are provided in the report entitled "Background Document Supporting the Economic Impact Assessment of the Lead Ambient Air Quality Standard".

1.2.1 Reasons for Selection of Sources for Consideration

In 1975, about 142 thousand metric tons of lead were emitted nationwide. Combustion of lead containing gasoline accounted for 90% of those emissions. Combustion of waste crankcase oil, solid waste, oil, and coal accounted for an additional 5% of national emissions in 1975. The remaining 5% came from 19 industrial stationary source types.[1] As a result of phasedown of lead in gasoline, lead emissions from gasoline combustion are expected to decrease about 60% by 1985 from current levels.[2] Although this is a large relative decline, gasoline combustion emissions are still projected to be the greatest emission source nationally in 1985. Because of this,

gasoline combustion sources (mobile sources) are included in the economic impact assessment.

Combustion of waste crankcase oil, solid waste, oil, and coal is not considered in the economic impact assessment.[3] Combustion of waste crankcase oil is not considered because the phasedown of lead in gasoline will cause combustion of waste crankcase oil to cease to be a major source. Combustion of solid waste is not considered in the analysis since many solid waste combustion facilities (i.e., municipal incinerators) are scheduled to be closed. Therefore, lead emissions from this source category will be substantially reduced. Finally, sources burning oil and coal are not considered since dispersion modeling and ambient data analysis near these sources have indicated that oil and coal combustion will probably not result in violations of any of the alternative ambient standards under consideration.

Growth projections as well as analyses of estimated emissions and measured ambient impacts were developed for the 19 industrial stationary source types previously mentioned. As a result, 8 of the 19 were identified as sources probably requiring additional emission control.[4] These 8 industrial source types are primary lead smelters, secondary lead smelters, primary copper smelters, gasoline lead additives manufacturing plants, lead-acid battery manufacturing plants, grey iron foundries, ferroalloy plants, and lead ore crushing and grinding plants. The economic impact assessment includes the first six of the aforementioned source types. Ferroalloy plants are not considered in the economic impact assessment because dispersion modeling indicated that emissions from a model ferroalloy plant in zero background-isolated

ource situations should not result in violations of any of the alternative standards under consideration. Ore crushing and grinding plants are not considered in the economic impact analysis because of the inability to adequately measure fugitive emissions from these sources and also to predict the ambient impact of these emissions. These fugitive emissions are a function of particle density and wind speed. The density data is not currently available nor is a dispersion model which handles windblown emissions.

One assumption which tends to understate the economic impact of any given ambient lead standard is that each model plant is an isolated source with no background ambient levels of lead present. To the extent that sources of lead emissions may be clustered, the combined ambient lead concentrations of the cluster result in higher control costs and impacts than assumed.

In addition, even if the isolated source assumption were valid, there are other factors that influence the results of the economic impact analysis. These include topographical and meteorological conditions, stack characteristics, particulate emission factors, lead content and particle size of particulate, fugitive emissions factors, and baseline process economics. Values for many of these factors are initially specified as range estimates with midpoints (arithmetic means) of the ranges used in the model plant analysis. For other factors, values used in the model plant analysis are derived from site specific measurements. However, the degree of error in the measurement per se or in the application of the measured value to the model plant is not well known.

Variations in these data inputs (factors) among plants and source types limit the accuracy of the economic impact assessment. However, the assessment does explicitly address some variations via a reasonable range analysis for certain data inputs.

1.2.2 Methodology

1.2.2.1 Stationary Source Assessment Methodology

Plant, dispersion, control cost, and discounted cash flow models provide the bases for the economic impact assessment for the selected stationary sources. Outputs of the plant models include emission, size, process, and location characteristics. These are inputs to the dispersion model. The dispersion model provides maximum predicted concentrations and source contribution file estimates. The latter relate point and fugitive emissions generated by the plant to maximum predicted ambient concentrations. The outputs of the dispersion model are used together with control systems engineering and cost data to produce estimates of investment and annualized control costs. These estimates are the outputs of the cost model. They are used together with process economic data in the discounted cash flow models to produce a numerical estimate of the value of a plant after control. If these calculations show a plant is worth more closed than it is open, closure is predicted.

In situations where all control costs could be passed on without any effect on production levels, closure would never be predicted using the

aforementioned methodology. However, the ability of an individual plant to pass costs on and sustain pre-control production levels becomes less likely as alternatives to accepting the cost pass on become available to his customers or raw materials suppliers. The assumptions of the economic impact assessment and the competitive structure of the industries analyzed imply many alternatives to accepting a cost pass on. Consequently, no cost pass-on is considered in the closure analysis.

1.2.2.2 Mobile Source Assessment Methodology

A 1975 source emissions inventory and projected mobile and stationary source growth rates are used to estimate a 1982 lead emissions inventory for each Air Quality Control Region. In a similar manner, ambient concentrations are rolled forward. If the alternative ambient standards are predicted to be exceeded, the 1982 source emissions inventory and ambient concentrations are rolled back so that the standard is achieved. Of course, several different combinations of mobile and stationary source control can achieve the same rollback. In this analysis mobile source control is assumed used as a last resort and then with emission reduction effectiveness limited to 75%.

The 1982 stationary source emissions inventory used in the mobile source assessment includes eleven types of process sources. These are primary lead smelting, secondary lead smelting, primary copper smelting, grey iron production, gasoline lead additives production, lead-acid storage battery production, ferroalloy production, coal-fired power generation, oil-fired power generation, solid waste incineration, and iron and steel production. It is important to note that only primary lead smelting and primary copper smelting were projected to require additional rollback in 1982. This runs counter to the dispersion

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model findings of the stationary source assessment which identify the first 6 of the 11 aforementioned sources as requiring further control. This apparent inconsistency is a function of the different methodologies employed and serves to underscore another source of variability. Moreover, like data variability, this inconsistency limits our ability to make accurate judgements regarding impact.

1.2.2.3 <u>State and Local Control Agency Assessment Methodology</u>

The state and local control agency assessment builds on the stationary and mobile source assessments. Control requirements for the stationary source model plant assessments for the three alternative standards are aggregated to a national level and used as inputs to EPA's Air Pollution Strategy Resource Estimator (APSRE). APSRE then provides an estimate of additional stationary source related state and local control agency needs. Additional resource requirements resulting from mobile source control are developed as supplementary calculations using the findings of the mobile source assessment.

2.1 PRIMARY LEAD SMELTING

2.1.1 Industry Structure

Six primary smelters owned by four corporations comprise the domestic industry. Company names, the plant capacities and locations are given in Table 2-1.

The four corporations smelting lead are both vertically and horizontally integrated. For example, they mine lead ore and refine smelted lead. In addition, they mine, smelt, and/or refine zinc, silver, coal, molybdenum, and copper. The dependence that these corporations have on lead varies, ranging from 6.1% of revenues for AMAX to 17.9% for Gulf Resources and Chemical.

Lead is an intermediate good. As such, the demand for lead is derived from the demand from lead-using products. These include batteries, gasoline lead additives, electrical cables and sheathing, paints, sheeting, plumbing, and ammunition. Through the year 2000, U.S. lead demand is projected to grow at 1.5% per year.[5]

Lead is a small percent of end product value and has few close substitutes. Therefore, its demand is charactericterized as price inelastic.[6] This means that when lead prices increase, total revenue (price times quantity sold) increases.

Price inelastic demand notwithstanding, domestic primary smelters still could face competitive pressures from other lead suppliers. For example, unilateral price increases by domestic primary smelters could foster increased competition from domestic secondary producers. Also, unilateral price increases by domestic primary smelters could also foster increased competition from foreign producers. As indicated in Table 2-2, foreign producers' prices

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Table 2-1. U. S. PRIMARY LEAD SMELTERS

Company	Plant(s) Location(s)	1974 Capacity (thousands of metric tons)
Amax	Boss, Missouri	127
ASARCO	East Helena, Montana	82
	El Paso, Texas	82
	Glover, Missouri	100
Gulf Resources & Chemical	Kellogg, Idaho	118
St. Joe Minerals Corp.	Herculaneum, Missouri	204
		713

Source: U.S. EPA, October 1974. Background Information for New Source Performance Standards: Primary Copper, Zinc, and Lead Smelters; Volume 1: Proposed Standards. Bureau of Mines Minerals Facts and Problems, 1975.

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Table 2-2.   LEAD PRICES

(Average annual price, cents per kilogram)

Year	London Metals Exchange	New York
1964	27.8	30.0
1965	31.8	35.3
1966	26.3	33.6
1967	22.7	30.9
1968	24.1	29.1
1969	28.9	32.9
1970	30.5	34.7
1971	25.4	30.7
1972	30.2	33.1
1973	43.0	36.0
1974	59.2	49.7
1975	41.5	47.5
1976	45.3	51.0

Source: Bureau of Mines, Mineral Facts and Problems, 1975.
          Bureau of Mines, Minerals and Materials, December, 1976.
          Bureau of Mines, Minerals Yearbook, 1970, 1972, 1974.

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(London Metals Exchange) have been consistently less than domestic producers' prices (New York Exchange). Anticipated reaction by foreign producers to domestic primary smelter price increases may determine whether domestic smelters elect to absorb long run cost increases or push them forward as price increases.

2.1.2 Model Plant Specifications and Dispersion Model Results

The model plant specifications used in the economic impact assessment are primarily dependent on the assumptions and data requirements of the dispersion model. The dispersion model employed in the assessment is the Single Source (CRSTER) Model.[7] It is a steady state Gaussian plume dispersion model. CRSTER will be recommended to the states to develop lead emission regulations for isolated stationary sources.

Flat terrain is a basic assumption inherent in the CRSTER dispersion model, and hence is one of the model primary lead smelter's specifications. The flat terrain assumption may be important in predicting the distance of the maximum concentration from plant. The maximum concentration for the model primary lead smelter is predicted to be 300 meters away from the plant. With rugged terrain, the maximum concentration could be expected to be closer to the plant. A review of topographical maps for all six smelters indicates elevations greater than the smelter site within 300 meters of the plant. Consequently, the maximum concentration may occur closer to the plant than 300 meters.

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Data requirements of the dispersion model include meteorological
conditions such as wind speed, wind direction, and ambient temperature.
Such data is not always available for every plant location. St. Louis
meteorological data is available and is used in the analysis, since three
of the six smelters are located near St. Louis.

Data requirements of the dispersion model also include emission
characteristics such as stack gas exit velocity and temperature as well
as point and fugitive emission rates and release heights. These emission
characteristics are sometimes related to plant size. The production rate
used in the dispersion modeling is 62 thousand metric tons annual production.
This size is smaller than the current production rates of 4 of the 6
'elters. However, this size was chosen because fugitive emission
measurements were available for a plant of that size. Furthermore, because
emission characteristics are dependent on factors other than size, scaling
up the fugitive emission measurements of the model plant to be consistent
with an average plant size could provide atypical results.

The model smelter is assumed to have both stack and fugitive emissions
of lead particulate. Stack emissions are assumed controlled to average
SIP particulate allowable process weight rates. The fugitive emissions
are assumed uncontrolled. These emissions come from the sinter machine
building, blast furnace building, reverberatory furnace building, zinc
fuming area, and the zinc furnace building.

Stack emissions from the model smelters have a negligible effect on
oredicted maximum ambient lead concentrations. Moreover, higher stack emission
.ates within a range thought to be reasonable do not change this finding.

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Fugitive emissions have the predominent impact on predicted ambient concentrations, and this impact appears to vary significantly from smelter to smelter. For example, fugitive emission rates derived from measurements at a Montana primary lead smelter result in a maximum predicted concentration for the model smelter of 3.8 $\mu g/m^3$, monthly average. Fugitive emission rates derived from measurements at an Idaho smelter are higher and result in a maximum predicted concentration before control of 78.2 $\mu g/m^3$, monthly average.

2.1.3 Control Costs

2.1.3.1 Model Plant

The alternative ambient standards considered here are 2.0, 1.5, and 1.0 $\mu g/m^3$, monthly average. The predicted ambient concentrations from both sets of fugitive emission rates mentioned above are greater than the alternative standards. Hence, control costs corresponding to reduced fugitive emission rates which achieve the alternative ambient standards should be developed for the model primary lead smelter. Control costs representing the least costly means of achieving the three standards were developed for the lower set of derived fugitive emission rate. For the higher set, control costs corresponding to 95% control efficiency were developed. The 95% estimate is an engineering judgement based on the best demonstrated control system currently available (building evacuation to a fabric filter). However, 95% control applied to the higher set of fugitive emission rates still results in a predicted maximum concentration of 3.9 $\mu g/m^3$ which exceeds any of the alternative standards. The control efficiencies required to get to 2.0, 1.5, and 1.0 $\mu g/m^3$, respectively, are estimated to be 97.4%, 98.1%, and 98.7% as compared with 95% which is judged to be the maximum attainable.

The absolute and relative magnitude (as a percent of annual revenue) of the developed investment and annualized costs are presented in Table 2-3. For the lower fugitive emission rates, relative annualized control costs range from 0.9% to meet a standard of 2.0 $\mu g/m^3$ to 1.8% to meet a standard of 1.0 $\mu g/m^3$. For the higher fugitive emission rates, relative annualized costs are 7.7% to meet an ambient level of 3.9 $\mu g/m^3$.

2.1.3.2 <u>Industry</u>

The most critical factor in the model plant control cost assessment is the fugitive emission rates. As indicated previously, these rates have been derived from fugitive emission measurements at two of the six currently existing primary lead smelters. However, site specific topographical, meterological, and smelter size, configuration, and emission rates data are required to assess the ambient and cost impact at these six smelters with reasonable certainty. Assuming all primary lead smelters have the same site specific characteristics as the model smelter, five of the six existing smelters would probably have low fugitive emission rates and hence have ambient impacts closer to 3.8 than to 78.2 $\mu g/m^3$, monthly average. For three (the Missouri smelters) of the five smelters this judgement is based primarily on the presumption that since these smelters are newer they are better controlled. For the other two of the five smelters (Montana and Texas), similarity to the hypothetical smelter in terms of size, lower measured fugitive emissions, and/or lower measured ambient concentrations is the basis for the judgement. Higher measured fugitive emission and ambient concentrations are the reasons for classifying the Idaho smelter (the sixth smelter) as having ambient impacts closer to 78.2 $\mu g/m^3$.

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Table 2-3. CONTROL COSTS FOR THE MODEL PRIMARY LEAD SMELTER

	Maximum Predicted Ambient Levels ($\mu g/m^3$, monthly average)			
	3.9	2.0	1.5	1.0
Higher Fugitive Emission Rates				
Investment 000's of $	10800	*	*	*
as a % of annual revenue	34.4%	*	*	*
Annualized Cost 000's of $'s	2400	*	*	*
as a % of annual revenue	7.7%	*	*	*
Lower Fugitive Emission Rates				
Investment 000's of $'s	0	1300	1600	2400
as a % of annual revenue	0	4.0%	5.2%	7.5%
Annualized Cost 000's of $'s	0	300	400	600
as a % of annual revenue	0	0.9%	1.2%	1.8%

*The control efficiency of the best demonstrated control system is limited according to engineering judgement to 95%. This is not sufficient to achieve the alternative ambient standards for the model plant with higher fugitive emission rates.

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To draw further inferences from the model plant assessment is tenuous. However, assuming production is proportional to the number of smelters in each category and the model smelter costs can be extrapolated linearly to higher production volumes, industry control cost estimates can be developed. For 83.3% of the industry (current production share at the five plants assumed to have low fugitive emission rates), the respective investment costs in 1982 for meeting the 2.0, 1.5, and 1.0 $\mu g/m^3$ standards are $11.9 million, $15.3 million, and $22.4 million. The corresponding annualized costs are $2.8 million, $3.5 million and $5.3 million. For the remaining 16.7% of the industry (current production share of the other smelter), control cost estimates are those corresponding to 95% control efficiency. They are $20.5 million for investment and $4.6 million for annualized costs.

2.1.4 <u>Model Plant Closure Assessment</u>

Using a discounted cash flow analysis technique, synthesized model plant process economics, the aforementioned control costs, and assuming no other lead emitters in the vicinity, the potential for closing the smelter on financial grounds is assessed. Process economics (e.g., revenues, costs) were developed using Bureau of Mines data as well as financial data from specific companies.

Given the lower set of derived fugitive emission estimates, the model smelter should not close regardless of the level of the standard. This finding is true for several sets of circumstances. They include a range of marginal tax rates and minimum acceptable return rates thought to be reasonable, full

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absorption of control costs, low profit margin and fully depreciated smelter, and full absorption of operation and maintenance cost required for the proposed Occupation Safety and Health Administration Lead Standard (100 $\mu g/m^3$, 40 hour time weighted average and 60 $\mu g/100$ g whole blood).

Given the higher set of derived fugitive emission estimates, the ability of the model smelter to achieve maximum (95%) control of fugitive emissions (assuming this amount of control is satisfactory) and remain open is unclear. The critical factors among previously described set of circumstances are the marginal tax rates and the minimum acceptable return rates. Marginal tax rates are the rates applicable to plant and not, for example, to the parent firm. Minimum acceptable return rates are the profits available from the next best investment opportunity. If the minimum acceptable return rates are not realized, the plant will close; and, the next best investment opportunity will be capitalized. If the tax and return rates are on the high end of the range thought to be reasonable, it would be in the best financial interest of model smelter to close. If the rates are lower, the model smelter with higher fugitive emission rates should make the expenditures to achieve 95% control and remain open.

2.2 SECONDARY LEAD SMELTING

2.2.1 Industry Structure

The secondary lead smelting industry is a subset of the secondary lead industry. The latter includes melters as well as smelters. Unfortunately, industry structure statistics are only available for the secondary lead industry.

The secondary lead industry in the United States supplied 545,000 metric tons or 39 percent of total lead consumption in 1974. Approximately 90 companies operating 130 plants produce lead and lead alloys for industrial use from recycled materials, principally old batteries.[8] Two companies, NL Industries, Inc., and RSR Corporation, operating about 18 secondary plants, account for over 50 percent of the total secondary lead production.[9] Thirteen other companies operating approximately 24 plants that manufacture storage batteries and other metal products account for 45 percent of secondary lead production.[10]

Roughly two-thirds of all lead produced at secondary smelters is antimonial lead and goes into the manufacture of batteries. Therefore, demand for secondary lead in the future is tied to growth in battery use. While new, longer lasting batteries are becoming more and more popular, demand for replacement batteries is still expected to be 35 percent of total demand each year until the end of the decade.

Prices are a critical factor in determining the supply of secondary lead. Primary lead prices affect secondary lead prices in a direct way. To the extent that the secondary industry acts as a broker, any change in the price of primary lead will be reflected in the price of scrap. Secondary producers,

therefore, could expand or contract their collection effort depending on changes in the price of lead. Although it may vary above and below the primary lead price, the secondary soft lead price follows the average prices quoted in <u>Metals Week.</u> Historical primary lead prices are provided in Table 2-2.

2.2.2 Model Plant Specifications and Dispersion Model Results

To provide reasonably accurate predictions of ambient impact, the model plant specifications should be consistent with the assumptions and data requirements of the dispersion model. CRSTER, the dispersion model employed in the assessment, is designed to predict ambient impacts of emissions from a plant located in flat terrain with meteorological conditions representative of the area. To avoid modeling an atypical situation, an actual smelter located in flat terrain with local meteorological data available is the plant modeled. The smelter produces about 30 metric tons of lead a day. However, this is somewhat low when compared to the midpoint of the range of plant sizes specified in the Control Techniques Document worksheets. The range specified there is 18 to 68 metric tons per day with the midpoint being 43 metric tons per day. But the actual size distribution of the secondary lead smelters is unknown. Moreover, an explicit attempt is made to avoid modeling atypical situations. Hence, the size of the model plant is not adjusted upwards to reflect the midpoint of a size range.

The model smelter has lead particulate stack emissions controlled to average SIP process weight rates. These emissions have a negligible impact on the maximum predicted ambient concentrations. In addition there are

fugitive emissions assumed for the model smelter. These emissions are uncontrolled and result in a maximum predicted concentration of 56.6 $\mu g/m^3$, monthly average for the midpoint (arithmetic mean) fugitive emission estimate. For a low fugitive emission estimate the maximum predicted concentration is 33.2 $\mu g/m^3$. For a high fugitive emission estimate the maximum predicted concentration is 80.5 $\mu g/m^3$. The maximum predicted concentrations for all fugitive emission estimates are extremely sensitive to the assumed release height of the fugitive emissions. For example, increasing the release height by 5 meters for the midpoint emission estimate reduces the maximum predicted concentration from 56.6 $\mu g/m^3$ to 20.0 $\mu g/m^3$. However, the release height assumed originally (10 meters) is thought to be typical of secondary lead smelting release heights.

If the release height is typical and best demonstrated control cannot achieve the standard, another consideration might be land acquisition. The predicted maximum of 56.6 $\mu g/m^3$ occurs 150 meters from the plant. If legally feasible and cost effective, the plant may supplement the fugitive emission control system by purchasing surrounding land which has ambient concentrations greater than the standard. Under such a strategy, and with barriers to limit access to these areas, the public would still be protected from the adverse consequences of concentrations exceeding the standard. However, the feasibility of land acquisition as a control strategy is beyond the scope of this assessment.

2.2.3 Control Costs

As previously noted, the maximum predicted concentrations of 33.2 to 80.5 $\mu g/m^3$, monthly average exceed the considered alternative ambient standards for all sets of fugitive emission estimates. Consequently, fugitive emissions will have to be reduced to some degree at the model smelter regardless of the level of the standard. Building evacuation to a fabric filter has been applied to secondary lead smelters before. However, the achieved level of control efficiency is not known. At present, 95% control efficiency seems to be the limit applied by engineering judgement on this technically demonstrated system.

Applying a 94% or 95% efficient control system to the model smelter is estimated to require an investment of $1.8 million which is about 32% of annual revenue. Corresponding annualized cost is $0.4 million which is about 7% of annual revenu A 94% or 95% control efficiency will achieve the 2.0 $\mu g/m^3$ standard for the low fugitive emission estimates, but will not achieve any of the more restrictive alternative ambient standards. Furthermore, 95% control efficiency will not achieve any of the considered alternative ambient standards given the dispersion modeling results for the midpoint and high fugitive emission rate estimates. With the midpoint fugitive emission rate estimate, 95% control efficiency results in a predicted maximum of 2.8 $\mu g/m^3$. With the high fugitive emission rate estimate, 95% control results in a predicted maximum of 4.0 $\mu g/m^3$.

2.2.4 Model Plant Closure Assessment

The model plant closure assessment for secondary lead smelting includes

an analysis of high, average, and low profit margin smelters. The process economics (e.g., revenues, costs) for these profit margins are developed using publicly available financial data on NL Industries and RSR.

High profit margin model smelters with plants that are not fully depreciated should be able to absorb the costs associated with the 94% or 95% efficiency system and remain open. This finding holds within a range of marginal tax rates and minimum acceptable return rates thought to be reasonable. However, high profit margin model smelters that are fully depreciated will only be able to remain open under similar conditions if they have relatively low marginal tax rates and minimum acceptable return rates.

Average profit margin model smelters not having fully depreciated plants should be able to absorb the costs associated with the 94% or 95% efficiency system and remain open under most conditions. However, with a 94% efficiency system, this model smelter will close if the marginal tax rates and minimum acceptable return rates are reasonably high. With a 95% efficiency system, this model smelter will close if the minimum acceptable return rate is reasonably high and the marginal tax rate is within a range thought to be reasonable.

Low profit margin model smelters regardless of the depreciation circumstances and average profit margin model smelters that are fully depreciated would probably close rather than absorb the cost of a 94% or 95% efficiency system.

2.3 PRIMARY COPPER SMELTING

2.3.1 Industry Structure

Eight companies with a combined total of 16 smelters make up the U.S. primary copper smelting industry. Table 2-4 lists the companies, plants, their locations, and capacities.

Smelting is an intermediate production process preceeding refining and fabrication and following mining, ore beneficiation, and/or scrap collection. Consequently, the demand for smelted copper is derived from the demand for refined and fabricated copper. Refined and fabricated copper is used primarily by the construction, communications, and motor vehicle manufacturing industries. Substitutes for refined and fabricated copper do exist. They include aluminum, steel, and plastic.

Smelted copper can be supplied by secondary or primary producers either located in the U.S. or elsewhere. Foreign producers supplied about 10% of the 1974 U.S. demand for copper.[11] Domestic producers on the other hand used about 4% of the 1974 production to satisfy foreign demand for copper.[12] Of the domestic production used to satisfy domestic demand in 1974, about 45% was supplied by domestic secondary producers with the remaining 55% being supplied by primary producers.

Historical prices for domestic producers refined copper are presented in Table 2-5.

The demand for domestic primary smelting output is projected to grow at 3% per year.[13] However, limited domestic smelter capacity could constrain this growth resulting in excess demand and upward price pressures for blister, refined, and fabricated copper. Given future excess demand and upward price

Table 2-4. PRIMARY COPPER SMELTERS

Company	Smelter Location	1974 Smelter Capacity Furnace Charge (metric tons/yr)
The Anaconda Company	Anaconda, Montana	680,000
ASARCO	El Paso, Texas	523,000
	Hayden, Arizona	871,000
	Tacoma, Washington	544,000
Cities Service Corp.	Copper Hill, Tenn.	68,000
Copper Range	White Pine, Michigan	82,000[a]
Inspirational Consolidated Copper	Miami, Arizona	408,000
Kennecott Copper Corp.	Hayden, Arizona	381,000
	Hurley, New Mexico	363,000
	McGill, Nevado	363,000
	Garfield, Utah	907,000
Newmont Mining Corp.	San Manuel, Arizona	726,000
Phelps Dodge	Ajo, Arizona	227,000
	Douglas, Arizona	635,000
	Morenci, Arizona	816,000
	Hildago, New Mexico	91,000

[a]Measured as copper product.

Source: Background Information for New Source Performance Standards: Primary Copper, Zinc, and Lead Smelters - Volume I - Proposed Standards. U.S. EPA, Document No1 EPA-450/2-74-002a, October 1974, p. 6-3. Also ADL estimates for the EPA-MBO Study, forthcoming 1977.

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Table 2-5. COPPER PRICES
(average annual price, cents per kilogram)

Year	F.O.B. Domestic Primary Producer Refined Price[a]
1964	70.5
1965	77.2
1966	79.8
1967	84.2
1968	92.2
1969	104.7
1970	127.2
1971	113.3
1972	111.6
1973	129.9
1974	168.9
1975	140.0
1976	151.7

[a]Source: Metals Week

pressures, domestic smelters will probably find it better to push forward any increases in production cost. The alternative, pushing the costs back to the ore and matte suppliers, could spell the loss of critical raw materials from marginal ore and matte suppliers. However, if only one domestic smelter is faced with production cost increases, it may find it difficult to pass them forward because of dependence on other domestic smelters following its lead. Passing production costs forward becomes much more plausible, however, if all or several domestic smelters incur similar production cost increases.

2.3.2 Model Plant Specifications and Dispersion Modeling Results

As mentioned in the primary and secondary lead smelting assessments, the requirements of the dispersion model affect the specifications of the model plant. Terrain and meteorological conditions are the two major influences. In essence, the model plant should be located in flat terrain with nearby meteorological condition data available. Furthermore, to be typical, the size and location of the model plant should correspond to an actual plant.

The model smelter is located in flat terrain, has Tucson, Arizona meteorological conditions, and has furnace charge capacity of 635,000 metric tons per year. These specifications do correspond to an actual plant. Moreover, some of the other existing smelters do have similar characteristics. For example, 5 of the 16 are located in flat terrain and 6 have meteorological conditions similar to Tucson, Arizona.

The charge rate of the model smelter is high when compared to the industry average of 500,000 metric tons per year. However, no existing smelters of that charge rate are located in flat terrain with nearby meteorological condition data available. Consequently, the model smelter size was not scaled up to the industry average.

Other model plant specifications include the process equipment. These specifications are for an actual plant with the aforementioned terrain, meteorology, and size characteristics. The model plant has a reverberatory smelting furnace, Pierce-Smith converters, and multiple hearth roasters. Of the 16 existing smelters, 12 have reverberatory smelting furnaces and 15 have Pierce-Smith converters. However, only four have multiple hearth roasters. The others have either fluidized-bed roasters or no roasters at all. The effect of process equipment variations among smelters on ambient air quality is presently unknown.

The model smelter is assumed to have both stack and fugitive emissions of lead particulate. Stack emissions are assumed controlled to average SIP particulate allowable process weight rates. The fugitive emissions are assumed uncontrolled and to emanate from the roaster, reverberatory furnace, and converter buildings.

Stack emissions have a negligible predicted impact on ambient lead concentrations. Moreover, higher emission rates within a range thought to be reasonable do not change this finding. Fugitive emissions do have a noticeable predicted ambient impact. However, fugitive emission estimates are dependent on the percent lead content of the materials handled. This

percentage varies among smelters. The fugitive emission estimates felt to be most typical of a middle estimate result in a predicted maximum ambient concentration of 3.1 $\mu g/m^3$, monthly average. The fugitive emission estimates felt to represent a reasonable lower limit on the percent lead content yield a predicted maximum ambient concentration of 0.4 $\mu g/m^3$, and, estimates for a reasonable higher limit result in a maximum predicted concentration of 10.7 $\mu g/m^3$, monthly average.

2.3.3 Control Costs

2.3.3.1 Model Plant

As indicated above, the monthly maximum predicted ambient concentration for the middle and reasonable higher limit fugitive emission estimates exceed the alternative ambient standards (2.0, 1.5, and 1.0 $\mu g/m^3$) at the model smelter. Consequently, control costs corresponding to reduced fugitive emission rates which will achieve the alternative ambient standards are developed. These costs are specifically designed to approximate the least cost means of achieving each standard. No costs are developed for the reasonable lower limit fugitive emission estimates since the predicted maximum concentration in that case is less than all considered alternative standards.

The investment, annualized control cost, and investment and annualized cost as a percent of annual revenue for the model smelter are presented in Table 2-6. The middle fugitive emission estimates investment costs range from $5.2 million for the 2.0 $\mu g/m^3$ standard to $9.8 million for the 1.0 ug/m^3 standard. The corresponding annualized costs range from $1.1 million to $2.1 million. With the reasonable higher limit fugitive emission estimates,

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Table 2-6. CONTROL COSTS FOR THE MODEL PRIMARY SMELTER

	Maximum Predicted Ambient Levels ($\mu g/m^3$ monthly average)		
	2.0	1.5	1.0
Reasonable Higher Limit Fugitive Emission Rates			
Investment			
000's of $'s	22,300	28,900	35,400
as a % of annual revenue	15.2	19.7	24.2
Annualized Cost			
000's of $'s	4,800	6,200	7,600
as a % of annual revenue	3.3	4.3	5.2
Middle Fugitive Emission Rates			
Investment			
000's of $'s	5,200	7,600	9,800
as a % of annual revenue	3.5	5.2	6.7
Annualized Cost			
000's of $'s	1,100	1,600	2,100
as a % of annual revenue	0.8	1.1	1.4
Reasonable Lower Limit Fugitive Emission Rates	0*	0*	0*

*Investment and annualized costs are zero since the maximum predicted concentration is less than all considered alternative ambient standards.

corresponding investment costs range from $22.3 million to $35.4 million.
The annualized cost range from $4.8 million to $7.6 million.

2.3.3.2 Industry

A critical factor in drawing inferences from the model plant assessment and applying them to the entire industry is the amount of control required. To determine the amount of control required necessitates categorizing existing smelters as indicative of the middle, reasonable lower, or reasonable higher limit fugitive emission estimates. On the basis of the estimated amount of lead in the furnace charge at full capacity, three existing smelters are believed to be indicative of the middle fugitive emission estimate; seven are indicative of reasonable lower limit fugitive emission estimate; and six are indicative of the higher limit fugitive emission estimate. To draw further inferences is tenuous. However, if it is assumed that production is proportional to the number of smelters in each category and the model smelter costs can be extrapolated linearly to higher production volumes, industry control cost estimates can be developed. The investment costs for the year 1982 are $184.4 million for a standard of 2.0 $\mu g/m^3$, $241.8 million for a standard of 1.5 $\mu g/m^3$, and $298.7 million for a standard of 1.0 $\mu g/m^3$. The corresponding annualized costs are $40.0 million, $52.3 million, and $64.4 million.

2.3.4 Model Plant Closure Assessment

Using a discounted cash flow analysis technique and model plant process economics synthesized from publicly available company financial reports, the potential for closing the smelter on financial grounds is assessed. Given the reasonable lower limit fugitive emission estimates, the model plant should not close. With a maximum predicted concentration of 0.4 $\mu g/m^3$, no control

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expenditures are required. Given the middle fugitive emission estimate, the model smelter should not close even though control costs must be expended to achieve all alternative standards. This finding is true for a range of marginal tax rates and minimum acceptable return rates thought to be reasonable, full absorption of all control costs, and a fully depreciated model plant.

Given the reasonable higher limit fugitive emission estimates, the ability of the model smelter to remain open on financial grounds alone is unclear. However, the potential for remaining open is greater with a standard of 2.0 $\mu g/m^3$ than with either a standard of 1.5 or 1.0 $\mu g/m^3$. With a standard of 2.0 $\mu g/m^3$ certain marginal tax rate and minimum acceptable return rate combinations within a range thought to be reasonable do permit a fully depreciated plant absorbing all the control costs to remain economically viable. With the 1.5 or the 1.0 $\mu g/m^3$ standards, a fully depreciated plant absorbing all the control cost is not economically viable under any marginal tax rate and minimum acceptable return rate combinations judged to be reasonable.

2.4 GREY IRON FOUNDRY CASTING

2.4.1 Industry Structure

There are about a 1000 establishments classified as grey iron foundries.[14] Grey iron is produced at these foundries in cupola, electric, and reverberatory furnaces. The main output of the foundries is castings. These come in a variety of sizes and shapes having different chemical and physical properties.

The grey iron foundry industry produces intermediate goods. Castings become part of and/or are used in the production of automobiles and trucks, construction machinery, railway equipment, electrical and farm machinery, rolling mills, and machine tools. Consequently, the demand for grey iron is a function in part of the demand for these products. Demand for grey iron is projected to grow at 3.2% per year.[15]

Historically, the average price of grey iron castings has risen slightly faster than the Wholesale Price Index. However, what product that average price represents is not clear. The selling price for grey iron varies depending on the size, shape, and chemical and physical properties of the product. In 1976 the average price of a grey iron casting was $340/metric ton.[16]

2.4.2 Model Plant Specifications and Dispersion Modeling Results

The model foundry specifications are consistent with the assumptions and data requirements of the dispersion model. For example, the model grey iron foundry is located in flat terrain with representative meteorological condition data available. The model foundry specifications are also consistent with the objective of modeling a realistic situation. For example, like 60% of the grey iron foundry establishments, the model smelter is located in an east north central state.[17] Moreover, like 70%

of the grey iron produced nationally, the model foundry produces grey iron in a cupola furnace.[18] In addition, the size of the model foundry, 7.3 metric tons/hour melt rate, corresponds to an actual foundry located in flat terrain in an East North Central State.

The model smelter has lead particulate stack emissions controlled to average SIP process weight rates for particulate. Stack emissions have a negligible impact on the maximum predicted ambient concentrations. Fugitive emissions are assumed for the model grey iron foundry. These emissions are assumed uncontrolled. For a low fugitive emission rate estimate, the maximum predicted concentration is 0.3 $\mu g/m^3$, monthly average. For a midpoint fugitive emission rate estimate, the maximum predicted concentration is 1.8 $\mu g/m^3$. And, for a high fugitive emission rate estimate, the maximum predicted concentration is 3.7 $\mu g/m^3$, monthly average.

2.4.3 Control Cost

No control costs need to be developed for the low fugitive emission rate estimate since the predicted monthly average maximum concentration of 0.3 $\mu g/m^3$ is less than any of the alternative standards (i.e., 2.0, 1.5, and 1.0 $\mu g/m^3$). For the midpoint fugitive emission rate estimate control costs are developed for the 1.5 and 1.0 $\mu g/m^3$ alternatives since the predicted maximum (1.8 $\mu g/m^3$) is greater than these levels. However, no control costs are developed for the 2.0 $\mu g/m^3$ alternative since the predicted maximum is less. For the high estimate, since the predicted monthly average maximum of 3.7 $\mu g/m^3$ is greater than the three considered alternative standards, control costs are developed for all three standards.

The investment, annualized costs, and investment and annualized costs as a percent of annual revenue are presented in Table 2-7. The control system costed is side draft and canopy hoods which are ducted to a fabric filter. For the midpoint fugitive emission rate estimate, investment cost as a percent of annual revenue is 9.8% for both the 1.5 and 1.0 $\mu g/m^3$ standards. Annualized cost as a percent of annual revenue for both standards is 2.0%. The reason the costs do not vary between the 1.5 and 1.0 $\mu g/m^3$ standards is that the control system costed is assumed incapable of distinguishing between the required control efficiencies needed to attain both standards.

For the high fugitive emission rate estimate, the required control efficiencies for the 1.5 and 1.0 $\mu g/m^3$ standard are greater than for the midpoint fugitive estimate. These greater efficiencies are assumed reflected in different control system design and operating needs, and hence in the cost. Investment cost as a percent of annual revenue ranges from 9.8% for the 2.0 $\mu g/m^3$ standard to 30.4% for the 1.0 $\mu g/m^3$ standard. Corresponding annualized cost as a percent of annual revenue ranges from 2.0% to 6.2%.

2.4.4 Model Plant Closure Assessment

The baseline process economics for the grey iron foundry model plant are developed using financial data contained in Leo Troy's 1977 Almanac of Business and Industrial Financial Ratios.

Assuming zero background concentrations of lead and no other lead emitters in the area, the model grey iron foundry with low or midpoint fugitive emission rates should remain open regardless of the level of the standard. For the model with low fugitive emission rates, no control costs need be expended since all alternative standards are predicted to be achieved.

Table 2-7. CONTROL COST FOR THE MODEL GREY IRON FOUNDRY PLANT

	Maximum Predicted Ambient Levels ($\mu g/m^3$ monthly average)		
	2.0	1.5	1.0
High Fugitive Emission Rates			
Investment			
000's of $'s	300	600	1100
as a % of annual revenue	9.8%	18.4%	30.4%
Annualized Cost			
000's of $'s	70	130	220
as a % of annual revenue	2.0%	3.8%	6.2%
Midpoint Fugitive Emission Rates			
Investment			
000's of $'s	0*	300	300
as a % of annual revenue		9.8%	9.8%
Annualized Cost			
000's of $'s	0	70	70
as a % of annual revenue	0	2.0%	2.0%
Low Fugitive Emission Rates	0*	0*	0*

*Investment and annualized costs are zero since the maximum predicted concentration is less than all considered alternative ambient standards.

Hence, it is clear that the model foundry should remain open. For the model with midpoint fugitive emission rates, no control cost expenditures are required for the 2.0 $\mu g/m^3$ standard. However, the model foundry must expend control costs to achieve the 1.5 $\mu g/m^3$ and 1.0 $\mu g/m^3$ standards. Given that these costs must be absorbed, the model foundry is fully depreciated and the foundry faces a reasonable range of marginal tax and minimum acceptable return rates; it should remain open on financial grounds.

The model foundry with high fugitive emission rates requires control expenditures for all alternative standards. For the 2.0 and 1.5 $\mu g/m^3$ standard, the model foundry should remain open on financial grounds given the cost absorption, depreciation, and marginal tax and return rate conditions mentioned previously. However, with the 1.0 $\mu g/m^3$ standard, a fully depreciated foundry absorbing the control costs should close for most marginal tax rate and minimum acceptable return rates within a range thought to be reasonable. Only with marginal tax and minimum acceptable return rates at the low end of the reasonable range will a fully depreciated model foundry absorb the control costs needed to meet a 1.0 $\mu g/m^3$ standard and remain open on financial grounds.

2.5 GASOLINE LEAD ADDITIVES MANUFACTURING

2.5.1 Industry Structure

Four companies with a combined total of six plants comprise the U.S. gasoline additives (lead alkyl) industry. Table 2-8 lists the companies, their plants, capacities, and locations. Present annual capacity is 403 million kilograms of tetraethyl lead (TEL) equivalent. Annual production in 1974 was about 318 million kilograms of TEL equivalent or about 80% of capacity.[19]

Gasoline lead additives are mixed with gasoline to raise the Octane Number and consequently, reduce engine knock. Low production cost and high effectiveness in raising the Octane Number resulted in widespread use of lead additives with little competition from other compounds.

However, EPA's lead phasedown regulations will result in the development and acceptance of other compounds and hence, slow down future domestic production and consumption of gasoline lead additives.[20] Although most analysts agree the future U.S. production of lead additives will be less than it is today, the exact decline in future production is unknown. Industry representatives are optimistic with regard to export possibilities even though domestic consumption will decline.[21] However, others feel the export market growth may not materialize if foreign countries also adopt lead phasedown regulations.

Even with a production decline, given tight energy supplies and projected increases in the demand for gasoline, future lead additives prices should not decline. In 1976, pure TEL sold for about 223.3¢/kilogram. Prices of pure TEL for recent years are presented in Table 2-9.

Table 2-8. U.S. GASOLINE ADDITIVE (Lead Alkyl) MANUFACTURING PLANTS

Company	Plant(s) Location(s)	1974 Capacity (millions of Kg Tetraethyl Lead)
E.I. duPont de Nemours & Company, Inc.	Antioch, California Deepwater, New Jersey	154
Ethyl Corporation	Baton Rouge, Louisiana Pasadena, Texas	177
PPG Industries, Inc.	Beaumont, Texas	54
Nalco Chemical Company	Freeport, Texas	18
		403

Source: Chemical Economics Handbook p. 671.5042 C, December, 1975.

Table 2-9.   PRICES OF 100% PURE TETRAETHYL LEAD (TEL) IN TEL MOTOR ANTIKNOCK
(¢/Kg)

1964	124.6
1965	127.9
1966	126.3
1967	125.0
1968	124.1
1969	127.4
1970	128.5
1971	133.6
1972	135.4
1973	137.3
1974	157.6
1975	200.0
1976	223.3

Source: Chemical Economics Handbook, "Tetraethyl Lead and Tetramethyl Lead", Stanford Research
Institute, p. 671.5042 R, December 1975, and DuPont, 1976. Antiknock mix prices were
multiplied by 1.626 assuming 1.626 pounds of antiknock per pound of pure TEL.

2.5.2 Model Plant Specifications and Dispersion Modeling Results

Of the six gasoline lead additives plants, all are located in flat terrain, 74% of their combined capacity produces tetraethyl lead (TEL) using the sodium-lead alloy process, three are located in Southeast Texas, and the average capacity of each plant is 67,000 metric tons of TEL equivalent. The model plant used in the dispersion modeling is located in flat terrain, produces TEL using the sodium-lead alloy process, has Houston, Texas meteorological conditions, and produces about 54 thousand metric tons of TEL annually.

The model plant is assumed to have lead stack emissions in both the particulate and vapor phases. The lead recovery furnace stack emits lead in the particulate phase and is controlled to the average SIP allowable process weight rate. The process vents and sludge pit exhaust stacks emit lead in the vapor phase and are uncontrolled. No fugitive emissions are assumed. The maximum predicted concentration for the lead stack emissions is 15.7 $\mu g/m^3$, monthly average.

2.5.3 Control Costs

2.5.3.1 Model Plant

Since 15.7 $\mu g/m^3$ is greater than all the considered standards, control costs indicative of reduced stack emission rates are developed for all the considered standards. The costed control system includes packed scrubbers and increased pressure drop on an existing venturi scrubber. The model plant investment, annualized control cost, and investment and annualized cost as a percent of annual revenue are presented

in Table 2-10. Investment control costs for the model plant range from $519 thousand for meeting the 2.0 $\mu g/m^3$ standard to $521 thousand for meeting the 1.0 $\mu g/m^3$ standard. Annualized control cost as a percent of product sales price is about 0.2% for the three considered standards.

2.5.3.2 Industry

A critical factor in the model plant impact assessment is the required reduction in the baseline emission rates to achieve the alternative ambient standards. The required reduction could be greater for larger TEL plants or for TEL plants clustered among other lead emitters. However, to the extent that the required reductions at the six existing gasoline lead additive plants are similar to those at the model plant, achievement of all three alternative ambient standards would appear to be technically possible by all plants. Furthermore, if model plant control costs are related linearly to 1974 production, the estimated 1982 total industry investment costs in this industry are $3.03, $3.03, and $3.05 million for the 2.0, 1.5 and 1.0 $\mu g/m^3$ standards, respectively. The corresponding annualized costs are $1.57, $1.57, and $1.58 million.

2.5.4 Model Plant Closure Assessment

Using a discounted cash flow analysis technique, synthesized model plant process economics, the aforementioned control costs, and assuming no other lead emitters in the vicinity, the potential for closing the model plant on financial grounds is assessed. The model plant process economics are a composite of published financial data for the U.S. gasoline lead additives producers. The major finding of the closure assessment is that the model gasoline lead additives plant is better off remaining open and complying with reduced stack emission rates necessary

Table 2-10. CONTROL COSTS FOR THE MODEL GASOLINE
LEAD ADDITIVES PLANT

	Maximum Predicted Ambient Levels (μg/m^3 , monthly average)		
	2.0	1.5	1.0
Investment			
000's of $'s	519	519	521
as a % of annual revenue	0.4%	0.4%	0.4%
Annualized Control Cost			
000's of $'s	270	270	271
as a % of annual revenue	0.2%	0.2%	0.2%

to achieve all standards under a variety of circumstances. These include all marginal tax rate and minimum acceptable return rates thought to be reasonable, fully depreciated plant, sustained production decline (25%), an increase in the raw material lead price (as a result of the lead ambient air quality standard, i.e., 1.8%), and full absorption of all control costs.

2.6 LEAD-ACID BATTERY MANUFACTURING

2.6.1 Industry Structure

Currently there are about 200 lead acid battery manufacturing plants in the United States ranging in size from about 50 to about 11,500 batteries per day.

Two major types of lead acid storage batteries are manufactured in the United States. Starting-Lighting-Ignition (SLI) batteries which are used in auto, aircraft, and golf carts are one type. The units account for more than 80 percent of the market.[22] The second type includes industrial storage batteries for such uses as low-voltage power systems and industrial forklift trucks.

The market for lead-acid storage is composed of three segments. The largest segment in terms of sales is the domestic replacement market. This includes replacement batteries for automobiles, trucks, buses, farm machinery, and heavy equipment. The original domestic equipment market is the second largest segment. This includes batteries sold to producers of new vehicles and equipment. The export sector is the smallest market. This includes replacement batteries in existing equipment and batteries for new equipment. The overall demand for batteries in these market segments is expected to grow between 3.5% and 8.2% per year.[23]

Prices for automobile SLI batteries are about $16 to $22 f.o.b. plant and about $35 to $50 retail.[24] Prices for industrial storage batteries range from $200 to $11,500.[25] Because batteries represent such a small percentage of vehicle costs and appear to have few close

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substitutes, demand is thought to be price inelastic. However, the replacement demand market segment for batteries is thought to be less price inelastic than the new demand segment since useful battery life can be extended by improved maintenance, servicing, and repair.

2.6.2 Model Plant Specifications and Dispersion Modeling Results

Two model lead acid battery plants are used in the dispersion modeling. One is capable of producing 500 batteries per day; the other is capable of producing 6500 batteries per day. These two plant sizes are thought to bound the reasonable range of actual industry plant sizes. Consistent with the dispersion model, both plants are located in flat terrain with area meteorological condition data available. This situation is not atypical since there is an actual battery plant with similar terrain and meteorological features.

None of the model lead acid battery plants are assumed to have fugitive emissions. All emissions emanate from point sources. These point sources are controlled to average SIP allowable process weight rates. The maximum predicted concentration for the 500 battery per day plant is 0.9 $\mu g/m^3$, monthly average. The maximum predicted concentration for a 6500 battery per day plant is 7.6 $\mu g/m^3$, monthly average.

2.6.3 Control Cost

Since the maximum predicted concentration for the model 500 battery per day plant does not exceed any of the considered standards, no control costs are developed for that model plant. Control costs are developed for the model 6500 battery per day plant since the maximum predicted concentration

(7.6 $\mu g/m^3$) does exceed the considered standards of 2.0, 1.5, and 1.0 $\mu g/m^3$.

The only point source requiring control is the three process operation stack. Required control efficiencies for this source are about 75 percent, 81 percent, and 88 percent for the respective standards of 2.0, 1.5, and 1.0 $\mu g/m^3$. A wet impingement scrubber is assumed to achieve those control efficiencies at least cost. The investment cost is not assumed to vary with the required control efficiency and is estimated at $130 thousand. Operating costs are, however, assumed affected to some degree by the required control efficiency. Respective annualized costs for meeting 2.0, 1.5, and 1.0 standards are $57,000, $57,400, and $57,900. Annualized cost as a percent of annual revenue (assumes price per battery of $18.50) is about 0.1% for each of three standards.

2.6.4 Model Plant Closure Assessment

A low profit margin fully depreciated model 6500 battery per day plant should be able to absorb the control costs associated with any of the standards and still remain open. This finding holds for a range of marginal tax rates and minimum acceptable return rates thought to be reasonable. It also holds given the assumptions that raw material lead prices increase as a result of the lead ambient air quality standard and that this cost increase (1.8 percent) is absorbed.

Process economics were developed using published financial data for Gould, Inc. and Northwest Industries, Inc.'s General Battery Division.

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3.0 OTHER AFFECTED SECTORS

3.1 MOBILE SOURCE ASSESSMENT

Several assumptions are used to project mobile source impact. These include phasedown of lead in the gasoline pool, improved fuel economy, and retirement of some older leaded gasoline using vehicles. For an ambient standard of 2.0 $\mu g/m^3$, one Air Quality Control Region (AQCR) is predicted to require mobile source emission control in 1982. For an ambient standard of 1.5, the number predicted is two AQCRs. And, for an ambient standard of 1.0, it is four AQCRs.

Vehicles using leaded gasoline are retired as they get older, and often these vehicles are replaced with newer cars using unleaded gasoline. Hence, the number of AQCRs requiring mobile source emission control might be less in for example 1985 than in 1982. In 1985, the number of AQCRs requiring mobile source emission control is predicted to be one for the 2.0 and 1.5 $\mu g/m^3$ standards, and two for the 1.0 $\mu g/m^3$ standard.

To achieve the alternative ambient standards in 1982 by retrofitting existing leaded gasoline using light duty vehicles with 75% efficient lead trap mufflers (if available) could affect the following number of vehicles. For the 2.0 $\mu g/m^3$ standard, the predicted number is 58,000. For the 1.5 $\mu g/m^3$ standard, the predicted number is 106,500. And, for 1.0 $\mu g/m^3$ standard the predicted number of light duty vehicles affected is 1,300,000.

Of course retrofitting lead trap mufflers is not the only means of controlling mobile source lead emissions. Reduction in vehicle miles traveled (VMT) and further reduction in the lead content of gasoline are alternatives. VMT reductions can be achieved many ways including

carpooling, mass transit, and reduced trips. Further reduction in the lead content of gasoline can also be achieved in many ways including using non-lead gasoline additives and increasing the reforming capacity of the refineries. Costs for these many ways to achieve alternatives to retrofitting lead trap mufflers have not been developed. Consequently, relative cost effectiveness of retrofitted lead traps is not known.

3.2 STATE AND LOCAL AIR POLLUTION CONTROL AGENCY ASSESSMENT

Currently there are 55 state and 235 local air pollution control
agencies. Annually they spend approximately 7100 man-years of effort and
$157 million dollars implementing air pollution control regulations.

An ambient lead standard can impose additional requirements (costs)
on State and local air pollution control agencies to administer the
standard. The added requirements could take the form of more data gathering,
enforcement, monitoring, laboratory, support, and management activities.
The previously described stationary and mobile source assessments are
the bases for estimating these added requirements. To the extent that
these bases understate the magnitude of the problem (for example the
number of source inspections) the added requirements for State and local
control agencies are also understated. But, even if the stationary and
mobile source assessments do not understate the magnitude of the problem,
control agency requirements could be understated for another reason.
The estimates of additional state and local control agency costs do not
include the requirements for developing completely new fugitive emissions
inventories. However, the estimates do include the requirements for
additional maintenance and update of existing inventories.

Some requirements (costs) are estimated to be incurred in the first year
only while others are on-going. First year requirements include the costs
for ambient monitors and laboratory equipment such as hi-vols and spectro-
photometers. In addition, there is non-recurring labor for activities
such as State implementation plan development and site preparation for monitors.

No enforcement is assumed to take place during the first year while strategy and regulations are being developed. Also, in the first year monitoring and laboratory activities are limited while equipment is being installed. The first year requirements in dollar terms range from $1.0 million with a standard of 2.0 $\mu g/m^3$, monthly average to $1.7 million with a standard of 1.0 $\mu g/m^3$. The relative magnitudes of these costs compared to current expenditures are 0.6% and 1.0%. In terms of people, the corresponding first year requirements are 30 man-years and 40 man-years. Compared to current man-years expenditures, these correspond to 0.4% and 0.6%, respectively.

On-going or annual costs include operating costs but not depreciation or interest. Examples of operating costs are maintenance, supplies, and power for ambient monitors and laboratory equipment. Operating costs also include a labor component. For example, there are the on-going labor-using activities of mobile and stationary source inspection and enforcement. On-going costs range from $1.4 million with a standard of 2.0 $\mu g/m^3$ to $2.8 million with a standard of 1.0 $\mu g/m^3$. The relative magnitude of these costs are 0.9% and 1.8%. The corresponding man-year requirements are 60 and 120. Compared to current man-year expenditures these correspond to 0.9% and 1.7%, respectively.

First year and on-going costs for the 3 considered standards are presented in Table 3-1.

Table 3-1.   STATE AND LOCAL AIR POLLUTION CONTROL
AGENCY STANDARDS ADMINISTRATION COST

	Alternative Ambient Standards ($\mu g/m^3$, monthly average)		
	2.0	1.5	1.0
First Year Cost			
000's of $'s	1000	1400	1700
$ Expenditures as a % of current expenditures	.6%	.9%	1.0%
Man-year requirements	30	40	40
Man-year requirements as a % of current expenditures	0.4%	0.6%	0.6%
On-Going (Annual Costs)			
000's of $'s	1400	2300	2800
$ Expenditures as a % of current expenditures	0.9%	1.5%	1.8%
Man-year requirements	60	100	120
Man-year requirements as a % of current expenditures	0.9%	1.4%	1.7%

References

1. PEDCo-Environmental Specialists, Inc., Draft Document prepared for the U.S. Environmental Protection Agency, <u>Control Techniques For Lead Air Emissions</u>, April, 1977, p. xix.

2. <u>Ibid.</u>, p. xix.

3. Mitre Corporation/Metrek Division and Office of Air Quality Planning and Standards, U.S. Environmental Protection Agency, Draft <u>Environmental Impact Statement for the National Ambient Air Quality Standard for Lead</u>, November, 1977, Chapter 2.

4. <u>Ibid.</u>, and background information in support of the aforementioned document.

5. Bureau of the Mines, U.S. Department of the Interior, <u>Commodity Data Summaries</u>: 1977, p. 91.

6. John Short and Associates, Inc., "Preliminary Technological Feasibility, Cost of Compliance and Economic Impact Analysis of the Proposed OSHA Standard for Lead", prepared for U.S. Department of Labor under Contract No. J-9-F-6-004, 1/77, p. 34. See also Charles River Associates, <u>Economic Analysis of the Lead-Zinc Industry</u>, prepared under contract for the U.S. General Services Administration, revised April, 1969, p. 15.

7. Office of Air Quality Planning and Standards, U.S. Environmental Protection Agency, <u>Users Manual for the Single Source (CRSTER) Model</u>, EPA-450/2-77-013, July, 1977.

8. Bureau of the Mines, U.S. Department of Interior, <u>Mineral Yearbook - 1974</u>, p. 731.

9. Federal Trade Commission, <u>Docket #8959, 4/20/76</u>.

10. <u>Ibid.</u>

11. Stanford Research Institute, <u>Chemical Economics Handbook: Copper</u>, February 1976, p. 736.1000C.

12. <u>Ibid.</u> p. 736.1000B.

13. Office of Air Quality Planning and Standards, U.S. Environmental Protection Agency, <u>Background Information for New Source Performance Standards: Primary Copper, Zinc, and Lead Smelters, Volume I: Proposed Standards</u>, EPA-450/2-74-002a, October, 1974, p. 6-14.

14. Bureau of the Census, U.S. Department of Commerce, <u>1972 Census of Manufacturers</u>, p. 33-B-6.

15. U.S. Department of Commerce, 1977 U.S. Industrial Outlook, p. 82.

16. Office of Air Quality Planning and Standards, U.S. Environmental Protection Agency, Standards Support and Environmental Impact Statement: An Investigation of the Best Systems of Emission Reduction for Electric Arc Furnaces in the Grey Iron Foundry Industry, October, 1976, p. 8-32.

17. Bureau of the Census, U.S. Department of Commerce, op. cit., p. 33-B-6.

18. PEDCo-Environmental Specialists, Inc., op. cit., p. 4-166.

19. U.S. International Trade Commission, Synthetic Organic Chemicals, U.S. Production and Sales. Also, Stanford Research Institute, Chemical Economics Handbook: Lead Alkyls, December, 1975, p. 6715042E.

20. Federal Register, December 6, 1973, 38 (234) 40CFR80: 33734-33741.

21. Stanford Research Institute, op. cit., pp. 6715042R-S.

22. Barkand, R. A. A Report by the Battery Council International Statistical Committee. Replacement Battery; Industry Forecast 1975-1979. Globe Union, Inc. Milwaukee, Wisconsin, p. 1.

23. Office of Air Quality Planning and Standards, U.S. Environmental Protection Agency, Draft Standards Support and Environmental Impact Statement: Control of Emissions from the Manufacture of Lead-Acid Storage Batteries, September, 1977, p. 3-9 and p. 8-16.

24. Compiled from Company responses to U.S. Environmental Protection Agency inquiry regarding product prices. The inquiry was issued under Section 114 of the Clean Air Act as Amended, 1970.

25. Conversation between the staff of JACA Corporation and two battery companies: Illinois Battery on September 8, 1977, and Moore Battery Company on September 14, 1977.

TAB K- Proposed Equivalency Regulations (Signature item)

ENVIRONMENTAL PROTECTION AGENCY

[40 CFR Parts 51 and 53]

AMBIENT AIR MONITORING REFERENCE AND

EQUIVALENT METHODS FOR LEAD

Notice of Proposed Rulemaking

AGENCY: Environmental Protection Agency (EPA)

ACTION: Proposed rulemaking

SUMMARY: On December 14, 1977, new national primary and secon-

dary ambient air quality standards for lead were proposed (42FR

63076).   Atmospheric lead is proposed to be measured as elemental

lead, either by the proposed reference method or "by an equiva-

lent method."   The amendments proposed below would provide the

necessary and appropriate changes in the existing equivalent

method regulations (primarily contained in 40 CFR Part 53) to

allow the designation of equivalent methods for measuring atmos-

pheric lead concentrations.

DATES: Comments relative to these proposed regulations must be

received by [45 days after publication in the Federal Register].

ADDRESS: Send comments to: Mr. Larry J. Purdue
                             Department E (MD-76)
                             Environmental Monitoring and Support
                               Laboratory

U.S. Environmental Protection
Agency
Research Triangle Park, N.C. 27711

FOR FURTHER INFORMATION CONTACT: Mr. Larry Purdue, Telephone

919/541-3076 (FTS 629-3076).

INCIDENTAL INFORMATION: The proposed reference method for mea-

suring atmospheric lead, as well as much associated information,

was published in the December 14, 1977 issue of the Federal

Register (Volume 42), starting on page 63076.

SUPPLEMENTARY INFORMATION:

Background

When the first National Ambient Air Quality Standards were

promulgated in 1971 (36 FR 8186, April 30, 1971), EPA established

the concept that measurements of ambient air pollutants used to

determine compliance with the standards must be made with either

a specified "reference method" or with an alternate method which

could be shown to be "equivalent" to the reference method. The

air quality standards are now contained in Part 50 of Title 40 of

the Code of Federal Regulations (40 CFR Part 50). Appendixes to

Part 50 specify either a prescribed reference method, or a measure-

ment principle and calibration procedure applicable to reference

methods, for each pollutant for which a standard has been promulgated.

On February 18, 1975, EPA promulgated regulations to establish definitive requirements and procedures by which methods for measuring specified air pollutants may be designated "reference methods" or "equivalent methods" (40 FR 7044, February 18, 1975). These regulations are contained in 40 CFR Part 53.   Originally these "equivalency" regulations were applicable only to methods for measuring SO_2, CO, and photochemical oxidants (O_3), but were subsequently amended to cover methods for NO_2 as well (41 FR 52692, December 1, 1976).

On December 14, 1977, EPA proposed amendments to 40 CFR Part 50 to establish new National Primary and Secondary Ambient Air Quality Standards for lead. Also proposed was a new appendix to Part 50 specifying a reference method for measuring atmospheric lead. The method proposed measures the lead content of suspended particulate matter collected on glass fiber filters using high volume samples. The lead is extracted from the particulate matter and measured by atomic absorption spectroscopy. The procedure proposed is necessarily very restrictive and specific in order to maintain the high level of accuracy and reproducibility and the low level of variability requisit for a reference method. However, other procedures are available for measuring lead which are likely to be as good as the reference method and may be advantageous to particular users. For example, using the same sampling procedure as the reference method (high volume sampler), several alternate analytical principles (flameless atomic absorption, optical emission spectrometry, and anodic stripping voltametry) are known to be suitable for lead analysis.

If these alternate procedures can be designated as "equivalent" methods, then users would have much more flexibility in selecting a method for lead measurements which fits their own circumstances of available equipment, personnel, and expertise.

Also, EPA sees no reason why lead measurements must be restricted to a particular sampling technique, such as the high volume sampler. For example, low volume particulate samples can be analyzed for lead by X-ray fluorescence. Other non-high volume techniques may also be available or under development. By allowing for the possibility of qualifying such alternate methods as equivalent methods, EPA hopes to permit and encourage continued advancement in the technology of measuring atmospheric lead.

For the reasons given above, EPA believes it is advantageous to propose appropriate amendments to 40 CFR Part 53 to extend the equivalent method regulations to cover methods for measuring lead in the atmosphere. Since most, if not all, candidate equivalent methods for lead are likely to be manual methods, EPA expects relatively little initial incentive for commercial organizations to apply for equivalent method determinations. Consequently, most equivalent method applications for lead methods will have to be originated by EPA under section 53.7 "Testing of methods at the Initiative of the Administrator." Specifically, EPA intends to pursue designation of some of the methods noted earlier, which are already in use among some monitoring agencies. These would include methods which use the same sampling procedure as the reference method, but use alternate analytical principles such as flameless atomic absorption, optical emission spectrometry, and

anodic stripping voltametry. Direct analysis of high volume
filters by X-ray fluorescence is also a likely candidate method
for early designation by EPA.

General Approach

As suggested above, any method which purports to measure
atmospheric lead could be considered as a candidate equivalent
method, regardless of the sampling procedure or analytical tech-
nique used. To be designated as an equivalent method, the candi-
date method must demonstrate a "consistent relationship" to the
reference method. This is done by taking simultaneous measure-
ments with both methods in accordance with the procedures and
requirements to be specified in 40 CFR Part 53. In addition, the
candidate method must also demonstrate adequate precision among
repeated analyses of the same sample.

Since the proposed reference method provides 24-hour inte-
grated measurements, candidate methods would have to be compared
on that basis. Shorter-term integrated methods or even automated
methods could be considered as candidate methods. But only 24-
hour averages could be compared to the reference method. There-
fore, any subsequent designation of such a method as an equivalent
method would apply only to 24-hour averages.

Amendments to 40 CFR Part 51

Paragraph (a) of section 51.17a provides general requirements

for air quality monitoring methods used by States in their Imple-
mentation Plan monitoring networks. Subparagraph (1) requires use
of reference or equivalent methods for SO_2, CO, O_3 and NO_2,
and would be amended to also include lead. Subparagraph (3)
provides certain "grandfather" periods for use of existing methods
for SO_2, CO, O_3 and NO_2. It would be amended by adding a similar
"grandfather" provision allowing existing methods for lead to be
used until February 18, 1980--the same expiration date as that for
existing methods for SO_2, CO, and O_3.

Amendments to Part 53

Subpart C of Part 53 contains the test procedures prescribed
for determining a consistent relationship between the reference
method and a candidate equivalent method. Since these test pro-
cedures were originally designed for gaseous pollutants, several
significant changes and additions are required to adapt the proce-
dures for lead.

Determination of Consistent Relationship

Section 53.30, paragraph (a) pertaining to the determination
of a consistent relationship would be changed to indicate that the
specifications for lead appear in a separate table (table C-3)
than the specifications for SO_2, CO, O_3 and NO_2.

Test Site

Section 53.30, paragraph (b), pertaining to test sites would be changed in several ways. First, the paragraph would be subdivided to differentiate the various requirements applicable to (1) all methods, (2) methods for gaseous pollutants, and (3) methods for lead. Multiple test sites would be allowed for lead methods in order to facilitate measurements in the required range, since pollutant augmentation would not be feasible for particulate methods. Also, a new provision would allow an applicant to request approval of the test site or sites from EPA prior to conducting the tests.

A final minor change proposed for paragraph (b) would delete the stipulation that test sites be "...away from large bodies of water...". This change has nothing to do with lead, but is prompted by general confusion among applicants as to its specific meaning. Since the requirement is not essential, the current revision of the paragraph provides a good opportunity to eliminate both the stipulation and the confusion.

Other General Provisions

Paragraphs (c), (d), and (e) of section 53.30 would also be revised and reorganized to reflect the differences in requirements for methods for gaseous pollutants and for lead particulates. Revised paragraph (c) specifies the general requirement for simultaneous measurements at the test site in each of the required

concentration ranges indicated by Tables C-1 or C-3. Paragraph (d) would be revised and subdivided to clarify the different requirements for sample collection. Subparagraph (1) indicates the general requirement for homogenous samples. Subparagraph (2) specifies the use of a common distribution manifold and allows artificial pollutant augmentation for gaseous pollutants. Subparagraph (3) specifies the relative location requirements for lead samplers. And paragraph (4) would specifically allow the use of a common sample when the candidate method uses a sampling procedure identical to that of the reference method. Finally, the present paragraph (d) on "Submission of Test Data..." would be changed to paragraph (e).

Test Conditions

In section 53.31 on "Test Conditions," paragraphs (a), (c), and (d) would be revised slightly to clarify certain differences between gaseous and particulate methods, and to clarify the requirements pertaining to calibration and range.

Test Procedures

Because the test procedures being proposed for lead differ considerably from those for gaseous pollutants, existing section 53.32 would be retitled "Test procedures for gaseous pollutants" and a new section 53.33, "Test procedures for lead," would be added. The proposed new section 53.33 is similar in form to

section 53.32, but the specific requirements for lead methods differ in several ways from the requirements for gaseous pollutant methods. First, a new Table C-3 summarizes the test specifications pertinent to methods for lead. Only one concentration range is specified, into which 5 or more of the measurements must fall. The difference specification for lead is specified as a per cent of the reference method measurement, as opposed to the fixed, absolute values specified for gaseous pollutant methods. An accuracy specification for the reference method based on analysis of audit samples supplied by EPA is specified. In addition, a performance specification for analytical precision is also being proposed to apply to lead methods.

Because most methods for lead provide a result only after collected samples are analyzed in a laboratory, the test acceptance criteria are based on a single sampling plan rather than the double sampling plan prescribed for gaseous pollutant methods. Ten or more (simultaneous) samples are collected and analyzed to provide at least 5 samples which fall into the required range of 0.5 to 4.0 $\mu g/m^3$. Each sample is analyzed 3 times and the results of all samples in the range are subjected to both the precision test prescribed in paragraph (e) and the consistent relationship test prescribed in paragraph (f). For the candidate method to qualify for designation, no test failures would be permitted in either test.

Public Participation

Interested persons are invited to comment on any aspect of

these proposed amendments. Comments should be submitted in dup-

licate and must be received by [45 days after publication in the

Federal Register]. Address comments to:

> Mr. Larry Purdue
> Department E (MD-76)
> Environmental Monitoring and Support Laboratory
> U.S. Environmental Protection Agency
> Research Triangle Park, North Carolina 27711

_____   _____

Date   Administrator

It is proposed to amend Chapter I, Title 40, Code of Federal

Regulations, as follows:

PART 51--REQUIREMENTS FOR PREPARATION, ADOPTION, AND SUBMITTAL

        OF IMPLEMENTATION PLANS

1.   In section 51.17a, paragraph (a) is revised to read as follows:

§51.17a Air quality monitoring methods.

(a) General requirements. (1) Except as otherwise provided

in this paragraph (a), each method for measuring SO_2, CO, O_3, NO_2,

or lead used for purposes of §51.17(a) shall be a reference method

or equivalent method as defined in §53.1 of this chapter. ***

(2) ***

(3) *** Any manual method for lead in use before [date of promulgation of these amendments] may be used for purposes of §51.17(a) until February 18, 1980.

PART 53--AMBIENT AIR MONITORING REFERENCE AND EQUIVALENT
        METHODS

2.   In section 53.30, paragraphs (a), (b), (c), (d), and (e) are revised to read as follows:

§53.30 <u>General Provisions</u>

(a)   *** A consistent relationship is shown for SO_2, CO, O_3 and NO_2 methods when the differences between (1) measurements made by a candidate manual method or by a test analyzer representative of a candidate automated method, and (2) measurements made simultaneously by a reference method are less than or equal to the value specified in the last column of Table C-1. A consistent relationship is shown for lead methods when the differences between (1) measurements made by a candidate method and (2) measurements made simultaneously by the reference method are less than or equal to the value specified in Table C-3.

(b)   <u>Selection of Test Sites</u>. (1) <u>All methods</u>. Each test site shall be in a predominantly urban area which can be shown to have at least moderate concentrations of various pollutants. The site shall be clearly identified and shall be justified as an

appropriate test site with suitable supporting evidence such as maps, population density data, vehicular traffic data, emission inventories, pollutant measurements from previous years, concurrent pollutant measurements and wind or weather data. If desired, a request for approval of the test site or sites may be submitted prior to conducting the tests. The Administrator may in his discretion select a different site (or sites) for any additional tests he decides to conduct.

(2) Methods for gaseous pollutants. All test measurements are to be made at the same test site. If necessary, the concentration of pollutant in the sampled ambient air may be augmented with artificially generated pollutant to facilitate measurements in the specified ranges. (See paragraph (d) (2) of this section.)

(3) Methods for lead. Test measurements may be made at any number of test sites. Augmentation of pollutant concentrations is not permitted, hence an appropriate test site or sites must be selected to provide lead concentrations in the specified range. Test sites for lead measurements must be between 5 and 100 meters from the edge of a heavily-traveled roadway.

(c) Test Atmosphere. Ambient air sampled at an appropriate test site shall be used for these tests. Simultaneous concentration measurements shall be made in each of the concentration ranges specified in Table C-1 or Table C-3.

(d) Sample Collection. (1) All methods. All test concen-tration measurements or samples shall be taken in such a way that both the candidate method and the reference method receive air samples that are homogenous or as nearly identical as practical.

(2) Methods for gaseous pollutants. Ambient air shall be sampled from a common intake and distribution manifold designed to deliver homogenous air samples to both methods. Precautions shall be taken in the design and construction of this manifold to minimize the removal of particulates and trace gases, and to insure that identical samples reach the two methods. If necessary, the concentration of pollutant in the sampled ambient air may be augmented with artificially generated pollutant. However, at all times the air sample measured by the candidate and reference methods under test shall consist of not less than 80 percent ambient air by volume. Schematic drawings, physical illustrations, descriptions, and complete details of the manifold system and the augmentation system (if used) shall be submitted.

(3) Methods for lead. The intake points of the candi-date and reference samplers for lead shall be located between 3 and 5 meters apart, and between 1.5 and 5 meters above ground level.

(4) Methods employing a common sampling procedure. Candidate methods which employ a sampler and sample collection procedure which are identical to the sampler and sample collection procedure specified in the reference method may be tested by ana-lyzing common samples in accordance with the candidate and refer-

ence analysis procedures. The common samples are to be collected according to the sample collection procedure specified by the reference method, and must be divided such that identical portions are analyzed by the analysis procedures of the two methods.

(e) <u>Submission of Test Data and Other Information</u>. All recorder charts, calibration data, records, test results, procedural descriptions and details, and other documentation obtained from (or pertinent to) these tests shall be identified, date, signed by the analyst performing the test, and submitted.

3. In section 53.31, paragrphs (a), (c), and (d) are revised to read as follows:

§53.31 <u>Test Conditions</u>.

(a) <u>All Methods</u>. All test measurements made or test samples collected by means of a sample manifold as specified in §53.30 (d) (2) shall be at a room temperature between 20° and 30°C, and at a line voltage between 105 and 125 volts. All methods shall be calibrated as specified in paragraph (c) of this section prior to initiation of the tests.

(b) ***

(c) <u>Calibration</u>. The reference method shall be calibrated

according to the appropriate appendix to Part 50 of this Chapter (if it is a manual method) or according to the applicable operation manual(s) (if it is an automated method). A candidate manual method (or portion thereof) shall be calibrated if such calibration is a part of the method. ***

(d) Range. (1) Except as provided in paragraph (d) (2) of this section, each method shall be operated in the range specified for the reference method in the appropriate appendix to Part 50 (for manual reference methods), or specified in Table B-1 of this part (for automated reference methods).

(2) ***

(e) ***

4. In section 53.32, the title of the section is revised to read as follows:

§53.32 Test procedures for gaseous pollutants.

* * * * * *

5. A new section is added to read as follows:

§53.33 Test procedure for lead methods.

(a) Sample collection. Collect simultaneous 24-hour samples

(filters) of lead at the test site or sites with both the reference and candidate methods until at least 10 filter pairs have been obtained. If the conditions of §53.30 (d)(4) apply, collect at least 10 common samples (filters) in accordance with §53.30 (d)(4) and divide each to form the filter pairs.

(b) Audit samples. Three audit samples must be obtained from the Director, Environmental Monitoring and Support Laboratory, Department E, United States Environmental Protection Agency, Research Triangle Park, N.C. 27711. The audit samples are 3/4 x 8 inch glass fiber strips containing known amounts of lead at the following nominal levels: 100 µg/strip; 300 µg/strip; 750 µg/strip. The true amount of lead in total µg/strip will be provided with each audit sample.

(c) Filter Analysis. (1) For both the reference method and the audit samples, analysis each filter extract 3 times in accordance with the reference method analytical procedure. The analysis of replicates should not be performed sequentially (i.e. any single sample should not be analyzed 3 times in sequence). Calculate the indicated lead concentrations for the reference method samples in $µg/m^3$ for each analysis of each filter. Calculate the indicated total lead amount for the audit samples in µg/strip for each analysis of each strip. Label these test results as R_{1A}, R_{1B}, R_{1C}, R_{2A}, R_{2B}, ..., Q_{1A}, Q_{1B}, Q_{1C}, ..., where R denotes results from the reference method samples; Q denotes results from the Audit samples; 1,2,3 indicates filter number and A,B,C indicates the first, second and 3rd analysis of each filter, respectively.

(2) For the candidate method samples, analyze each sample filter or filter extract 3 times and calculate, in accordance with the candidate method, the indicated lead concentration in $\mu g/m^3$ for each analysis of each filter. Label these test results as C_{1A}, C_{1B}, C_{2C}, ..., where C denotes results from the candidate method. (For candidate methods which provide a direct measurement of lead concentrations without a seperable procedure, $C_{1A} = C_{1B} = C_{1C}$, $C_{2A} = C_{2B} = C_{2C}$, etc.)

(d) For the reference method, calculate the average lead concentration for each filter by averaging the concentrations calculated from the 3 analyses:

$$R_{i \, ave} = \frac{R_{iA} + R_{iB} + R_{iC}}{3}$$, where i is the filter number.

(e) Disregard all filter pairs for which the lead concentration as determined in the previous paragraph (d) by the average of the 3 reference method determinations, falls outside the range of 0.5 to 4.0 $\mu g/m^3$. All remaining filter pairs must be subjected to both of the following tests for precision and consistent relationship. At least 5 filter pairs must be within the 0.5 to 4.0 $\mu g/m^3$ range for the tests to be valid.

(f) <u>Test for precision</u>. (1) Calculate the precision (P) of the analysis (in per cent) for each filter and for each method, as the maximum minus the minimum divided by the average of the 3 concentration values, as follows:

$$P_{Ri} = \frac{R_i \text{ max} - R_i \text{ min}}{R_i \text{ ave}} \times 100\%, \text{ or } P_{Ci} = \frac{C_i \text{ max} - C_i \text{ min}}{C_i \text{ ave}} \times 100\%,$$

where i indicates the filter number.

(2) If any reference method precision value (P_{Ri}) exceeds 15 per cent, the precision of the reference method analytical procedure is out of control. Corrective action must be taken to determine the source(s) of imprecision and the reference method determinations must be repeated according to paragraph (c) of this section, or the entire test procedure (starting with paragraph (a)) must be repeated.

(3) If any candidate method precision value (P_{Ci}) exceeds 15 per cent, the candidate method fails the precision test.

(4) The candidate method passes this test if all precision values (i.e. all P_{Ri}'s and all P_{Ci}'s) are less than 15 per cent.

(g) _Test for accuracy_. (1) For the audit samples calculate the average lead concentration for each strip by averaging the concentrations calculated from the 3 analysis:

$$Q_i \text{ ave} = \frac{Q_{iA} + Q_{iB} + Q_{iC}}{3},$$

where i is audit sample number.

Calculate the percent difference (D_q) between the indicated lead

concentration for each audit sample and the true lead concentration (T_q) as follows:

$$D_{qi} = \frac{Q_i \text{ ave } - T_{qi}}{T_{qi}} \times 100$$

(2) If any difference value (D_{qi}) exceeds ±5 percent the accuracy of the reference method analytical procedure is out of control. Corrective action must be taken to determine the source of the error(s) (e.g. calibration standard discrepancies, extraction problems, etc.) and the reference method and audit sample determinations must be repeated according to paragraph (c) of this section or the entire test procedure (starting with paragraph (a)) must be repeated.

(h) <u>Test for consistent relationship</u>. (1) For each filter pair, calculate all 9 possible percent differences (D) between the reference and candidate methods, using all 9 possible combinations of the 3 determinations (A, B, and C) for each method, as:

$$D_{in} = \frac{C_{ij} - R_{ik}}{R_{ik}} \times 100\%, \text{ where i is the filter number, and n}$$

numbers from 1 to 9 for the 9 possible difference combinations for the 3 determinations for each method (j = A, B, C, candidate; k = A, B, C, reference).

(2) If none of the cent differences (D) exceeds ± 20 percent, the candidate method passes the test.

(3) If one or more differences (D) exceeds ± 20 per cent, the candidate method fails the test for consistent relationship.

(i) The candidate method must pass both the precision test and the consistent relationship test to qualify for designation as an equivalent method.

TABLE C-3 TEST SPECIFICATIONS FOR LEAD METHODS.

Concentration range, $\mu g/m^3$:	0.5 to 4.0
Minimum number of 24-hour measurements:	5
Maximum analytical precision, per cent:	15%
Maximum analytical accuracy, per cent:	± 5%
Maximum difference, per cent of reference method:	±20%

TAB L- Advance Notice of Proposed Rulemaking - ambient monitoring
requirements for significant lead point sources (Signature item)

ENVIRONMENTAL PROTECTION AGENCY

[40 CFR Part 51]

IMPLEMENTATION PLANS FOR LEAD NATIONAL

AMBIENT AIR QUALITY STANDARD

Proposed Requirements for Ambient Air Quality

Monitoring in the Vicinity of Certain Lead Point Sources

Advance Notice of Proposed Rulemaking

AGENCY: Environmental Protection Agency.

ACTION: Advance notice of proposed rulemaking.

SUMMARY: This is an advance notice of EPA's intent to propose regulations
that would require the State implementation plans (SIPs) for attainment
and maintenance of the national ambient air quality standard (NAAQS) for
lead to provide for the owner or operator of each primary or secondary
lead smelter or primary copper smelter to establish a lead air quality
monitoring system in the vicinity of the source and report the data to
the State.   EPA intends to propose this requirement partly in response
to a comment received on the proposed lead implementation plan requirements
of December 14, 1977 (42 FR 62087), but mainly as the initiation of a
procedure for obtaining information concerning the nature, extent, and
impact of fugitive lead emissions from the smelters, since very little
accurate information is currently available. The intended effect of
this requirement would be to obtain sufficient air quality data around
the subject sources to determine if they are causing violations of the

lead NAAQS. If violations are recorded, the States and EPA will determine whether additional or alternative control strategies would be adequate to attain and maintain the NAAQS for lead.

DATES: Comments on this advance notice must be received on or before: [the date sixty days after publication]. Comments submitted in duplicate will facilitate internal distribution and public availability.

ADDRESSES: Persons may submit written comments on this advance notice to: U.S. Environmental Protection Agency, Office of Air Quality Planning and Standards, Control Programs Development Division (MD 15), Research Triangle Park, N.C. 27711, Attention: Mr. Joseph Sableski.

EPA will make all comments received on or before [the date sixty days after publication] available for public inspection during normal business hours at: EPA Public Information Reference Unit, 401 M Street, S.W., Room 2922, Washington, D.C. 20460.

FOR FURTHER INFORMATION CONTACT: Mr. John Silvasi, U.S. Environmental Protection Agency, Office of Air Quality Planning and Standards, Control Programs Development Division (MD 15), Research Triangle Park, N.C. 27711, telephone: Commercial--919-541-5437; FTS--629-5437.

SUPPLEMENTARY INFORMATION:

BACKGROUND

In another part of this FEDERAL REGISTER, EPA promulgated the national ambient air quality standards (NAAQSs) for lead and requirements for the preparation, adoption, and submission of State implementation plans (SIPs) for the attainment and maintenance of those standards. Further information about the standards and the SIPs appears in those notices.

States must now prepare and submit to EPA within nine months SIPs that demonstrate that the NAAQSs will be attained. In doing so, the States will have to quantify the lead emissions from sources and determine the effect of those emissions on the ambient air concentrations. For emissions that originate from stacks or tailpipes, the quantification can be done with a fair degree of accuracy. For emissions that originate from other than a primary exhaust system, such as through a plant's doors, windows, leaks in equipment, and so forth, the quantification is far more difficult. Such emissions are commonly called fugitive emissions. Fugitive emissions are difficult to quantify accurately since they are dependent on a wide range of site-specific parameters, such as the lead content of the raw materials used in the process; number and size of open windows, doors and vents; wind speed and direction; rainfall; and so on--factors other than process throughput or production rates.

Furthermore, there has not been much lead air quality data gathered around sources of these fugitive emissions. Also, there have never been any specific requirements in the regulations that apply to SIPs for requiring such data to be collected around individual sources. Consequently, there is little accurate information concerning the amounts of fugitive emissions and the ambient air lead levels in the vicinity of sources of large amounts of lead emissions. EPA's assessments of the environmental and economic impacts of the lead NAAQSs[1,2] indicate that several categories of sources that emit predominantly fugitive lead emissions have the potential for the greatest air quality impacts. The categories of concern are primary and secondary lead smelters and primary copper smelters.

NATURE OF PROPOSAL

EPA intends to propose regulations to enable the States and EPA to obtain an air quality data base needed to determine compliance with the NAAQSs around sources in the above-mentioned categories. The regulation would require the subject sources to establish and operate an air quality monitoring system in the vicinity of the sources. If the ambient data reveals that concentrations are not as high as had originally been predicted when the State developed its initial lead SIP, and the source has not yet implemented the control called for in that SIP, the State may wish to revise its SIP to require less stringent control, thereby requiring a lesser burden on the source. Conversely, if the ambient data reveals that concentrations greater than the NAAQS occur after the control strategy in the SIP has been implemented, EPA could require the State to revise the SIP to require additional control of the sources.

The regulations would require that the method for sample collection be the reference method as defined in 40 CFR Part 50; this method is the high-volume sampler. No other collection methods would be allowed for monitoring in the vicinity of point sources, since it appears that other samplers would not sample the same quantity of larger particles that the high-volume sampler would collect. The analysis method could be the reference method or an equivalent method as defined in 40 CFR Part 50. The sources would also have to obtain certain meteorological data to properly locate the samplers.

EPA intends to restrict this requirement only to primary and secondary lead smelters and primary copper smelters because EPA modeling studies[2] of the six major lead point source categories (the other three being gasoline additive plants, lead-acid battery manufacturing plants,

4

and gray iron foundries) indicate that these three categories have a potential for an air quality impact that far exceeds that of the sources in the other categories.

EPA would require the States to place the requirement for monitoring directly on the source owners and operators, using the authority of § 114(a)(1)(C) of the Clean Air Act. This section authorizes the Administrator to require any source subject to a requirement of the Act to ". . . install, use, and maintain such monitoring equipment or methods. . ." The implementation plan would have to require the source owners or operators to periodically report a summary of the data to the States and EPA. The data would then be used to determine whether a future plan revision is indicated.

The amount of ambient point source monitoring needed would vary and depend on the number of emission points at the source, the emission patterns, the topography, and the meteorology. EPA will develop a guidance manual on the number, siting, and operation of monitors around point sources. EPA estimates that the guidance will recommend that a network of about five samplers be placed in the vicinity of each source to which the regulation applies. States would have nine months after the promulgation of this requirement to revise their lead implementation plans to require the monitoring around the selected point sources. The sampling network would then have to be in place within one year after the date required for submission of the plan revision to account for this requirement.

EPA solicits comments on any issues concerning the intended proposed rulemaking and particularly solicits comments on the following topics:

--The need for the requirement for ambient monitoring in the vicinity of the lead point sources mentioned above or alternatives to this requirement that will accomplish the objective of obtaining more accurate data concerning these sources.

--Other sources around which EPA should require ambient monitoring.

--The criteria for the number, operation, and location of the samplers.

--The criteria for the length of period of each sample, sampling frequency, and duration of the existence of the sampling system.

--Procedures for accounting for other sources in the vicinity of the source, including roadways.

--Procedures for accounting for complex topography.

--Procedures for accounting for meteorological conditions and obtaining meteorological data.

--Procedures for accounting for the nature and magnitude of fugitive emissions.

--Procedures for accounting for background concentrations.

--Procedures for accounting for source configuration.

--Procedures for reporting the collected data to the State and EPA.

--The time allowed for revision of the State implementation plan to account for the requirement.

--Time allowed for compliance with the requirement contained in the implementation plan.

--Whether the burden of responsibility should lie with the State agency or with the source.

--The cost to the States or the sources for compliance with these requirements.

EPA intends to propose rulemaking on this matter by December, 1978, and intends to make available for public review at the same time a draft of the detailed guidance on ambient lead monitoring in the vicinity of lead point sources.

FUGITIVE EMISSION FACTORS

Also, EPA intends to develop more accurate emission factors that relate the operation of a source to the amount of fugitive emissions the source generates. These factors will not be available, however, until some time after the States must submit their implementation plans. Therefore, the States will have to rely on available fugitive emission factors to perform their air quality analyses in support of their implementation plans or develop their own factors based on any data that may be available, such as emission factors for total particulate matter and information concerning the lead content of that particulate matter.

Alternatively, States could develop their own emission factors based on field studies. There are several methods for doing this.[3,4,5]

After EPA develops emission factors for fugitive lead emissions, States could then determine whether their initially developed plans require too much or too little control; they could then make any necessary

adjustments to their implementation plans through revisions of those plans. The initial plan could require that sources phase in their control fairly slowly so that significant resources are not expended by the sources before EPA develops its fugitive emission factors.

REFERENCES

1. National Ambient Air Quality Standard for Lead: Final Draft: Environmental Impact Statement. U.S. Environmental Protection Agency, Office of Air and Waste Management, Office of Air Quality Planning and Standards, Research Triangle Park, N.C. July, 1978.

2. Economic Impact Assessment for the National Ambient Air Quality Standard for Lead and the Economic Implications of a Quarterly Mean Averaging Time for the Lead National Ambient Air Quality Standard. U.S. Environmental Protection Agency, Office of Air and Waste Management, Office of Air Quality Planning and Standards, Research Triangle Park, N.C. June, 1978.

3. Technical Manual for the Measurement of Fugitive Emissions: Upwind-Downwind Sampling Method for Industrial Fugitive Emissions. U.S. Environmental Protection Agency, Industrial and Environmental Research Laboratory, Research Triangle Park, N.C. April, 1976. Publication No. EPA-600/2-76-089a.

4. Technical Manual for the Measurement of Fugitive Emissions: Roof Monitor Sampling Method for Industrial Fugitive Emissions. U.S. Environmental Protection Agency, Industrial and Environmental Research Laboratory, Research Triangle Park, N.C. May, 1976. Publication No. EPA-600/2-76-089b.

5. Technical Manual for Measurement of Fugitive Emissions: Quasi-Stack Sampling Method for Industrial Fugitive Emissions. U.S. Environmental Protection Agency, Industrial and Environmental Research Laboratory, Research Triangle Park, N.C. May, 1976. Publication No. EPA-600/2-76-089c.

(Sections 110, 114(a)(1), and 301(a) of the Clean Air Act as amended (42 USC 7410, 7417, and 7601)).

Date   Administrator