



## AZI-LIA EXPANDED RESEARCH PROGRAM



AMERICAN ZINC  
INSTITUTE, INC.

LEAD INDUSTRIES  
ASSOCIATION, INC.

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Director of Research

IN REPLY REFER TO  
PROJECT NO.

November 23, 1962

To All Members of the Industry Development  
Committee of the Lead Industries Association, Inc.

Gentlemen:

Enclosed you will find a resume and recapitulation of the Expanded  
Research Program budget for 1963.

We regret the short time that you will have available for your  
review; however, timing of all of our subcommittee and Technical Steering  
Committee meetings has made it impossible to put this information  
in your hands before this date.

Very truly yours,

SFR:ga  
encs.

1963 BUDGET RECAPITULATION  
EXPANDED RESEARCH PROGRAM - LIA

| Project<br>No: | Title                                                                                                | Funds Required<br>1963 |
|----------------|------------------------------------------------------------------------------------------------------|------------------------|
|                | <u>Architectural Market</u>                                                                          |                        |
| IM-16          | Lead for Sound Attenuation                                                                           | \$40,000               |
| IM-67          | Development of the IM Process for Continuous<br>Casting of Lead Sheet                                | 9,000                  |
| LE-36          | High Speed Plating of Lead                                                                           | 27,500                 |
| IM-44          | Joining of Lead to Lead and Other Substrates                                                         | 17,500                 |
| ULM-18         | Lightweight Lead Sheet Roofing System                                                                | 7,500                  |
| ULM-19         | Hot Dipped Lead Coatings for Galvanized Steel                                                        | 5,000                  |
|                | <u>The Transportation Market</u>                                                                     |                        |
| IM-9           | Fiber Reinforced Lead                                                                                | 15,000                 |
|                | <u>Powder Metallurgy</u>                                                                             |                        |
| IM-45          | Investigation of the Conversion of Particulate<br>Lead to Wrought Forms                              | 15,000                 |
|                | <u>The Chemical Market</u>                                                                           |                        |
| LC-18          | A Fundamental Study of Organolead Chemistry                                                          | 25,000                 |
| LC-28          | Organolead Chemistry                                                                                 | 10,000                 |
| LC-49          | Lead Compounds as Lubricants and Lubricant<br>Additives                                              | 32,800                 |
| LC-63          | Improvement of Textile Materials by Lead<br>Chemical Treatment                                       | 3,500                  |
|                | <u>Lead Chemicals in Paints</u>                                                                      |                        |
| LC-34          | Anticorrosive properties of Lead Pigments in<br>Water Thinnable Ferrous Metal Primers                | 18,000                 |
|                | <u>Lead Chemicals in Ceramics</u>                                                                    |                        |
| LC-12          | Clemson Agricultural College                                                                         | 2,500                  |
| LC-14          | Pennsylvania State University                                                                        | 3,930                  |
| LC-19          | University of Illinois                                                                               | 3,000                  |
| LC-21          | Rutgers, The State University                                                                        | 3,000                  |
| LC-22          | Alfred University                                                                                    | 3,000                  |
| LC-23          | University of California                                                                             | 2,000                  |
| LC-37          | Pennsylvania State University                                                                        | 4,100                  |
| LC-54          | North Carolina State College                                                                         | 2,980                  |
| ---            | Strength of Glasses                                                                                  | 1,500                  |
|                | <u>Health and Safety</u>                                                                             |                        |
| ---            | The Determination of the Level of Lead Concentra-<br>tion in an Ambient Atmosphere                   | 35,000                 |
| ---            | The Testing of Organolead Compounds for possible<br>Endocrinological and Anti-Mammary Tumor Activity | 5,000                  |

1963 BUDGET RECAPITULATION  
EXPANDED RESEARCH PROGRAM - LIA

| Project<br>No. | Title                                                                     | Funds Required<br>1963 |
|----------------|---------------------------------------------------------------------------|------------------------|
|                | <u>General</u>                                                            |                        |
| LE-29          | A Fundamental Study of Surface Reactions of Lead                          | \$ 4,000               |
| LE-70          | Chemical and Electrochemical Corrosion of Lead Alloys                     | 5,000                  |
| LE-73          | Lead Anodes in the Purification of Domestic and Industrial Effluent Water | 5,000                  |
| LP-38          | Corrosion Research Council                                                | 500                    |
| LP-52          | Abstracting Service                                                       | 7,500                  |
| ---            | Undesignated Research Fund                                                | 50,000                 |
|                |                                                                           | <hr/>                  |
|                | Total 1963 Research Budget Recommendation                                 | 363,810                |
|                | Total 1963 Administrative Budget Recommendation                           | 112,907                |
|                |                                                                           | <hr/>                  |
|                | TOTAL                                                                     | \$ 476,717             |

BUDGET PRESENTATION TO THE INDUSTRY DEVELOPMENT COMMITTEE  
OF THE LEAD INDUSTRIES ASSOCIATION

Introduction

The following pages present a compendium of the research and development programs currently in progress and the work proposed for 1963. The projects are described by market areas, so that they may be seen in proper perspective and reviewed comprehensively as to their commercial feasibility.

Most of the programs are in applied research and their primary objectives are (1) to maintain consumption at the highest possible level in defensive areas, and (2) to develop improvements and innovations for expansion into new markets.

A much smaller percentage of the programs is devoted to basic research where the effects are not measurable in tons of metal sold, although the results are equally real and in the long run may bring great benefits to the industry.

In substance, the programs are selected with great care to produce a balanced integrated structure, and the total research effort is aimed at pointing out new directions which will best serve the needs of the industry.

### The Architectural Market

In size and opportunity, the architectural field offers the largest single potential market for lead products. This giant \$7 billion dollar industry absorbs annually 9 million tons of steel, 620,000 tons of aluminum, 760,000 tons of plastic, and mountains of concrete, bricks, lumber, plywood, and other structural materials. Percentage-wise, the amounts of aluminum and plastic used by the construction industry represent 25% of the entire consumption of these materials in the United States. Steel products that go into construction involve 14% of the total consumption, and this quantity does not include contractors' products and other steel components which find their way indirectly into construction.

The market opportunities in the architectural field are virtually unlimited. What the future sales volume of lead products will be in this market depends on relative cost, appearance and practicality for specific applications. Our research endeavors to improve the properties of lead, develop new products, simplify methods of installation, reduce production costs, and provide technical data which will point up the advantages of lead products in architectural applications. The realization of this market potential, however, is directly proportional to promotion and sales efforts.

#### DM-16 - Lead for Sound Attenuation, Lewis S. Goodfriend and Associates

This program was started in January 1961 with the broad objective of developing data on the effectiveness of lead for the control of noise in architectural and industrial applications. During the first year a group of representative panels were acoustically tested, definite values were established for the sound isolation qualities of the lead partitions, and a draft was prepared of a manual which incorporated the results of these tests. Based on the manual, a semi-technical brochure is now in preparation by the LIA and will be given wide distribution to architects and contractors.

A new series of the most commonly used panels in offices, schools, and hotels are currently being laminated with the lead sheet, and acoustical data on these panels will be added to the manual. Among these panels are partitions of interest to owners of the Washington Hilton Hotel with whom discussions have been held concerning the use of leaded partitions in the hotel. Careful consideration is given to the proper design of construction details to eliminate sound leakage through air ducts, electrical outlets and other flanking paths.

Due to a lack of precedent and insufficient experience in possible areas of utilization, an exhaustive market appraisal cannot be made at this time. The most promising immediate markets seem to be in movable office partitions, and leaded plastics, flexible fabric curtains interwoven with lead wire, and lightweight partitions of plaster board and thin lead sheet laminates. The near term potential can be estimated conservatively at 10,000 tons per year, with the long term outlook, 5 to 10 years, at several times this consumption.

Required 1963 Funds - \$40,000

IM-7 - Lead Asbestos Pads for Vibration Attenuation, Lewis S. Goodfriend and Associates

Performance tests on the effectiveness of lead asbestos pads at various conditions of static loading and at different frequencies are proceeding and definitive results are expected soon. Preliminary findings from the dynamic testing of machinery mounts seem to indicate that some modifications may be required in the lead asbestos pads to make them more effective in low frequency applications.

The market potential for lead asbestos pads in building, machinery, and appliances is very encouraging. In the appliance market alone, sales of home laundry equipment (washers and dryers) exceed  $4\frac{1}{2}$  million units, refrigerators -  $3\frac{1}{2}$  million units, freezers - 1 million, fans - 5 million, air conditioners - 2 million. An average of 4 pounds for each of these 16 million units would involve 15,000 tons of lead per year. If we assume the potential in this area at 3,000 tons and an additional 3,000 tons in buildings and heavy machinery such as industrial presses, machine shop equipment, and printing machines, it would provide a market for 6,000 tons of lead annually. Although there is a substantial potential if the program is successful, we must caution that our data do not yet indicate that we can compete technically with competitive anti-vibration systems.

Presently available funds are sufficient to complete this program.

Required 1963 Funds - NONE

IM-26 - Lead Powder Cladding of Steel, University of British Columbia

During the first part of this program, the feasibility of powder cladding steel container stock with lead was demonstrated. The program was extended to August 1963 to study the factors necessary to obtain well bonded coatings, and to establish the range of coating thicknesses that can be produced.

An interest has been shown by several steel companies in the commercial application of our process and a cooperative pilot plant program will be given consideration at the completion of the current research. Approximately \$19,500 are available in this project area from previous budget approvals, and it is recommended that this sum be retained for possible future action.

Required 1963 Funds - NONE

IM-67 - Development of the IM Process for Continuous Casting of Lead Sheet, Broken Hill Associated Smelters Pty.

Previous evaluation by the industry has established the ability of the IM Casting Process to produce thin lead sheet of good quality at minimum cost at high production rates. The possibility of marketing thin lead sheet at a price only slightly above that of pig lead is of major importance in the successful utilization of lead products for the control of noise and for architectural applications, and further development of the continuous casting machine is

therefore very important.

The development work currently in progress at BEAS will continue until mid 1963. It is recommended however that a fund of \$9,500 be set aside for the possible extension of this program, predicated on the findings of the present work.

Successes derived from this work can be applied to the commercial realization of other research projects such as air sound attenuation and the market potential of this project is therefore very high.

Required 1963 Funds - ~~NONE~~ \$9,000

#### IM-56 - Lead Composite Products in Construction

Initiation of this program has been deliberately delayed until guidance on bonding of lead to other substrates is available from IM-44 "Joining of Lead to Lead and Other Substrates" which is currently being conducted at ASARCO. Results from the work on the IM Process for the production of low cost thin lead sheet for the composites will also have bearing on this project. \$5,000 were allocated for this program in the 1962 budget and it is recommended that these funds be retained.

The market potential for roofing, acoustical products and other architectural components was estimated previously at about 20,000 tons per year.

Required 1963 Funds - NONE

#### IM-57 - Heavy Lead Cladding for Chemical Plant Use

Since the 1962 budget recommendation, no promising approach has been found to the problem of bonding heavy lead coatings to steel, improving rates of application and lowering costs. Available funds for this project are therefore released for other research areas.

Required 1963 Funds - NONE

#### IM-58 - Plumbing Applications of Lead

This cooperative program is being carried out with the Twisted Jute Packing & Oakum Institute and the Cast Iron Soil Pipe Institute to find the solution to the leakage problem of cast iron soil pipe joints under conditions of hot and cold water discharge. Contingent upon successful findings at the completion of this program, further confirmation of these results will be considered.

Required 1963 Funds - NONE

LC-59 - Ceramic Coatings for Cementitious and Metallic Substrates

The development of improved techniques of application for low temperature glazes offer a good opportunity for opening new market areas to the lead industry, and promises large potential consumption of lead ceramic coatings in the fields of building bricks, concrete blocks, and other cementitious and metallic construction products.

After examination of several proposals in this area, the technical committees recommended the initiation of a high spot investigation of flame spraying techniques and equipment as outlined in the Armour Research Foundation proposal at \$10,000. These funds are available from the 1962 budget of \$30,000 which was approved for this research, and the remaining \$20,000 are to be retained for further research at a later date, if the high spot test is successful.

The market potential in this area has been previously estimated conservatively at 10,000 tons of lead per year.

Required 1963 Funds - NONE

LE-36 - High Speed Plating of Lead, Graham, Savage and Associates

This program has successfully identified addition agents which permit the uniform electrodeposition of lead on steel at high current densities. We now have sufficient laboratory information to produce coatings of extremely low porosity at high speeds, and it seems advisable to demonstrate the commercial value of these coatings by means of atmospheric and canned corrosion tests.

Considering the increased popularity ofterne plate in recent months, commercial interest in the advantages offered by economically priced, pore-free electrodeposited lead on steel sheet may lead to a significantly greater consumption of lead coatings as corrosion barriers for steel substrates. According to the AISI, 3,280 tons of lead has been used for coating purposes on steel during 1961. It is estimated that the improved quality and increased applicability of electrodeposited lead coatings can raise the market potential to about 8,000 tons annually, in the architectural field and in containers for non-food containers.

A description of the work performed in this program has been published in one technical paper which appeared in PLATING and two further papers have now been accepted by the American Electroplaters Society for presentation at their annual convention and for subsequent publication.

Required 1963 Funds - \$27,500

LM-44 - Joining of Lead to Lead and Other Substrates, American Smelting & Refining Company

This program involves the compilation of data on various organic adhesives for the joining of lead and the establishment of reliable bonding techniques.

Consultation with adhesive manufacturers has shown that their technical information is of a general nature and that these data cannot be applied directly to the bonding of lead. Independent tests are therefore necessary to isolate the factors which affect the bonding strength of adhesives with lead.

Although the original objectives of this program remain valid, greater emphasis is now being given to the development of data on curing times, temperatures, yield strength, and other factors which were previously given secondary consideration. A large number of lap shear joints were made, and test studies are conducted on the effects of chemical environments, duration of lead and contact with water on the bond strength of the adhesives with lead adherends.

Further investigations are required before definitive conclusions can be reached for the preparation of an effective applications manual, and it is recommended that the program be extended for another year.

Required 1963 Funds - \$17,500

#### ULM-18 - Lightweight Lead Sheet Roofing System

This proposed research program involves a lead roofing system developed by the Broken Hill Associated Smelters to increase the utilization of lead in roofing by means of simplified design, ease of fabrication and economy of installation. Exposure experience with this system to date has been limited and it is therefore the purpose of the proposed program to initiate field exposure tests, to obtain installation criteria, performance history, and economic data which are necessary to introduce this system to the roofing market in general.

Consumption data of lead for roofing in individual countries on a world wide basis are not available. However, using the 1,355,000 new housing starts in the United States during 1961, an average of 1,200 sq.ft. of roofing area per house, and 1 lb of lead per sq. ft., we can estimate the market potential at 40,000 tons annually if we assume that one half of 1% of the total market will use lead for roofing.

Required 1963 Funds - \$7,500

#### ULM-19 - Hot Dipped Lead Coatings for Galvanized Steel

The increasing sulfur concentration in the air of cities and urban areas gives credence to the possibility that a composite coating of zinc and lead will greatly improve the utility of our metals in industrial atmospheres. While lead alone provides excellent resistance to sulfuric acid environments, localized corrosion can take place in holidays of commercial lead coatings. On the other hand, galvanized steel alone likewise does not always give satisfactory performance in industrial areas. Thus a lead top coating combined with a zinc undercoating to furnish the anodic barrier may provide the most effective corrosion protection for steel.

It is believed that a high spot investigation of limited scope should be initiated to appraise the production, performance and economic factors involved in hot dip lead coatings on galvanized steel, and to determine whether a more extensive program in this area is warranted.

Based on the consumption of slab zinc for galvanizing steel sheet, the potential consumption of lead coatings over the galvanizing could be substantial.

Required 1963 Funds - \$5,000

### The Transportation Market

The project discussed under this heading pertains primarily to the automobile and railroad industries, but is not limited to these areas. Likewise, several other projects, although finding application in the transportation market, are discussed under different headings.

#### DM-9 - Fiber Reinforced Lead, Armour Research Foundation

This program which was originally devoted to fundamental research, became commercially important with the discovery that lead remains contained within its fiber reinforcement even when heated to the melting point of lead. New market opportunities were opened up for fiber reinforced lead as a bearing material for railroads, municipal transportation systems, engines and motors and as a solder tape for use in automobiles, plumbing and similar applications.

In an independent evaluation of steel fiber reinforced lead bearings, the Association of American Railroads found that less than 20% of steel fiber reinforcement was sufficient to keep the lead in the matrix even under conditions of high temperature and pressure, that the reinforced lead bearings have excellent recovery properties, and that they have a 50% to 75% longer life than conventional bearings. As a result, the Association of American Railroads is considering the adoption of reinforced lead bearings by the railroad industry.

The British Railways are also interested in reinforced lead bearings and samples have been submitted to them for evaluation.

The use of reinforced lead bearings in automotive application is the subject of another evaluation proposed to be carried out on a cooperative basis with Detroit Aluminum and Brass. It is felt that reinforced lead bearings have definite technical advantages and that an investigation of the economic justification in automotive applications is definitely warranted.

The Buick Corporation is maintaining an active interest in the commercialization of reinforced lead solder tape and is awaiting the completion of the technical research at Armour. Elack Hawk Manufacturing Company also expressed an interest in specific uses of lead solder tape for automobile body repair.

The market potential for reinforced lead in railroad car bearings is estimated at 1,000 tons annually, and for reinforced lead as body solder and solder tape at 5,000 tons per year.

Required 1963 Funds - \$15,000

Powder MetallurgyDM-8 - Fundamental Investigation of Lead Powder Metallurgy,  
The University of British Columbia

Previous work at Kaiserlaur on the development of promising lead alloy systems did not meet research objectives and a new fundamental research program has been proposed for the University of British Columbia to study the mechanisms of wrought powder metallurgy. Results of other investigators, such as Alloys Research and Development Corporation, have demonstrated, although not conclusively, that the powder metallurgy approach for producing superior wrought lead alloys has great merit from a technical as well as from a commercial standpoint. In England, commercial interest in powder metallurgy is increasing as a result of research performed there, and our program DM-45 at American Smelting and Refining Company is investigating the feasibility of producing wrought materials from particulate lead on a pilot plant basis.

Initiation of this program has been deferred until the first of the year to get the program on a calendar year basis. Sufficient funds are available for this project through 1963.

Required 1963 Funds - NONE

DM-45 - Investigation of the Conversion of Particulate Lead to Wrought  
Forms, American Smelting and Refining Company

While DM-8 was devoted to fundamental research on particulate lead alloy systems, to improve their properties with regard to strength, creep resistance and thermal stability, the program at ASARCO involves a pilot plant operation to produce end products from the most promising of these alloys and to investigate their commercial feasibility. Recent investigations have shown that the oxide content of lead products has the greatest effect on ductility and strength, and that commercially available powders are too high in oxide content to maintain the delicate balance required for best strength properties and ductility.

A portion of the new program will be devoted to the production of required experimental lots of powder with controlled oxide and alloy content. Primary emphasis will be given to the development of suitable controls to achieve optimum properties of strength, creep and ductility. The advisability of producing pilot lots of particulate lead internally under ERP's sponsorship is supported by the following reasons:

1. The techniques and methods used will be available to the Lead Industry and to potential manufacturers of end products from lead powders.
2. Oxidation problems arising from shipping and storage will be minimized if the conversion to wrought products can be done directly by the powder manufacturer.
3. Pilot plant manufacturer of particulate lead will provide a controlled source of supply of powders having specific characteristics.
4. Dependency on commercial powder sources could delay and handicap the progress of research in this area.

Required 1963 Funds - \$15,000

### The Chemical Market

During 1961, U.S. consumption of tetraethyllead was 170,000 tons while the combined total of all other lead chemicals, exclusive of paint pigments and lead oxide in batteries, was 100,000 tons. The market for lead chemicals is thus based almost entirely on the production of TEL. However, this market is now threatened by the shift from piston engines to gas turbines, diesel engines, and lean fuel engines, as well as by legislative investigations of alleged health hazards caused by TEL exhaust gases.

Our efforts in this area are aimed primarily at the development of a large number of new lead chemicals to minimize the effects of possible market losses and to open up new market potentials. By way of illustration our research has indicated that certain lead chemicals may be useful as anti-carcinogens and in the treatment of inflammatory diseases. The medicinal market may not consume large tonnages of lead compounds, but it can provide invaluable publicity to offset the negative propaganda which has held back lead usage because of historical reputation.

Based on these considerations, increased research efforts to develop new lead chemicals and new applications for lead compounds are not only of major importance but, in addition, of immediate urgency.

### LC-18 - A Fundamental Study of Organolead Chemistry, Organisch Chemisch Instituut, TNO Holland

This fundamental research program conducted at TNO, Holland, is aimed at increasing our understanding of the chemistry of organolead compounds, at synthesizing new lead chelates, exploring their radical reactions and evaluating their biocidal properties. A number of organolead compounds possessing unusual characteristics have been synthesized in this program and the commercial feasibility of some of these chemicals is very high. Of particular interest is one of the synthesized products, hexaphenyldilead, which has been found to be more effective than inorganic lead compounds for the stabilization of polyvinylchloride (PVC) plastics and as an antifouling additive in marine paints. Sample quantities of this compound are being made available to various laboratories in Europe, England, the United States and Canada for evaluation.

Other lead organics synthesized in this program have shown unusual properties as insecticides, fungicides and mildicides, as catalysts, lead polymers and fuel additives. It was also noted that some lead compounds have favorable effects in treating inflammatory illnesses and tumors.

The technical value of this program is very high and it is anticipated that worthwhile commercial benefits will accrue to the lead industry as a result of this fundamental research program.

Required 1963 Funds - \$25,000

LC-28 - Organolead Chemistry, Quartermaster Research & Engineering Command

This research at Setick, Mass. is a companion program to that being conducted at TNO and there is a continual exchange of information and close cooperation between the two organizations. Thus lead compounds developed by TNO have been submitted for testing to the Entomological Laboratories of the US Quartermaster Command and to the US Department of Agriculture, where efforts are made to evaluate the potentialities of these new chemicals for possible application in textiles, protective coatings and other related applications.

Further research will include studies of the behavior of lead bonded directly to carbon and sulfur, and efforts at synthesizing new organolead compounds continue to center around those containing these elements. A manuscript describing the important results of this research and entitled "Synthesis of Organolead-Sulfur Compounds" was prepared and is to be submitted to the Journal of Organic Chemistry.

Work performed at the Quartermaster as well as at TNO runs along parallel lines, stimulating and supplementing each other, but avoiding duplication of effort. Likewise, compounds synthesized in these two programs are being incorporated in the work of other R&D projects, such as the lubricant additive program at Ethyl Corporation. The over-all results achieved to date from our work on organolead chemicals are most encouraging.

Required 1963 Funds - \$10,000

LC-49 - Lead Compounds as Lubricants and Lubricant Additives, Ethyl Corporation

This program on the applicability of lead compounds as lubricant additives involves an evaluation of organolead compounds which were developed in our fundamental research programs on the synthesis of lead organics. Several of the compounds tested were found to have remarkable effectiveness in reducing wear under boundary lubrication conditions and the materials seem to have excellent commercial possibilities.

One compound in particular has demonstrated outstanding stability over a wide range of temperature and an effectiveness ten times greater than any commercially available lubricant additive on the market. The market potential of this compound alone is estimated by a specialist in this field at ten million pounds of lubricant per year.

Further research will be directed primarily toward developing a commercially feasible lubrication system employing these lead additives as well as to continue the evaluation of new compounds as they are synthesized. Continuation of this applied research program is strongly recommended.

Required 1963 Funds - \$32,800

LC-63 - Improvement of Textile Materials by Lead Chemical Treatment,  
Department of Agriculture

This program was initiated in September 1962 and its objective is to supplement the work of the Department of Agriculture on textiles and to investigate the effectiveness of various organic and inorganic lead compounds in improving the properties of textiles.

Successful developments in this field will introduce lead chemicals to a new market involving over 3 million tons of wool, rayon, silk and synthetic fibers. Assuming an estimated consumption of lead in textiles at 1/2 of 1%, the market potential will be 15,000 tons of lead or more. Furthermore, the lead used in textiles is completely consumed and does not return to the market as scrap.

Since this program is funded through September 1963, additional funding of \$3,500 is recommended to continue the program through December 1963, if such an extension should be required.

Required 1963 Funds - \$3,500

Lead Chemicals in Paints

LC-34 - Anticorrosive properties of Lead Pigments in Water Thinnable Ferrous Metal Primers, Eagle-Picher Company

This program has identified a series of lead compounds having superior rust inhibitive properties and investigations are continuing in two major areas:

1. Development of heat curing, water thinnable lead pigment metal primers, having good storage stability and application properties.
2. Development of air drying, water thinnable lead pigment maintenance primers, having good durability and application properties.

An effective lead primer, free of volatile solvents, would certainly be a welcome boon to automobile manufacturers, and research in this area offers a promising market opportunity. Although many vehicles and formulation variables have been systematically evaluated, a truly successful breakthrough has not been accomplished to date with regard to air drying systems. However, with regard to baking finishes, excellent results have been obtained which will soon be publicized.

Although the superior performance of lead primer pigments has been demonstrated, research must continue until satisfactory vehicles and formulations can be developed for air drying metal primers.

The market potential for lead primers on automobiles is estimated at 5,000 tons annually, and for the priming of structural steel at 12,000 tons per year.

Required 1963 Funds - \$18,000

LC-50 - The Use of Lead Pigments in Air Drying Water Miscible Paints for Wood  
Eagle-Richer Company

Most water thinned paints suitable for exterior applications are generally formed by the chemical process of emulsion polymerization.

The most common latex paints are made from styrene-butadiene-copolymers, polyvinyl acetate, or acrylic resins, and can be made with high or low gloss, are easy to apply, and resist water, ammonia and household detergents. Since they are water thinned, they can be applied over damp concrete as well as on to all metals and woods.

The volume of latex paint has grown from 40 million gallons in 1952 to an expected 92 million gallons in 1963, and this market growth certainly justifies compatibility studies with lead pigments.

The work currently in progress is primarily concerned with exposure tests of a series of prepared panels to make comparisons of lead compounds, vehicles, and top coat formulations. Additional vehicles are being tested as they become available. Funds required for this program are included in LC-34.

Required 1963 Funds - NONE

Lead Chemicals in Ceramics

In terms of long range benefits, the ceramic program gives the lead industry an excellent return on research expenditures. Leading universities are stimulated to work on lead, new fundamental information is developed for a better understanding of the reactions of lead in ceramics, future ceramists are provided with experience and knowledge of lead products, technical papers describing our research are published in scientific journals, and favorable findings of the advantages of lead in ceramics are given international publicity. Our ceramic research fellowships involve a suitable blending of theoretical studies with applied investigations. Close watch is kept on any developments that may be directed into practical market applications.

The following ceramic fellowships are currently in progress:

LC-12 - Clemson Agricultural College, involves two topics for investigation: The first study will determine whether control of particle size distribution can be used to minimize bubbles in the glaze. The second topic involves studies to determine the merits of lead compounds as constituents in fast cooling glazes.

Required 1963 Funds - \$2,500

LC-14 - Pennsylvania State University, continues the study on the preparation of high frequency dielectric materials by crystallization of glasses containing considerable amounts of lead oxide. Special attention is given to phase relationships and physical properties of selected ceramic systems.

Required 1963 Funds - \$3,930

LC-19 - University of Illinois, involves an extensive study of lead molybdate as an opacifier in low firing temperature lead bearing enamel. This fellowship has the possibility of developing commercial low temperature lead glazes for application to steel and aluminum substrates.

Required 1963 Funds - \$3,000

LC-21 - Rutgers, The State University, continues its work on lead fluxed tile bodies. The objective of this fellowship is to develop lead containing ceramic bodies possessing low fusion temperatures, high resistance to abrasion and chemical attack, high strength and thermal shock resistance. Preliminary results have shown marked improvements in physical properties and the possibility of reducing firing temperatures.

Required 1963 Funds - \$3,000

LC-22 - Alfred University, pertains to studies of the effect of lead and other constituents on the thermal expansion of various glass systems, primarily the  $PbO-SiO_2-K_2O$  system. Measurements will be carried out from liquid nitrogen temperatures to the yield point of the glass.

Required 1963 Funds - \$3,000

LC-23 - University of California, involves research on the magnetic properties of leaded ferroelectric compounds. A graduate fellow for this research has not been appointed at this time, but it is hoped that the project will begin soon.

Required 1963 Funds - \$2,000

LC-37 - Pennsylvania State University, is continuing work on the study of lead oxides and hydroxides under conditions of high temperature and pressure, to obtain a better understanding of their thermodynamic behavior.

Required 1963 Funds - \$4,100

LC-54 - North Carolina State College, concerns the effects of composition on thermal expansion of glazes, using as a starting composition a typical lead glass which has been successfully used on fast firing bodies.

Required 1963 Funds - \$2,980

Strength of Glasses, Rutgers, The State University

Another newly proposed fellowship project involves the relationship between strength and elasticity in ceramic materials. Since oxides of metals, such as ZnO and PbO, have the ability to modify the properties of glasses, it is recommended that a fellowship study be initiated in this area and that it be cooperatively sponsored by the AET, LIA and the Selenium and Tellurium Committee. The LIA share of this \$5,000 project is \$1,500.

Required 1963 Funds - \$1,500

Health and SafetyThe Determination of the Level of Lead Concentration in an Ambient Atmosphere, The Kettering Laboratory

This proposed program is a continuation of a research project which was initiated late last year under the financial sponsorship of Dupont and the Ethyl Corporation. Later (effective September 1, 1962) the United States Public Health Service assumed one fourth of the yearly cost by means of a grant to Kettering.

The research project is designed to increase our knowledge of the effect on the human system of inhalation of particulate lead over periods of time longer than 8 hours per day. The need for this study is demonstrated by the insistence of official health agencies, California especially, that ambient air limits be set for all toxic materials. Unless specific and scientifically accurate data are developed, health agencies in many parts of the country will act in a purely arbitrary manner and set limits having little or no relation to reality. This has already happened in California where the State Health Department set a limit for carbon monoxide in air that was one third of the recognized industrial standard for eight-hour exposures.

It is necessary to obtain authoritative data on the permissible level of lead concentration in the atmosphere and to have these data confirmed by official health agencies. This procedure is particularly important in order to avoid the possibility of arbitrary legislation which may be detrimental to lead usage.

The proposed study is a complement to our program LC-69 at Stanford Research Institute, entitled "Variation of Atmospheric Lead Concentration and Type with Particle Size", and the Kettering "Proposal" was approved by the Health and Safety Committee at its meeting on November 13, 1962.

Required 1963 Funds - \$35,000

The Testing of Organolead Compounds for possible Endocrinological and Anti-Mammary Tumor Activity - The Worcester Foundation for Experimental Biology

The Worcester Foundation for Experimental Biology is engaged in fundamental research on cancer and inflammatory diseases, and part of their investigations include tests to determine possible beneficial effects from the use of various chemicals as therapeutic agents. Among the chemicals tested in this program so far are organolead compounds developed in our program at the Quartermaster Research and Engineering Command, Natick, Mass. These lead chemicals have shown promise as anti-carcinogens and in the treatment of inflammatory diseases and tumors.

It is recommended that a modest screening program be initiated at the Worcester Foundation for a maximum sum of \$5,000 for one year. In addition, it is suggested that other laboratories such as Sloan-Kettering and the National Cancer Institute be requested to incorporate our organolead compounds in their existing testing programs at no cost to us.

Required 1963 Funds - \$5,000

GeneralLE-29 - A Fundamental Study of Surface Reactions of Lead, University of  
Melbourne

Little knowledge is available on the effect that trace elements have on the surface structure of lead and on the rate of oxidation. The purpose of this research program is to provide fundamental data for the interaction between oxygen and lead under a variety of experimental conditions. It is felt that the contractor is breaking new ground here and is producing valuable information in lead technology.

Required 1963 Funds - \$4,000

LE-72 - A Survey of Research Requirements in the Battery Field,  
Dr. A. Fleischer

Considering the growing popularity of cordless appliances, portable tools, electronic equipment and various rechargeable devices, it seems advisable to determine in what area a research project would be most rewarding to the battery industry. Dr. A. Fleischer has been recommended as a man eminently qualified to carry out such a general survey of the battery field and to recommend what research is needed and not being done now.

It is estimated that the total value of conventional lead-acid batteries sold annually in the USA is in excess of \$600 million. In areas where weight is a consideration, the alkaline-electrolyte batteries, such as those using nickel-cadmium, nickel-iron, silver-cadmium, or silver-zinc electrodes, have become large volume sellers. Observers predict that their sales will increase five fold within the next ten years in spite of the high price of these systems. It is therefore necessary that the lead-acid battery producers seek ways to pack their power in smaller and better cells and strengthen their competitive position.

The technical committees recommended that Dr. Fleischer be commissioned to make a survey of the battery field and that \$6,500 be set aside for this purpose.

Required 1963 Funds - NONE  
(Not approved by the Technical Steering Committee)

LE-70 - Chemical and Electrochemical Corrosion of Lead Alloys,  
Departamento De Metales Non-Ferros Madrid

There is reason to believe that a number of lead alloys which have been identified from the work of Armour Research Foundation and others may find practical utilization in battery and general industry applications. It is therefore recommended by the technical committees that these alloys be checked for corrosion resistance and industrial applicability and that \$5,000 be set aside for this work.

Required 1963 Funds - \$5,000

LE-73 - Lead Anodes in the Purification of Domestic and Industrial Effluent Water

The widespread use of synthetic detergents and wetting agents, many of which are not attacked by the usual biological processes that destroy fatty acid soaps, has created serious problems in domestic and industrial effluent water. The presence of these detergents in potable water supplies presents an unknown health hazard.

A second problem arises from the use of certain types of toxic sprays which leach into the streams and are biologically concentrated in specific types of organisms.

It would appear reasonable to assume that a method of treatment might be developed in which the water would be passed through a cascade of lead oxide anodes which would at least partially oxidize the organic materials. There is also the possibility that cyanide containing effluents from plating operations could be rendered harmless by similar techniques.

Although a market potential in this field cannot be determined at this time, the technical as well as the commercial feasibility of this process could readily be ascertained after a limited amount of work. Substantial quantities of lead would be required in each treatment plant for the purification process.

Required 1963 Funds - \$5,000