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The HUD Lead-Based Paint Abatement Demonstration (FHA)

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National Institute of
BUILDING SCIENCES

LEAD-BASED PAINT TESTING, ABATEMENT, CLEANUP AND DISPOSAL GUIDELINES

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LEAD-BASED PAINT TESTING, ABATEMENT, CLEANUP AND DISPOSAL GUIDELINES

These guidelines present means and methods for the testing, abatement, cleanup and disposal of lead based paint in housing. They were developed in response to a national need for guidance in protecting building occupants, particularly children under seven years of age and women of childbearing age, from the adverse effects of lead.

March 14, 1989

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PREFACE

The National Institute of Building Sciences is pleased to forward to the Department of Housing and Urban Development (HUD) these Guidelines for the Testing, Abatement, Clean-up and Disposal of Lead-Based Paint in Housing. The Guidelines are an important step in HUD's five year program to address lead-based paint hazards.

The purpose of the document is to provide technical guidance during an interim period while definitive programs are conducted to resolve such difficult issues as cost effectiveness, worker and occupant health standards, administrative and managerial procedures, worker training, and funding. The proper forums for such programs are through efforts such as the HUD's lead-based paint Demonstration Program and appropriate health standard setting by the proper governmental agencies.

With better knowledge of the increased potential for adverse health effects, the lead-based paint problem is moving into a new and more complex era. This is expected to result in serious conflicts because funds are limited. These and other issues constitute the basis for the minority opinions included with this report. It is respectfully recommended that HUD disseminate these Guidelines with the full content of this Preface and the minority opinions included. Although many of the issues addressed in the minority opinions are beyond the intended scope of these Guidelines, we believe it is important that the opinions be widely disseminated in order that they be given due consideration in the development of appropriate means to ameliorate the adverse effects of lead-based paint in our environment.

The Institute's consensus procedures were used to develop these Guidelines under contract to HUD. The process was advised and guided by a Project Committee comprised of members of the health science, design, construction, operation, and other sectors of the housing community with special expertise on the many aspects of this problem. The Committee was carefully formed to assure all affected and knowledgeable interests had an opportunity to participate in the development of safe and pragmatic state-of-the-art technical guidance.

All project committee members deserve the sincere thanks of the Institute and nation's building and housing communities for unselfish contributions of their knowledge and time, often on extremely short notice due to the rigid project schedule. The Institute sincerely appreciates the dedicated contributions by project committee chairman, Jim Keck, for the knowledge, experience, and leadership he provided throughout this complex project. Our appreciation is extended to the discussion group chairmen who led the process to refine the individual chapters, and the steering committee for helping to resolve the many difficult issues complicating the lead-based paint problem. The names and affiliations of the Project Committee members are listed in Appendix 7.

MacDonald Becket, FAIA
Chairman, Board of Directors

David A. Harris, AIA
President

LEAD-BASED PAINT TESTING, ABATEMENT, CLEANUP and DISPOSAL GUIDELINES

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DISCLAIMER

THESE TECHNICAL GUIDELINES WERE DEVELOPED IN RESPONSE TO A PRESSING NATIONAL NEED FOR GUIDANCE IN THE AREA OF LEAD-BASED PAINT TESTING AND ABATEMENT AS EXPRESSED BY BOTH PUBLIC AND PRIVATE INTERESTS. THE NATIONAL INSTITUTE OF BUILDING SCIENCES (NIBS), IN AN EFFORT TO HELP TO FORMULATE SUCH GUIDANCE, PROVIDED A FORUM FOR A BALANCED GROUP OF PRIVATE AND PUBLIC REPRESENTATIVES TO BRING TO BEAR THEIR PROFESSIONAL JUDGMENT AND EXPERTISE TO THE ISSUES PRESENTED. THE GUIDE SPECIFICATIONS WERE DRAFTED BY QUALIFIED INDEPENDENT CONTRACTORS, AND WERE REVIEWED, MODIFIED, REFINED, AND APPROVED BY A VOLUNTEER PROJECT COMMITTEE COMPOSED OF A BROAD CROSS SECTION OF EXPERTS, WHOSE WORK WAS FACILITATED THROUGH THE ADMINISTRATIVE SPONSORSHIP OF NIBS.

NEITHER NIBS, IN ITS CAPACITY AS THE FACILITATOR OF THE PROCESS THAT CULMINATED IN THE GUIDELINES FOR TESTING ABATEMENT, CLEANUP, AND DISPOSAL OF LEAD-BASED PAINT IN HOUSING, NOR ANY OF THE INDIVIDUALS, ORGANIZATIONS, OR AGENCIES CONTRIBUTING FINANCIAL OR TECHNICAL SUPPORT MAKES ANY WARRANTY WITH RESPECT THERETO. NEITHER NIBS NOR ANY OF THE INDIVIDUALS, ORGANIZATIONS, OR AGENCIES CONTRIBUTING FINANCIAL OR TECHNICAL SUPPORT ASSUMES ANY RESPONSIBILITY FOR ANY INJURY TO INDIVIDUALS OR PROPERTY SUSTAINED AS A RESULT OF THE USE OR APPLICATION OF THE GUIDELINES. IT SHOULD BE NOTED THAT:

- O LEAD-BASED PAINT ABATEMENT ACTIVITIES INVOLVE POTENTIAL HEALTH RISKS TO THOSE IN PROXIMITY TO THE ABATEMENT.
- O EXPERTS FROM BUILDING, SCIENTIFIC, AND MEDICAL COMMUNITIES HAVE DIFFERING VIEWS AS TO MANY ASPECTS OF PROPER LEAD-BASED PAINT ABATEMENT.

THE PURPOSE OF THIS DOCUMENT IS TO BRING TOGETHER, FROM MANY SOURCES, INFORMATION AND VIEWPOINTS REFLECTING CURRENT KNOWLEDGE AND TECHNOLOGY.

THE GUIDELINES MUST BE CONSIDERED SOLELY AS A RESOURCE DOCUMENT REPRESENTING A CONSENSUS OF EXPERT OPINION. IT IS NOT THE PURPOSE OR BURDEN OF THIS DOCUMENT TO PROVIDE ALL-EMBRACING ANSWERS TO ALL LEAD-BASED PAINT ABATEMENT PROBLEMS. IT IS INTENDED THAT THE DOCUMENT SERVE AS A GUIDE FOR DESIGN PROFESSIONALS, TESTING AND ABATEMENT CONTRACTORS, AND BUILDING OWNERS FOR PLANNING AND CARRYING OUT ABATEMENT PROJECTS. USERS MUST BEAR ANY RISKS ASSOCIATED WITH RELIANCE ON THESE GUIDELINES AND SHALL HAVE THE SOLE RESPONSIBILITY TO EVALUATE THE INFORMATION CONTAINED HEREIN TO FORM THEIR OWN INDEPENDENT JUDGMENTS AS TO USING IT, AND TO MODIFY OR ADAPT IT AS MAY BE APPROPRIATE TO SPECIFIC CIRCUMSTANCES.

THESE GUIDELINES ARE NOT LAWS. DURING THE GUIDELINES' PREPARATION IT WAS DETERMINED THAT ADEQUATE NATIONAL HEALTH STANDARDS DID NOT EXIST FOR WORKER PROTECTION OR FOR THE TESTING TO ASSURE ADEQUATE CLEAN-UP OF LEAD CONTAINING DUST. IN THE ABSENCE OF SUCH HEALTH STANDARDS, PRACTICES AND STANDARDS DEVELOPED AND USED IN THE STATE OF MARYLAND AND THE CITY OF BALTIMORE HAVE BEEN USED AS THE BASIS FOR RECOMMENDATIONS AND PROCEDURES CONTAINED HEREIN. THUS, WHILE THIS DOCUMENT REFERS IN SOME CASES TO CERTAIN FEDERAL AND STATE LAWS AND REGULATIONS, IT IS NOT INTENDED TO SUPERSEDE OR SUPPLEMENT ANY LAW OR REGULATION OR TO IDENTIFY ALL LAWS/REGULATIONS APPLICABLE TO LEAD-BASED PAINT TESTING AND ABATEMENT IN BUILDINGS. NIBS DOES NOT ASSUME RESPONSIBILITY FOR CURRENCY OF REFERENCED DOCUMENTS, REQUIREMENTS, OR OTHER PROVISIONS, OR THE MODELS OR NAMES OF MANUFACTURERS' EQUIPMENT INCLUDED IN THESE GUIDELINES.

ABSTRACT

This section presents an overview or executive summary of the contents of this document and is intended to provide the reader with a brief introduction to the contents of the individual chapters. Appropriately modified to adhere to local conditions and projects, it could also be used by a planner as a summary checklist for the complete abatement process.

Chapter I - INTRODUCTION

1.1 Users of the Guidelines

These guidelines are intended for persons who are associated with, have an interest in, or a need for conducting effective abatements of single or multiple dwelling units in public or private housing. They are written so that the person who is familiar with the management and maintenance of housing can understand the process of abatement.

This document is the first attempt at the national level to present technical guidelines on this subject. Additional work must be done to develop and identify techniques to make lead-based paint abatement more practical and affordable. Additional work will also be necessary to integrate these Guidelines into HUD's internal procedures.

The preparation suffered from a lack of definitive information on a number of critical medical, scientific, and technical questions so they consistently take a conservative, protective approach in their recommendations. The resultant cost of the recommended abatement methods may, therefore, be significant in many cases. With this in view, the HUD demonstration program aimed specifically at identifying more cost-effective methods is of critical importance.

1.2 The Problem of Lead Dust in Housing

Human beings can receive lead from numerous sources, through several environmental pathways including paint pigments, auto and industrial emissions, surface and ground water and solder. It has been found that the intake of house dust contaminated with lead is a significant pathway for much of the increased lead in children with moderately elevated blood lead levels.

The groups most at risk from the exposure to lead and its associated health effects are infants, children under the age of seven, and women of child-bearing age. The primary parts of the body affected in children are the brain and central nervous system. Other systems that can be affected are the heme forming system, critical to the formation of blood, and the vitamin D regulatory system, involving the kidneys and calcium metabolism. In pregnant women the danger is to the fetus. In middle aged adult males, recent studies have indicated an association between lead exposure and increased blood pressure.

Lead-based paint in older housing has been addressed as a regulatory problem since the early 1970s and it is still a major issue. Since lead-based paint was used extensively in older houses, the problem is assumed to be extensive in these buildings. The Agency for Toxic Substances and Disease Registry (ATSDR) report indicates that there are approximately 42 million homes in the U.S. constructed prior to 1980 that contain lead-based paint. The report also estimates that 52% of the 80 million housing units in the U.S. have lead paint in them greater than or equal to 0.7 mg/sq.cm.

Lead-based paints chalk and powder on an existing surface due to the effects of moisture and ultra-violet light. On interior surfaces, the dusting is generally caused by poor quality lead-based paint, which breaks down due to aging or paint on windows which is abraded with the opening and closing. If these conditions exist in or around a dwelling unit, increased lead dust levels will exist and with that an increased probability that these small, easily absorbable particles will enter the body through normal hand to mouth activity, be ingested and result in lead poisoning.

Lead dust also tends to enter and accumulate in houses over time from other sources such as exterior soil and road dirt tracked into the home and airborne soil and dirt blown into the home.

Anyone conducting abatement in a dwelling unit containing LBP should be aware of the risks associated with incorrect abatement and the effects of improper protective measures. Abatement using unacceptable methods and work practices creates large quantities of lead-bearing dust which increases the health hazard and can be difficult to remove.

1.3 An Updated Abatement Methodology

This manual is based on an updated approach to abatement which provides work practices that address the hazardous characteristics of the lead dust created during the abatement process. The aim of the approach is to provide effective abatement through processes and procedures that protect humans and the environment.

The Guidelines describe the most effective and safe abatement procedures, while recognizing the need for more cost-effective techniques and advances in abatement technology during the next several years. They also recognize that certain situations may require alternative abatement options based on meeting criteria such as the law, protection of workers and residents, meeting set clearance levels and control of lead dust prior to repainting.

1.4 Involved Federal and State Agencies -

Numerous agencies at both the federal and state level have an interest in this issue. They include:

o The Department of Housing and Urban Development (HUD), the lead agency in this effort, is establishing procedures to eliminate, as far as practicable, LBP poisoning in housing constructed before 1978 and covered by mortgage insurance or housing assistance payments.

- The Environmental Protection Agency (EPA). EPA is now conducting research in two areas: lead in soil and lead in drinking water. EPA also is concerned about the waste disposal aspects of LBP.

- The U.S. Department of Labor. Many of the standards being utilized by states and mentioned in these Guidelines are derivatives of OSHA regulations.

- State Regulations

  a. The State of Maryland addresses the subject of LBP abatement in its regulations published in August 1988.

  b. The State of Massachusetts regulations for LBP abatement went into effect on November 25, 1988.

1.5 Project Administration

The Guidelines are intended as guidance and not as a regulatory measure which must be followed to the letter. There are numerous other documents pertaining to the building process, such as local building codes, federal, state and local regulations and individual guidance material for specific professionals such as architects and engineers, which govern in a specific jurisdiction.

These guidelines are intended to supplement those sources during the conduct of a project.

Chapter II. WORKER PROTECTION

The most effective way to achieve worker protection is to minimize exposure through the use of engineering and work practice controls and not to rely solely on a respirator protection (RP) program. Contractors should be aware that, as of the time these guideline were prepared, the exposures associated with various methods and phases of abatement were not well documented. Until such documentation is available, respiratory protection programs should be implemented. However, even programs that have instituted full worker protection programs have not always prevented increases in worker blood lead levels. A significant rise in worker blood lead levels over pre-employment levels merits medical referral and remedial action to either reduce exposure, change worker behavior, or both.

Any employer of abatement workers is responsible for preparing and implementing a worker protection plan to ensure that lead exposures are minimized. At least two states have modified the federal lead standard specifically for workers in the construction trades. These regulations define requirements for employers to meet their responsibilities for reducing and maintaining exposure levels.

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This chapter contains information and guidance on the following employer actions and responsibilities for worker protection.

Tasks to be done before abatement

- Educate and train workers
- Determine potential or actual worker exposures to lead
- Initiate a program of respiratory protection
- Perform initial medical surveillance
- Provide protective clothing and equipment
- Post appropriate warning signs three days before project start

Tasks to be done during abatement:

- Monitor exposure
- Implement engineering and work practice controls
- Conduct periodic medical surveillance and blood lead monitoring
- Provide daily changes of protective clothing and shoe cover
- Implement and enforce respiratory protection program
- Maintain and care for protective equipment

Tasks to be done after abatement:

- Maintain medical and exposure records
- Maintain company records

Chapter III - TESTING

Thorough and accurate testing is a key part of the effort to eliminate lead-based paint hazards. Testing is performed in three phases: during the initial survey to detect lead-based paint hazards; during abatement to monitor aerosol lead levels; and after abatement to determine whether abatement and clean-up is complete. This chapter presents requirements and recommendations for the following:

- Developing a plan for testing.
- Conducting an initial survey to detect lead-based paint.
- Conducting air monitoring during abatement.
- Conducting visual inspection and surface dust testing after abatement has been completed.
- Ensuring the safety of testing personnel.
- Finding qualified testing personnel.

It also contains details on how to perform the following actions during the three testing phases.

The Initial Survey

- Determine which units will be inspected.
- Learn the background and goals for the inspection.
- Notify laboratory to receive paint samples and discuss procedures.

- Fill out identifying information on survey form including sketches.
- Identify surfaces to be tested.
- Determine testing methodology(ies) to be used.
- Record test results on survey form.
- Note conditions that can impede abatement (e.g., water leaks).
- Pre test the XRF prior to use.
- Take paint samples for laboratory analysis where recommended.
- Notify owner, occupants, and state/local agencies of inspection results.
- Inform abatement contractor of all surfaces to be abated.

During Abatement

- Ensure that air monitoring equipment or air monitoring firm is on site.
- Notify laboratory to receive air samples.
- Conduct frequent work site inspections.

Post-Abatement

- Review surfaces/methods involved in the abatement.
- Perform visual inspection prior to and after repainting.
- Notify laboratory to receive dust samples.
- Conduct surface wipe testing after repainting.
- Document results of the final inspection.
- Notify appropriate agencies of results of the final inspection.

Chapter IV. ABATEMENT

The information contained in this chapter enables contractors, public housing authorities, and others to plan for and conduct interior or exterior lead-paint abatement projects. Specifically, guidance is provided for;

- Selecting a method of abatement for specific components and substrates,
- Planning for all aspects of abatement,
- Implementing abatement procedures and,
- Record Keeping, reporting, and notification.

This chapter provides details which are unique to, and necessary for, the abatement. Awareness of these details and the reasons for such an approach are important to the successful application of the abatement process.

This guidance manual recognizes that repair and maintenance activities in dwelling units may create exposures to lead. Therefore, whenever such activity breaks known or suspected lead-painted surfaces, the lead containment, cleanup, and worker protection sections of this document should be reviewed and applied as appropriate.

The chapter contains information on the following employer actions and responsibilities before, during, and after abatement:

Tasks to be done before abatement:

- Develop a detailed plan which identifies specific abatement management activities:
- Identify abatement and testing contractors
- Obtain any necessary permits for abatement and disposal of waste
- Notify occupants and residents of adjacent units
- Relocate residents and their belongings
- Satisfy any reporting requirements of federal, state and local agencies
- Conduct pre-construction conference
- Correct pre-existing conditions that would impede abatement
- Implement initial procedures for containment of lead dust and debris
- Post warning signs
- Provide a worker changing area

Tasks to be done during abatement:

- Continuous on-site supervision
- Limit access to work area
- Ongoing maintenance of the containment system for lead dust and debris
- Daily cleanup
- Proper on-site storage of waste prior to disposal

Tasks to be done after abatement:

- Break down the containment system
- First round of final cleanup
- Notify inspectors of readiness for inspection
- Obtain approval of inspector to complete abatement
- Cover and/or seal all floors and repaint abated surfaces as needed
- Final round of cleanup
- Notification of inspector of readiness for clearance testing
- Clearance testing
- Obtain final certification
- Dispose of abatement debris
- Record Keeping
- Satisfy any federal, state and local reporting requirements
- Relocate occupants

CHAPTER V - CLEAN-UP

This chapter presents the details and procedures of how to conduct a clean-up associated with LBP abatement. It includes information about:

- The critical importance of clean-up in a lead-paint abatement project
- How to schedule and coordinate the daily and final clean-ups properly
- Obtaining the necessary equipment and materials to clean effectively
- How to operate and maintain special cleaning equipment, and materials
- How to protect workers properly during clean-up

- The timing of surface dust testing and related visual inspections
- Containing and storing potentially hazardous debris
- Proper painting or sealing of appropriate surfaces
- Appropriate clearance criteria
- Appropriate record to keep to document clean-up
- Training and certification requirements

Chapter VI - DISPOSAL

Proper disposal of the wastes generated during abatement is an integral part of a safe and effective abatement process. Steps must be taken to ensure that these wastes do not harm human health or the environment. Federal, state, and local requirements for waste disposal must be followed.

The information contained in this chapter enables building owners, abatement contractors, and others to plan for and ensure the safe and legal disposal of wastes generated during lead-based paint abatement activities. It includes the regulations that govern the disposal of wastes; the types of wastes generated during abatement; guidelines for developing a disposal plan; and procedures for testing and arranging for safe disposal of wastes.

Other items included in the chapter:

- Lists of regional EPA, state, and local authorities to determine disposal requirements.
- Guidance on how to determine the type and quantity of wastes generated.
- How to choose a qualified laboratory to perform waste testing.
- Requirements for testing samples of each waste to determine whether it is nonhazardous or hazardous waste.
- How to establish a standard procedure for bagging and handling the wastes.
- Requirements for waste containers.
- How to select the timing and pathways for waste removal.
- Requirements for warning signs on any temporary storage areas.
- Requirements for transporting solid wastes in covered vehicles.
- Requirements for obtaining an EPA identification number.
- Procedures for protection of workers and residents during disposal work.

The appendices supporting each chapter are located at the end of the manual.

KEY WORDS; lead paint; abatement; testing; housing.

Chapter I - INTRODUCTION

1.1 Introduction

The National Institute of Building Sciences (NIBS) was created by Congress with the Housing Act of 1974 (Public Law 93-383, Section 809) to advise both the public and private sectors on building science and technology matters, to facilitate the introduction of new technology, and to gain its acceptance at the federal, state, and local levels.

On August 15, 1988, the Department of Housing and Urban Development (HUD) asked NIBS to develop, under contract, a consensus-based document providing guidelines for the testing, abatement, clean-up, and disposal of lead-based paint (LBP) in Public and Indian housing. The guidelines are to be the first important step of the five-year program mandated by legislation. They are intended as an authoritative source of technical information for government agencies involved in Public and Indian housing. The information contained in them is that currently in use and effective in abating LBP. Their content is intended to have broad application to all residential public housing containing LBP and, with appropriate modification, could be used to abate LBP in housing within other sectors of the built environment.

NIBS has often provided consensus-based technical recommendations on difficult technical matters that impact the building community. Key to this is the interaction of public interest advocates, the scientific community, and others with interest in a specific issue comparable to LBP in housing. These guidelines are the result of that process and are a natural progression of the work done by a NIBS task force in May 1987 to February 1988. The task force published a report in February of 1988 containing a recommendation that definitive guidelines for the abatement of LBP were required to assist in addressing the problem effectively.

As a result of the task force work, the NIBS Board of Directors agreed to undertake the guidelines project and had staff develop a project plan which was approved by HUD. NIBS also formed a project committee from its membership to guide the development of the guideline manual and provide the forum in which the document could be created on a consensus basis. The project committee was balanced to assure the manual would be beneficial to the public and reflective of the best available knowledge from the building design, construction, and operation sectors as represented by design and health professionals, product manufacturers and distributors, academicians, labor, builders, code officials, health and environmental officials and other government agencies, building owners/users, and consumers.

1.2 Cautions

1.2.1 Purpose of the Guidelines

The purpose of these guidelines is to provide persons who will be involved in planning for and conducting abatement of LBP in public housing units with practices, protocols, and standards currently being successfully applied by local governments in the absence of federal standards. The guidelines are not intended to be regulatory in nature, but merely a guide to persons conducting abatement or abatement-related activities. By applying the information from appropriate guidelines chapters, he or she should be able to approach this difficult and complicated subject successfully in a methodical and professional manner.

This document should be considered as a guideline only. Users are advised to be especially mindful of the regulatory documents pertaining to lead-based paint in effect in their jurisdictions. Those documents will provide the basis for their programs as well as their legal and financial responsibilities. These guidelines are intended to supplement and not supercede the regulations in those documents.

1.2.2. Limitations

This is the first attempt at the national level to present consolidated technical guidelines on the testing, abatement, cleanup, and disposal of lead-based paint. While these guidelines represent an important step forward, it is clear that substantial additional work must be done to develop and identify techniques to make lead-based paint abatement more practical and affordable.

First, while these guidelines cover the range of technical issues involved in addressing lead-based paint in public housing, additional work will be necessary to integrate them into HUD's internal procedures and into each PHA's comprehensive modernization program. In addition, more detailed "handbook" instructions will be needed to address administrative and project approval procedures and to assure the coordination of lead-based paint abatement with other modernization work.

Second, and more importantly, the preparation of these guidelines suffered from a lack of definitive information on a number of critical medical, scientific, and technical questions:

- o What blood lead levels present health concerns in children, women of child-bearing age, and adult male workers?
- o What exposures to airborne lead and surface lead dust are acceptable for abatement workers and residents?
- o To what degree must lead dust be controlled during abatement and cleaned up afterward to avoid adverse health effects?

Due to the lack of definitive guidance on these and related issues, these guidelines consistently take a conservative, protective approach in recommending testing methods, work practices, abatement options, and cleanup safeguards. The recommended approach to abatement is predicated on controlling the generation of lead dust to the extent possible consistent with sound public health practices. As a result, the cost of following the recommended abatement methods will be significant in many cases. It should be noted that some local officials with extensive lead-based paint experience believe that less rigorous and less costly abatement methods can still produce acceptable results.

Lead-based paint abatement has been done empirically for many years and has played a role in the reduction of symptomatic childhood lead poisoning.[1-3] However, there have been instances of improperly performed abatements causing an increase in childhood lead burden. Abatement methods have usually not been rigorously controlled, and contractors often have been poorly trained. It is difficult to evaluate the lead-paint abatement work that has been done to date because there are very few reports with data that include air lead and residual dust lead levels, and pre- and post-abatement blood levels of children and workers.

Methods that may have worked in reducing children's lead levels from, for example, 60 to 30 micrograms/dl may not be as effective in reducing blood lead levels from 25 (or greater) to less than 15 micrograms/dl. With the new levels of health concern described elsewhere in this document, there is an urgent need to reevaluate the way lead-based paint abatement is generally performed.[4] Unfortunately, the scientific base for this reevaluation is rudimentary. From a public health standpoint, the approach recommended in these Guidelines will lead to the least amount of residual paint lead and dust lead and theoretically, therefore, be maximally effective in reducing children's blood lead levels. Whether similar or equally effective results could be obtained by a less costly or simpler approach is uncertain. It should be remembered that a poorly performed abatement may be worse than no abatement at all. If resources are limited, the owner may be forced to decide, based on the level of pre-abatement hazard, whether to delay abatement, or apply the less than optional procedures outlined in the Introduction, Section 1.3.4.

While adherence to these guidelines can, with a high degree of confidence, be expected to produce safe and effective results, additional work is needed to develop and identify more cost-effective techniques. An assessment of the cost-effectiveness of other approaches, methods, and tradeoffs to "streamline" abatement projects was beyond the scope of this effort. However, it is clear that the goal of achieving maximum reductions in elevated blood lead levels -- with the finite resources available across the nation -- will be difficult to achieve without more cost-effective methods.

These NIBS Guidelines highlight the pre-existing need for more science and research related to lead paint abatement. In view of this and the disagreements encountered by the NIBS consensus process, this basic research need is obvious and essential. To be useful, the research also must be done quickly, and with consideration of long-term health and environmental outcomes.

1.2.3 Additional Research Needs

The major HUD demonstration of lead-based paint abatement in 300 units over the next year aimed specifically at identifying more cost-effective methods is of critical importance.

However, the NIBS committee feels strongly that a significant research agenda is needed beyond the HUD demonstration to answer many practical issues involved in establishing lead paint abatement guidelines, e.g., 1) what are the costs of the different components of the abatement guidelines, 2) what is the effectiveness, in terms of reduced dust lead and children's blood lead and in terms of worker blood lead, 3) what is the long-term effectiveness of the different components of the abatement guidelines (e.g., if we can abate a house to a dust level of 40 ug/sq ft, but the soil lead is 1000 ppm, how long can we maintain the low house dust level), 4) what is the proper mix of abatement methods that will work to keep children's blood lead levels below 15 micrograms per deciliter, 5) what newer, cost-effective methods are available, or should be developed, to enable lead-paint abatement to proceed in a cost- effective fashion.

The NIBS consensus process and Guidelines must be seen as the beginning of a logical, scientific approach to obtain the best data and develop the most appropriate techniques for conducting lead-paint abatement. The HUD demonstration and research and other support by EPA and other federal agencies, are essential to continue this process in a timely, effective, and enlightened manner.

In the interim, the conservative approach recommended in these Guidelines should insure the protection of workers and residents as abatement projects proceed.

1.2.4 Users of The Guidelines

These guidelines are intended for use by persons who are associated with, have an interest in, or a need for conducting effective abatements of single or multiple dwelling units or public housing. Familiarity with this type of housing and the public and private sector housing organizations created to manage it, would be helpful in planning the abatements. The guidelines are written so that the person who is somewhat familiar with planning, management, and maintenance of housing can understand the process of abatement. A knowledge and background in normal planning processes and how to manage family housing would also assist the user.

1.2.5 Use of the Manual

Separate chapters are devoted to worker protection, testing, abatement, cleanup, and disposal. Refer to the table of contents at the front of the manual to find the appropriate chapter and section for a specific subject. If additional information is needed, refer to the summary at the beginning of each chapter. If an overview of the abatement process is required, refer to the abstract after the table of contents.

1.2.6 The Relation of Lead Dust in Housing and Lead in Soil

Lead in soil and dust outside the dwelling unit can be a contributor to the lead-containing dust that exists in housing. Soil in proximity to housing that contains LBP can contain high levels of lead. This is caused by exterior lead-based paint weathering, improperly performed exterior deleading work, or activities totally unrelated to lead-based paint, i.e, automobile exhaust. Lead-contaminated soil poses a hazard because children may play in or near it.

The dirt may also be tracked into and significantly raise the level of lead-contaminated dust in a dwelling unit.

These guidelines address lead in paint and lead in dust generated inside housing units. It should be recognized, however, that the testing, abatement, clean-up, and disposal of lead-contaminated soil are being addressed by an ongoing, extensive multi-year study program by the Environmental Protection Agency (EPA). In various sections, this manual notes where the results of the EPA study and testing should be consulted.

1.3 Background

1.3.1 Who Is At Risk and How?

Human beings receive lead from numerous sources, such as paint pigments, auto emissions, industrial emissions, surface and ground water, and solder. Specific sources also include the air, dust, food, or drinking water (through lead pipes) to which humans are exposed. It has been found that the intake of house dust contaminated with lead is a significant cause of moderate to highly elevated blood lead levels in children.

The Agency for Toxic Substances and Disease Registry (ATSDR) report of July 1988 stated that the groups most at risk from the exposure to lead and associated health effects are infants, children, and women of child-bearing age. The women are not primarily affected, but a fetus they carry would be vulnerable to lead in the blood of the mother. The primary parts of the body affected in children are the brain and central nervous system. Other systems that can be affected are the heme forming system, critical to the formation of blood, and the vitamin D regulatory system, involving the kidneys and calcium metabolism. In middle-aged adult males, several recent studies have indicated an association between lead exposure and increased blood pressure.

The ATSDR report also indicated that results of the effects of lead poisoning can include coma, convulsions, seizures, mental retardation, delayed cognitive development, impaired hearing, reduced IQ scores, and even death. These are generally found in children and the most severe effects occur at lead blood levels above 40 to 80 micrograms per deciliter. IQ score deficits have been found in children with lead blood levels below 25 micrograms per deciliter, and low level effects have been shown on fetal and child development at blood levels of 10-15 micrograms per deciliter.

The main objective of these guidelines is to reduce blood lead levels of the at-risk groups to concentrations below those viewed as being associated with adverse health effects. Historically, the definition of acceptable blood lead levels has been repeatedly lowered as new medical evidence has become available which demonstrates adverse health effects at successively lower blood lead levels. For example, in 1978, the Centers for Disease Control (CDC) revised their criteria blood levels for unacceptable childhood lead levels from 40 micrograms per deciliter to 30 micrograms per deciliter and, after reevaluating new medical evidence in 1985, again lowered the criteria level further to 25 micrograms per deciliter. Based on even more recent medical evidence, several Federal Agencies (e.g., ATSDR, U.S. EPA) have cited 10-15 micrograms per deciliter as blood levels being associated with adverse health effects in children under 6 years old, and, also, as being of concern with regard to women of childbearing age (due to potential effects on their fetus should they become pregnant). Such blood lead levels (10-15 micrograms per deciliter) are currently cited as being associated with unacceptable risk to human health as the basis for proposed revision of U.S. EPA guidelines/regulations for airborne and drinking water lead; and it is expected that CDC will shortly reconvene a panel of medical experts to evaluate the need for further revision of the CDC childhood Lead Screening Program guidelines downward to the 10-15 micrograms per deciliter level. Several issues remain to be researched more fully with regard to the delineation of which specific health affects or constellation of affects are of sufficient magnitude or persistance to be considered adverse in the 10-20 micrograms per deciliter blood level range.

It is important to note that the members of these at-risk groups represent the occupants of housing and the workers involved in LBP abatement. Persons or firms involved in the abatement process should, therefore, keep in mind that the procedures suggested in these guidelines, while being management techniques or protocols or renovation means, are directed at protecting these groups, especially the children.

1.3.2 Lead-Based Paint in Housing

Lead-based paint in older housing has been identified as a problem since the early 1970's. It is still a major issue, since lead exposures from lead-based paint have not been reduced as significantly as they have been in food and gasoline. The recent ATSDR report indicates that there are approximately 42 million lead-based paint containing homes in the U.S. which were constructed prior to 1980. Of these, approximately 6 million are unsound, i.e., they have holes in the walls and contain peeling paint, and/or broken or cracked plaster. The report also estimates that there are approximately 12 million children under the age of seven living in lead-based painted homes and approximately 1.8 million living in unsound homes.

The second National Health and Nutrition Examination Survey (NHANES II) conducted between 1976 and 1980 pointed out that the influence of family income and residence is striking. The report noted that increased lead absorption is the highest among low-income urban black children (18.6%) and the lowest among rural white children (1.2%).

One should not assume, however, that the problem is relegated only to low income or public housing. More and more dwellings constructed prior to 1978 with a high probability that they contain LBP are being rehabilitated. The ATSDR report estimates that 52% of the 80 million housing units in the U.S. have lead paint in them greater than or equal to 0.7 mg/sq.cm.

1.3.3 The Hazard of Lead Dust

While most attention in the past has focused on paint chips containing lead, the problem of lead dust is of special concern. This is because the smaller the particle size, the more readily the lead is absorbed by the body. Any effort to remove lead paint from a residence can potentially create exposure to lead dust. Abatement using unacceptable methods and work practices creates large quantities of lead-bearing dust which can be difficult, if not impossible, to remove.

Exterior lead-based paints chalk and powder due to the effects of moisture and ultra-violet light. Therefore, exterior paint will generally exhibit more of the surface dusting characteristic than will interior paint. On interior surfaces, the dusting of non-covered lead-based paint is generally caused by poor quality paint, which breaks down due to aging or which is abraded when windows are opened or closed. Lead-based paint dust can also be created by disturbing or breaking the covering that has been placed over a lead-painted surface. If these conditions exist, increased lead-dust levels will exist. An increased probability will then also exist that these small, easily absorbable particles will enter the body through normal hand-to- mouth activity, be inhaled or ingested, and result in lead poisoning.

Lead dust tends to enter and accumulate in houses over time from the sources shown below. To prevent future exposures, abatement must address this pre-existing dust hazard in homes. In particular, older and deteriorated homes can have high levels of lead in dust that is difficult to remove using ordinary housekeeping measures. The following are the primary sources of lead particles that become incorporated into household dust:

- Poorly conducted abatements
- Deteriorating lead paint on interior and exterior surfaces
- Exterior soil and road dirt tracked into the home
- Airborne soil and dirt blown into the home
- Abraded lead-based paint, as on windows that are opened and closed

1.3.4 An Updated Abatement Approach

This manual is based on an updated approach to abatement which recommends work practices that address the hazardous characteristics of the lead dust created during the abatement process. The approach provides effective abatement through processes and procedures which protect humans and the environment by:

- o Reducing both lead paint and lead-dust hazards
- o Using methods that produce the least amount of lead dust
- o Controlling lead dust through proper work practices
- o Emphasizing clean-up procedures
- o Conducting post-abatement surface dust clearance testing
- o Providing for worker training and protection
- o Implementing floor treatments to enable long-term dust control
- o Repainting with "lead-free" paints
- o Implementing occupant protection plans
- o Protecting belongings during abatement
- o Emphasizing proper disposal of lead paint abatement waste

These guidelines describe the currently most effective and safe abatement procedures, while recognizing the need for more cost-effective techniques and advances in abatement technology during the next several years. These guidelines also recognize that the realities of certain situations may require alternative abatement options if strict adherence to these extensive guidelines would delay substantially or preclude abatement work entirely. The selection of any alternative abatement methods should be contingent upon 1) the selected methods not being prohibited by law, 2) the demonstrated ability to adequately protect workers and residents during abatement, 3) post-abatement cleanup to the clearance levels indicated in Chapter 5, and 4) adequate control and cleanup of lead dust prior to repainting so the lead dust particles do not become imbedded in freshly applied paint. The choice of specific abatement strategies that appropriately consider cost-effectiveness should involve experienced and trained planners, consultants, and contractors.

The guidelines contain detailed instructions for use by many sectors of the housing management community. Because the document is the first iteration of a needed set of technical guidelines it does not include specific information on the following subjects:

1. Guidelines for protecting the safety of PHA employees and residents.
2. Specific guidelines for protecting workers who perform small maintenance projects that break a painted surface.
3. Suggestions for effective PHA supervision of work performed to test, abate, clean-up, and dispose of lead-based paint.
4. Suggestions for coordinating lead-based paint abatement with comprehensive modernization.
5. Guidelines for conducting a visual inspection as part of an initial survey.
6. Quantitative evidence of the relative effectiveness, safety, and residual lead levels of various techniques -- in health (blood lead level of PHA employees and residents) and lead content (painted surfaces, surface dust, ambient dust measures).
7. Guidelines on relocation.
   a. Time estimates associated with different abatement techniques.
   b. Relocation guidelines on various levels of abatement: 1) exterior, 2) common area, 3) limited work area within an apartment or during maintenance projects in which a lead-based painted surface is broken,

4) whole rooms within apartment, and 5) whole apartments.

1.4 Involved Federal and State Agencies

1.4.1 HUD Association with Lead-Based Paint

The history of the Federal lead-based paint regulations of 1971 began with the Lead-Based Paint Poisoning Prevention Act (LBPPPA), which designated the Department of Health, Education and Welfare (HEW) as the lead agency. This act prohibited the use of LBP in residential structures constructed or rehabilitated by the federal government or with federal assistance and began a research program for LBP. In 1973, amendments to the LBPPPA made HUD the lead agency and directed it to establish procedures to eliminate, as far as practicable, LBP poisoning in existing housing constructed before 1950 and covered by mortgage insurance or housing assistance payments. As a minimum, these procedures were to eliminate the immediate hazards to children, and notify purchasers and tenants of LBP hazards, symptoms, treatment, and abatement techniques. HUD had discretion to apply these procedures to housing constructed during or after 1950. HUD also was directed to establish and implement procedures to eliminate the hazards of LBP poisoning in federal properties prior to their sale, if they were to be used as a residence.

HUD had initially published regulations in 1972 (24 CFR 35) which prohibited the use of LBP in federal and federally-assisted construction. Testing and required abatement were to be conducted only if a dwelling unit contained deteriorated paint or was occupied by a child who was found to have an elevated lead blood level. In 1976 HUD extended Part 35 to all HUD associated housing, including all HUD financially assisted housing when sold, bought, leased, constructed, or rehabilitated. Further revisions were made in August 1986 and January 1987 as a result of the Ashton vs. Pierce decision. This decision basically called into question several of the currently accepted methods of abatement, found that HUD had illegally limited its consideration of "immediate hazards" to peeling paint, and found that HUD had inadequately monitored Public Housing Authority (PHA) compliance with its lead regulations.

The Housing and Community Development Act of 1987 (PL 100-242) changed the definition of the LBP hazard and established a standard for identifying the existence of the hazard. The act also eliminated an elevated lead blood level in a child as the initiator of an abatement project, and as a substitute directed that testing and abatement of all surfaces of a dwelling unit must occur if the interior or exterior surfaces, as evaluated by an x-ray fluorescence analyzer, measured 1.0 mg/sq.cm.or above. HUD issued regulations on June 6, 1988, dealing with the same subjects. The implementation of these regulations was stayed by a subsequent appropriations act, pending completion of technical guidelines on safe and effective abatement techniques being developed through this effort.

The 1987 legislation also directs HUD to conduct, over an 18-month period, a demonstration program to determine what abatement techniques to use in HUD owned housing, recommendations for the best detection techniques, the cost and safety considerations associated with abatement, the reliability and accuracy of available testing technology, and an estimate of the regional distribution of housing containing LBP in the U.S. At the conclusion of the program, HUD is also directed to submit a report and a plan for the prompt and cost-effective inspection and abatement of privately-owned single family and multifamily housing.

The Stewart B. McKinney Homeless Assistance Amendments enacted on October 13, 1988, subsequently made several changes to inspection and abatement requirements. The major changes in that act relevant to these guidelines are;

- o Includes consideration of hazards from dust and waste generated by abatement activities.
- o Requires the demonstration program to include public housing.
- o Extends the period to 1994 for testing all pre-1978 public housing family units not undergoing comprehensive modernization.
- o Requires HUD to consult with additional federal health, environmental, and major public housing organizations.
- o Allows PHAs to use atomic absorbtion spectroscopy (AAS) as a test method and to seek HUD funding for the abatement of lead-based paint as low as 0.06% lead, the Consumer Products Safety Commission standard for lead in paint.
- o Deletes the requirement for 100% testing when all like surfaces in a project will be abated.

1.4.2 Environmental Protection Agency (EPA)

Historically, EPA has deferred to HUD on LBP issues and has no regulations on the subject. However, the EPA has been very aggressive in addressing air and water emissions from industrial sources and the lead content in gasoline. It also has recently proposed regulations to limit lead exposure in drinking water. EPA is also conducting extensive studies of lead in soil. The results of this research should be a concern to users of this manual since lead in soil can have an impact on the amount of lead dust in a dwelling unit. EPA also regulates the disposal of hazardous substances which may include certain LBP debris, pursuant to the Solid Waste Disposal Act (as amended). Subtitle D, C and I of this act pertain to LBP disposal. It should be noted however, that these subtitles have been further clarified by other publications at the local EPA level and these should be consulted as necessary. EPA regulations are being modified. The latest information available when this document was written is in Chapter VI, Disposal.

1.4.3 U.S. Department of Labor

The U.S. Department of Labor, Occupational Safety and Health Regulations 1910.1025 for Lead, should be of interest although they do not pertain to construction workers. Many of the standards being used by states and mentioned in these guidelines are derivatives of this regulation. OSHA Regulation 1910.134 Appendix A2 deals with respiratory protection, which is useful when using Chapter II, Worker Protection.

1.4.4 State Regulations

The State of Maryland published regulations covering LBP abatement (Title 26, Department of the Environment, Subtitle 02) in August 1988. Also of interest is the LBP section of the Maryland Occupational and Health Standard titled Occupational Exposure to Lead in Construction Work COMAR 09.12.32, dated January 16, 1984.

The State of Massachusetts regulations for LBP abatement went into effect in November 1988. The regulations, 454 CMR 22:00 Deleading Regulations, provide information on details of the abatement process including the certification and licensing of deleaders. The Massachusetts Department of Public Health and the state of Connecticut have proposed additional regulations which should be finalized in 1989.

Many states also have their own regulations concerning hazardous waste handling and disposal. These are listed in Appendices 6-3 and -4.

1.5 Roles and Responsibilities

The following are the primary participants in the LBP abatement process and the generalized responsibilities of each. The participants and their functions are amplified in the appropriate chapter where this is required.

- Architect/Engineer/Designer -- The person, firm, or corporation who will prepare the cost estimates, specifications, or detailed design work associated with a LBP-abatement project.

- Contractor -- The certified person, firm, or corporation with whom the owner has entered into an agreement to conduct one of the phases of or the complete abatement of the dwelling unit(s).

- Consultant -- The person, firm, or corporation, with specific expertise in an abatement related area, who has contracted to assist in the abatement process.

- Housing Authority -- An agency responsible for the care, maintenance, and upkeep of a number of public dwelling units and the associated administration of the property.

- Inspector -- A person, firm, or corporation certified and empowered to determine whether existing conditions meet established standards.

- Lender -- A person, firm, or corporation that provides financial resources to conduct one of the phases of abatement.

- Local Agency -- A county, city, or municipal agency empowered to oversee or perform a civic function at the level closest to the consumer, such as waste disposal or worker protection.

- Owner/Owners Representative -- The person or entity that holds title to a piece of real property and is legally bound to oversee its use and administration.

- State Agency -- An organization empowered to oversee or perform a civic function such as waste disposal or worker protection within the geographical boundaries of a specific state.

- Testing Agency -- A qualified firm that conducts the inspection of a property to determine the existence/extent of LBP or lead dust or aerosol lead on the property and/or conducts testing of samples in a laboratory of paint or dust sent in from field locations.

1.6 Project Administration

It is expected that these guidelines will be utilized by different members of the building community as a resource on the subject of LBP testing and abatement and as a guide to develop their own specific manuals and pamphlets.

The guidelines are intended as guidance and not as regulatory requirements. There are numerous other local requirements pertaining to the building process, such as local building codes and federal, state, and local regulations used by specific professionals such as architects and engineers, which must be followed.

For example, it is expected that a building owner will use these guidelines to develop his comprehensive testing and abatement plan, determine how he can best protect workers doing abatement on his properties, and select the most appropriate testing and abatement techniques.

The guidelines can also assist in determining the initial cost of a project. They can help the lender to determine if a proposed project is financially viable and deserving of financing. They can help an architect/engineer to select, formulate and design an abatement project. They can provide a contractor an outline of what is required to conduct a LBP project. And they can provide the housing manager with a guide to assist him with conducting testing and abatement in his dwelling units, while at the same time protecting his dwelling occupants.

References for Chapter I: Introduction.

1. Personal communication to NIBS, 1/89, Charles Copley, M.A., Deputy Health Commissioner, City of St. Louis, Department of Health and Hospitals.
2. Personal communication to NIBS, 1/89, Brad Prenney, Director, Childhood Lead Poisoning Prevention Program. The Commonwealth of Massachusetts, Department of Public Health.
3. Brown, Mary Jean, Effect of residential deleading on the blood lead levels of lead-poisoned children, paper from conference entitled "Leading Us Away from Lead Poisoning: Whose Responsibility," sponsored by the New England Consortium of Childhood Lead Poisoning Prevention Programs, October 5, 1987, Newport, Rhode Island.
4. Chisolm, J.J., Jr., 1988. Editorial. Removal of lead paint from old housing: the need for a new approach. Amer. J. Public Health. 76:236-37.

Chapter II Worker Protection

2.1 Introduction

As discussed in Chapter 1, significant lead exposures can and do occur during abatement.[1-6] Any lead paint abatement project, regardless of the method(s) used can potentially expose workers and homeowners doing the work themselves, to lead and other hazards. The most effective way to achieve worker protection is to minimize exposure through the use of engineering and work practice controls and not to rely solely on a respirator protection (RP) program. Contractors should be aware that, as of the time these guideline were prepared, the exposures associated with various methods and phases of abatement are not well documented. Until such documentation is available, respiratory protection programs should normally be implemented.

Through toxic and disease registries and case reports, lead poisoning in workers resulting from lead paint abatement have been well documented.[4,7,8] Most of these cases are the result of inadequate education and training in lead paint abatement and protection of workers and homeowners, poor work practices, and the use of traditional methods of abatement which produce high dust levels of exposure (see Sections 1.3 and 4.1.3). Worker protection programs can work[9], however, they have not always prevented increases in worker blood lead levels.[9-11] Depending on the extent of the increase in worker blood lead levels, additional testing, medical referral, and remedial action (to either reduce exposure, change worker behavior, or both) may be necessary.

Any employer of abatement workers is responsible for preparing and implementing a worker protection plan to ensure that lead exposures are minimized. Abatement projects will vary in terms of exposure and scope of activity. A common sense approach is needed, particulary for one-time projects which may only involve limited abatement. An example is the removal of a few interior doors. However, since worker protection planning requires technical skills and knowledge, and special testing equipment, as well as a common sense approach, employers may want to consider consulting with an industrial hygienist in developing and implementing the abatement worker protection plan (see section 2.2.7). Since repair and maintenance activities may break lead painted surfaces (e.g.,plumbing repairs), PHAs should also consider consulting with an industrial hygienist to develop a protection plan for workers involved in repair and maintenance.

Due to possible exposure to radiation from the radioisotopes used in the portable x-ray fluorescence analyzers for lead-paint detection, operators require special training in health and safety (see section 3.7.1). This training is usually conducted by the manufacturer or by a health physicist consultant.

At least two states have modified the federal lead standard specifically for workers in the construction trades.[12,13] Unless stated otherwise, regulatory standards that appear in this chapter come from Maryland or Massachusetts regulations.

In light of recent research on the health effects of lead in adults and fetuses mentioned in chapter 1, these regulations may not provide adequate safeguards, particularly for women in their childbearing years whose future children are at risk for developmental deficits.

The following is a list of employer actions and responsibilities for worker protection:

Tasks to be done before abatement:

- o Educate and train workers
- o Determination of potential or actual worker exposures to lead
- o Contact OSHA for copies of:
  - The OSHA occupational safety and health standard, occupational
  - Exposure to lead (29 CFR 1910.1025) including appendix "C" and qualitative respirator fit test protocols
  - Respiratory protection practice protocols
- o Forward copies of OSHA lead standard Appendix "C" and Appendix 2.2, Medical Surveillance of Lead Exposed Workers, to physician performing medical surveillance
- o Initiate a program of respiratory protection, including respirator selection and fit testing
- o Perform initial medical surveillance
  - medical examination
  - baseline blood lead levels
  - pulmonary function tests
- o Provide protective clothing and equipment
- o At least three days before the start of the job, post appropriate warning signs at entrances and exits of work areas and leave in place until clearance testing indicates that the unit is safe for reoccupancy.

The signs should include at least the phrase:

"CAUTION LEAD HAZARD - KEEP OUT" in bold lettering at least two inches high.

Post bilingual signs when the proportion of non-English speaking persons indicates the need.

Tasks be done during abatement:

- o Exposure monitoring
- o Implement engineering and work practice controls
- o Periodic medical surveillance and blood lead monitoring
- o Provide daily changes of protective clothing and shoe covers
- o Implement and enforce respiratory protection program
- o Maintain and care for protective equipment

Tasks to be done after abatement:

- o Maintain medical and exposure records
- o Maintain records of company studies concerning the employees' working conditions or environment

These measures, taken together can reduce both worker exposure and employer liability. This chapter assumes that the workers and contractors are familiar with and implement usual safety and health precautions for construction work.

2.2 How to Develop a Worker Protection Plan

Basic elements common to all worker protection plans and the need to tailor worker protection measures to the specific abatement methods are described in this section. It also familiarizes the reader with both employer and employee responsibilities for worker protection.

The basic elements of all worker protection plans are as follows:

- o Mandatory worker education and training
- o Exposure monitoring
- o Engineering and work practice controls
- o Respiratory protection program
- o Medical surveillance and medical removal
- o Protective clothing and equipment
- o Record keeping

2.2.1 Mandatory Worker Education and Training

Employers are responsible for worker education and training. Sections 2.2.7 and 4.11.3 provide information on sources of training for PHAs and other entities. It will not provide the actual content of a training program; instead, the aim is to enable the reader to evaluate the completeness of a training program.

The basic elements of a worker education and training program are as follows:

- o Worker right-to-know requirements
- o Health effects of lead
- o Personal hygiene and other worker responsibilities
- o Routes of exposure and potential exposure levels
- o Use and maintenance of protective clothing and equipment
- o Training in use of specific methods of abatement
- o The use of engineering and work practice controls
- o Other health and safety considerations

Employers may choose to provide training in an array of abatement methods (see Chart 4.3 in Section 4.4.1) or only for the methods specified in a particular abatement plan. Employers should provide hands on training as a part of training on containment and abatement methods.

2.2.1.1 Worker Right-to-Know

Under the U.S. Occupational Safety and Health (OSHA) Hazard Communication Standard (29 CFR 1910.1200), employees have the right to know what hazards they will be exposed to, what precautions to take, and what sources of information they can access. It also requires employers to have a written hazard communication program and an information and training program (see Appendix 2.1). All worker education programs should discuss and make available this standard and the federal OSHA Lead Standard. Employers should check local requirements as some states have adopted their own right-to-know regulations.

The OSHA right-to know standard also requires that the worker is assured access to three types of records:

- Medical Records
- Exposure Records
- Company Studies

The worker has the option to request a copy of his/her medical records with an explanation of what they mean. The worker also has the right to examine industrial hygiene sampling information, results of biological monitoring, exposure records and material safety data sheets.

2.2.1.2 Health effects

Lead serves no known useful function in the human body - all known effects of lead are adverse [14]. All worker education programs should cover the following areas with regard to health effects:

o The types and meanings of tests to determine lead exposure
o Routes of exposure for fetuses, children and adults
o Health effects in fetuses, children and adults
o Blood lead levels at which various health effects occur
o Signs and symptoms of lead poisoning
o Medical treatments and diet
o Conditions for medical removal from the job
o Conditions for medical referrals

This portion of worker training is important in motivating worker compliance with worker protection and abatement plans. A worker who understands the toxic potential of lead even at low levels of exposure will appreciate the need for precautions and attention to work quality. Workers should report any signs or symptoms of lead poisoning to their employers.

2.2.1.3 Personal hygiene

A few simple personal hygiene practices can contribute greatly to the control of worker exposure to lead. All training programs should include discussion of the following personal hygiene practices:

- o Prohibition of smoking, eating, drinking, chewing gum or tobacco, and the application of cosmetics in work areas
- o Use of designated changing and shower areas to avoid cross contamination of street and work clothes
- o Washing of hands and face at appropriate times
- o HEPA vacuuming of protective clothing before leaving the work area
- o Other measures to prevent the transfer of lead to the worker's home, car, or environment

2.2.1.4 Routes of Exposure and Potential Levels

The primary routes of worker exposure are inhalation and ingestion. Workers should be made aware of (a) the potential exposure levels associated with at least those abatement methods used in any given abatement project and (b) the importance of matching protection measures with anticipated or actual exposure levels. For example, heat guns require full worker protection, including at least half-mask air purifying respirators equipped with HEPA filters.[3,6] protective clothing and shoe covers.

Additionally, workers need to understand the potential for exposing family members to lead brought home on clothing, shoes, hair, and tools from the work site.

2.2.1.5 Training in Specific Methods of Abatement

Prior to abatement, workers should receive training in abatement methods, including their advantages and disadvantages, appropriate and inappropriate applications (see Charts 4.2 and 4.3 in Chapter IV) and the use of special tools and equipment.

2.2.1.6 Use of protective clothing and equipment

Workers must be taught the need for protective clothing and how to select, wear, and maintain appropriate protective clothing and equipment. This training includes procedures for dressing and undressing and the use of gloves, facial protection, eye protection, and shoe coverings. Respiratory protection programs (see section 2.2.5.1) and fit testing should be explained in detail during training. This training always includes individual fit testing of respirators and procedures to maintain and clean respirators. Prior to fit testing, employees must be referred for a medical examination (see Section 2.2.4.1). The employer has the ultimate responsibility for proper use and maintenance of protective clothing and equipment by workers.

2.2.1.7 Engineering and work practice controls

Workers need to understand and know how to implement the following types of engineering and work practice controls:

- Measures for control of debris and lead dust
- Measures for containment of debris and lead dust

- Housekeeping measures

See Section 4.7.2 for information on control and containment of lead dust and Sections 5.2.2.1 and 5.3.2.1 (a) for information on housekeeping measures.

Training should include information on measures for the control of lead dust exposure through HEPA filtered vacuums, and prohibition of dry sweeping (see Section 5.3.2.2.a (2)). Maintenance of HEPA vacuums and filters must be explained (see section 5.3.1.1). Containment measures, such as the use of polyethylene sheeting for interior and exterior use and containment of dry and liquid waste, should be reviewed (see Section 4.7.3). Hands on training should be provided for the implementation of containment measures.

2.2.1.8 Other Health and Safety Considerations

a. General Construction Safety

General construction precautions should be reviewed, particularly those relating to plastic sheeting and potential slips, trips, and falls and the use of hazardous chemicals. The need for special precautions when working in buildings with housing code violations and structural problems (e.g. damaged stairs, missing floor boards) should be reviewed. Particular attention should be paid to:

- Safe use of ladders and scaffolding
- Potential fire hazards
- Electrical safety
- Avoidance of heat stress and heat exhaustion while wearing protective gear
- Potential for exposure to carbon monoxide, solvents and caustic chemicals.

b. Pregnant Women and Women of Child-Bearing Age

No training program is complete without providing workers with the information from recent research studies which indicate that (1) lead is transferred from mother to fetus during pregnancy and (2) exposure of the fetus to even low levels of lead is associated with developmental delay during the first two years of life and possibly longer (see Section 2.2.4.1) [14].

2.2.2 Exposure Monitoring

Exposure monitoring is accomplished by measuring the concentration of lead in the breathing zones of workers. The purpose of exposure monitoring is to characterize exposure levels during different phases of an abatement project so that the abatement contractor can take appropriate measures to reduce exposure to the greatest extent possible.

Exposure monitoring allows the abatement contractor (and his/her industrial hygienist or health and safety technician consultant) to maximize protection of workers from exposure and himself from liability by:

- Determining the level of worker protection needed during different phases of an abatement project
- Evaluating, modifying and improving engineering and work practice controls
- Evaluating, modifying and improving methods of abatement, application techniques, and specific work practices
- Evaluating work quality and need for additional worker training

Exposure monitoring allows the contractor to avoid sole dependence on biological monitoring as the indicator of adequacy of worker protection and abatement methods. This is important because workers can attain exposures which put them at risk for health effects prior to biological testing.

Moreover, information on worker blood lead levels in the absence of exposure monitoring data does not indicate which abatement methods, processes or controls can be modified to reduce exposure. This is the case even if no worker blood lead increases are detected.

2.2.2.1 When Should Exposure Monitoring Be Done?

Current monitoring practices have come from industrial, and not construction settings. These practices do not reflect the research of the last ten years, which indicates detrimental health effects at lower levels of exposure.[14,15] This suggests that current practices do not adequately protect workers, in particular, female workers and their future children. Furthermore, air lead monitoring practices developed for an industrial setting are not necessarily adequate for, or applicable to all abatement work. Abatement may be of short or long duration and create widely varying lead exposures depending upon the tasks performed. Contractors performing one-time abatement work of short duration (e.g., less than two weeks) may chose to implement full worker protection in lieu of exposure monitoring.

Under current practice,[12,13] exposure levels of at least 30 micrograms per cubic meter per 8-hour time weighted average (TWA), trigger further exposure monitoring requirements and respirator protection.

However, due to concerns about health effects mentioned in Chapter I, employers should consider full worker protection combined with continued exposure monitoring (of air lead levels) and the institution of engineering and work practice controls to reduce exposure levels even if these levels are found to be less than 30 micrograms per cubic meter (TWA).

An initial determination should be made by the employer to determine potential exposure to lead of any employee at or above 30 micrograms per cubic meter (as an 8-hour time weighted average [TWA]).

For abatement work, this initial determination should be done, if possible, as part of planning prior to abatement. This monitoring may be done as a pilot project in the first unit of a series of units to be abated. Initial determinations will most likely include air lead monitoring due to the current lack of well documented exposure information for various methods, phases and processes of abatement and cleanup. When this information becomes available, an initial determination can also be based on any information, observations, calculations, or anticipated operations which would indicate employee exposure to lead, or any previous measurements of airborne lead.

Under current practice,[12,13] exposure monitoring should also be performed:

- o Whenever there is a production, job site, material, process, control or personnel change which may result in new or additional exposure.
- o Whenever the employer has any other reason to suspect a change which may result in new or additional exposures.
- o Whenever an employee complains of any signs or symptoms which may be attributed to lead exposure.
- o Whenever an initial determination or subsequent monitoring reveals the airborne exposure to be at or above 30 micrograms per cubic meter (TWA) then exposure monitoring shall be done at least every six months and until at least two consecutive measurements taken at least seven days apart, are below the 30 micrograms level. For abatement projects of duration less than six months, employers should advance the monitoring schedule to accommodate the abatement work schedule.
- o Whenever initial determination or subsequent monitoring reveals that airborne exposure is above 50 micrograms per cubic meter (TWA), repeat monitoring quarterly until at least two consecutive measurements taken at least seven days apart, are below 30 micrograms per cubic meter (TWA). For abatement projects of short duration, employers should advance the monitoring schedule to accommodate the abatement work schedule.

Employers should consider additional exposure monitoring anytime a worker has an increased blood lead level warranting medical referral and not solely when medical removal occurs (see section 2.2.4). Any increase in worker blood lead levels suggests the possibility that overexposure may be occurring and that actions may be needed to prevent overexposure of other workers. Additional exposure monitoring can help identify sources of overexposure and needed modifications to abatement practices to reduce exposure.

2.2.2.2 When is Exposure Monitoring Optional?

Despite the advantages and utility of exposure monitoring outlined above, there are circumstances under which the employer may want to forego exposure monitoring and institute a full program of worker protection, including a respirator protection program. These circumstances are as follows:

- o When abatement of limited duration is to be performed one time only (e.g., abatement of a single unit which is expected to last less than two weeks). Exposure monitoring should be done when the contractor or owner plans on doing a series of single unit abatements over time even if full worker protection is used.
- o When exposure has already been well documented for specific methods of abatement and for experienced workers using these previously documented methods.

2.2.3. Engineering and Work Practice Controls

The most effective way to achieve worker protection is to minimize exposure through the use of engineering and work practice controls and not to rely solely on a respirator protection (RP) program. In addition to helping protect workers from overexposure, engineering and work practice controls protect the environment and occupants of adjacent units and make cleanup an easier task. (see Section 4.3.2).

Engineering and work practice controls that have a direct bearing on worker protection are described in other sections of these guidelines as follows:

- o Prohibition of unacceptable methods of abatement such as open-flame burning and sanding (see Section to 4.1.3).
- o Limited use of certain methods of abatement such as on-site paint removal by heat gun, caustic and solvent-based chemicals and wet scraping (see Chart 4.3 in Chapter IV).
- o Provision of "clean rooms" on-site for changing clothes and provision of washing facilities (see Section 2.2.5.2).
- o Shutting down forced air systems and sealing all intake and exhaust points in the work area (see Section 4.7.4.2) and provide alternative sources of heat if necessary.
- o Daily cleanup procedures (see Section 5.3.2.2)
- o Spray misting of dry debris prior to clean-up and prohibition of dry sweeping (see Section 5.3.2.2.a.(2))

2.2.4 Medical Surveillance and Medical Removal

Medical surveillance, which consists of biological monitoring of worker blood lead levels and medical examinations and consultations, must be implemented prior to employment. One purpose of biological monitoring is to establish a baseline blood lead level and to detect early changes in worker blood lead levels. Medical examinations and procedures, including blood lead collection, should be performed by, or under the supervision of, a licensed physician and preferably, one with board certification in occupational medicine. Appendix 2.2 contains information for physicians on medical surveillance of lead-exposed workers. Employers should become familiar with the information in Appendix 2.2 and provide a copy to all physicians caring for their workers.

Blood lead testing should only be performed by laboratories accredited by the College of American Pathologists or the federal Occupational Safety and Health Administration (OSHA). Appendix 2.3 lists blood lead testing laboratories approved by federal OSHA. All results must be provided to workers along with an explanation.

The current practices for medical surveillance and medical removal are provided below.[12,13] However, more recent research indicates health effects at lower levels of exposure. Therefore, recent research suggests that the current standards do not adequately protect workers, in particular, female workers and their future children. Each of the following sections provides information for employers on additional measures to protect workers from exposure and themselves from liability.

2.2.4.1 Referring Workers for Medical Exams/Consultations

Under current practices it is necessary to refer the workers for medical examinations and consultations as indicated below.[13] If a medical referral is made, then careful investigation and remedial action should be taken to reduce exposure or change worker behavior or both. Medical referrals should be made:

- Prior to their starting abatement work and prior to respirator fit testing, workers must be referred to a physician for a medical examination which includes the following elements:
  - A detailed work and medical history, with particular attention to past lead exposure, personal habits and past gastrointestinal, hematologic, renal, cardiovascular, reproductive and neurological problems.
  - A thorough physical examination, with particular attention to teeth, gums, hematologic, gastrointestinal, renal, cardiovascular and neurological systems. Pulmonary status should be evaluated if respiratory protection will be used.
  - A blood pressure measurement
  - A blood sample and analysis which determines: blood lead levels; hemoglobin and hematocrit determinations; red cell indices; and examination of peripheral smear morphology; blood urea nitrogen; and serum creatinine.
  - A routine urinalysis with microscopic examination
  - Any laboratory or other test which the examining physician deems necessary
  - A discussion of the adverse effects of lead, particularly the effects on fetuses (see Section 1.2, Chapter I, for a summary of blood lead levels associated with adverse health effects in children, fetuses, and adults).
- Immediately, whenever blood lead levels exceed 30 micrograms per deciliter (whole blood).[16]
- As soon as possible after a worker notifies the employer that he/she has signs or symptoms associated with lead toxicity.
- Whenever the employee desires medical advice concerning the effects of current or past exposure to lead.
- Immediately, upon notification that an employee is pregnant.[16]
- Whenever the employee desires medical advice on lead's effects on the employee's ability to procreate a healthy child.
- Prior to restarting work following medical removal.

2.2.4.2 Blood Lead Monitoring

Under current practices, worker blood lead monitoring should be done as follows:[13]

- o Before assignment, for each employee.
- o At least every two months during the first six months and after that every six months.
- o At least every two months for each employee whose last blood lead analysis indicated a level at or above 25 micrograms per deciliter. Continue testing at least every two months until two consecutive blood lead levels are below 25 micrograms per deciliter.
- o At least monthly during medical removal (see Section 2.2.4.3)
- o At termination of employment.

For reasons of worker safety and employer liability additional biological (blood lead) monitoring should be done for all new workers regardless of prior blood lead levels and exposure levels in the work area as follows:[16]

- o 30 days after beginning employment
- o Thereafter at least once every two months for 6 months and after that every six months until termination of employment or termination of the employee's involvement with lead paint abatement work for reasons other than medical removal

2.2.4.3 Implementing Medical Removal

Medical removal is the temporary removal of workers due to elevated blood lead levels. A current practice for medical removal is as follows:[17]

- o Whenever worker blood lead level is 30 micrograms per deciliter or higher.
- o Whenever the average of the last three blood tests is above 25 micrograms per deciliter (whole blood)
- o Whenever indicated by a physician's judgment based upon medical determination
- o Workers can return to former job status when two consecutive blood sampling tests indicate that the employee's blood lead level is at or below 25 micrograms per deciliter. If removal was due to a medical determination, a physician must approve the return to work.

2.2.5 Protective Clothing and Equipment

Protective clothing and equipment should be provided to all workers in order to help assure that lead dust is not transferred from the abatement work area to the homes, vehicles, and environment of workers. Protective clothing and equipment also serve to prevent skin and hair contact with hazardous chemicals (solvents and caustics) or contact with skin or eye irritants that may be used on a limited basis during abatement.

The employer is responsible for:

- Providing clean protective clothing and shoe covers of appropriate sizes on a daily basis
- Providing a clean changing area
- Having water available for washing of hands and face and shower facilities if possible
- Enforcing the removal of protective clothing at the end of each work day and before eating, drinking, and smoking
- Enforcing the removal of shoe covers upon leaving the work area
- Appropriate disposal or laundering of work clothes
- Providing protective clothing and equipment when the possibility of skin or eye irritation exists
- Informing the worker how to maintain clothing and equipment

2.2.5.1 Types of Protective Clothing and Equipment

The following protective items may be required during abatement, cleanup and disposal:

- Gloves
- Hair protection
- Eye goggles and face shields
- Respirators and Respirator cartridges
- Protective coverall
- Shoe covers

Protective coveralls and shoe covers constitute basic worker protection gear and must be worn at all times by all workers. Disposable coveralls and shoe covers are preferred to avoid the need for laundering of gear.

Disposable items can either be breathable or non-breathable. Non-breathable coveralls should not be used when the possibility of heat stress and exhaustion exists. The possibility of heat stress and exhaustion should be discussed with the abatement project's health and safety consultant/expert.

Glove material should be appropriate for the specific chemical exposure (e.g., caustic or solvent). Cotton gloves provide some protection against contamination of hands and cuticles with lead dust. Paper suits and shoe covers are not appropriate for wet abatement processes. Employers have the responsibility of providing the appropriate respirator cartridges. The HEPA cartridge provides protection against dusts, mists and fumes and is always necessary when using a respirator on a lead abatement project. Additionally, an organic vapor cartridge needs to be added to the HEPA filtering cartridge when organic solvents are used on the work site. If the chemical stripper contains methylene chloride, then a supplied air respirator should be used.[16]

a. Respiratory Protection (RP) Programs

A limitation of RP programs is their reliance on strict worker compliance to attain necessary worker protection. Failure to wear or maintain the respirator at all times, and in accordance with manufacturer recommendations, can result in significant exposures to lead and/or other toxins. For this reason, contractors should conduct frequent random inspections to help ensure that respirators are properly selected, used, and maintained. For example, random inspections may need to be done daily or even periodically throughout the day, particularly to ensure that new employees develop safe work practices.

(1) When are RP Programs Necessary?

Respiratory protection programs are always necessary in the absence of exposure monitoring information that indicates, without a doubt, that respiratory protection is not needed. Contractors should be aware that, as of the time these guideline were prepared, the exposures associated with various methods and phases of abatement are not well documented. Until such time as exposure monitoring and research on effects of lead at lower levels indicates that respiratory protection is not needed, use RP as a measure to supplement engineering and work practice controls. When effective engineering controls are not available or feasible, then strict reliance on implementation of RP programs and an awareness of their limitations are necessary. Respirators should be furnished any time an employee makes a request.

The Maryland OSHA Lead in Construction Standard specifies that respiratory protection is needed when initial determination (see Section 2.2.2) indicates an airborne lead concentration above 50 micrograms per cubic meter^3 (TWA).

Employees concerned about exposure at or below 50 micrograms per cubic meter should request respirator protection. Female employees, in particular, may want added respirator protection.

(2) Respiratory Protection Program Requirements

The U.S. Occupational Safety and Health Administration (OSHA) has regulations that outline requirements for a minimal acceptable program of respiratory protection (29 CFR 1910.134). More stringent state and local requirements may apply. Therefore, the abatement contractor should check if there are any additional local and state requirements for respiratory protection programs.

When respirators are provided, a respiratory protection program must be established in accordance with these OSHA regulations and respirator fit testing must be conducted. A medical examination must be performed by a physician prior to fit testing and any time an employee exhibits difficulty breathing during respirator fit testing or use. Certain pre-existing health conditions may preclude a worker from safely using a respirator.

The requirements for a minimal acceptable respiratory protection program are as follows:

- o Establishment of written standard operating procedures governing the selection and use of respirators.
- o Selection of respirators on the basis of hazards to which the worker is exposed.

- o Training of workers on the limitations and use of respirators, including fit testing.
- o Assignment of respirators to individual workers for their exclusive use.
- o Daily cleaning and disinfecting of respirators.
- o Storage of respirators in a convenient and sanitary location.
- o Inspection of respirators for worn and deteriorated parts during cleaning.
- o Surveillance of work area conditions and degree of employee exposure or stress.
- o Evaluation of program effectiveness.
- o Medical examination of workers by a physician prior to fit testing and annually thereafter.
- o Use of approved respirators only.

2.2.5.2 How to Use Protective Clothing and Equipment

Procedures prior to the start of work:

- o Change into work clothing and booties in the clean section of the designated changing areas.
- o Don appropriate size work garments and use duct tape to reinforce seams (e.g., underarm, crotch, and back).
- o Any clothing not worn under protective clothing needs to be stored in the designated changing area.
- o Select and wear appropriate protective gear, including respirators if needed, before entering the work area.

Clothing that is appropriate for weather and temperature conditions should be worn <u>under</u> protective clothing.

Procedures upon leaving the work area:

- o Heavily contaminated work clothing should be HEPA vacuumed while still being worn.
- o Remove shoe covers and leave them in the work area.
- o Remove protective clothing and gear in the dirty area of the designated changing area prior to eating, drinking and smoking outside the work area and prior to leaving the work site. Protective coveralls should be removed carefully by rolling down the garment to reduce exposure to dust. Respirators should be the last item of gear removed.
- o Wash hands and face.
- o Clean respirators and change cartridges as needed when breathing becomes difficult.

Procedures upon finishing work for the day (in addition to procedures described above):

- o Place disposable coveralls and shoe covers with abatement waste.
- o Place clothes for laundering in a closed container.
- o Wash hands and face again.
- o If showers are available, take shower and wash hair.

- o Clean protective gear, including respirators according to standard procedures.
- o If shower facilities are not available at the work site, workers should shower immediately at home and wash hair.

2.2.5.3 Care and Maintenance of Protective Gear

a. Respirators

- Inspect daily for defects and perform a leak check
- Clean and disinfect daily
- Repair as needed
- Store in plastic bag at end of work day

b. Goggles, gloves, and rubber boots

- Wash and air dry daily
- Store in plastic bag at end of each work day

See Section 5.3.2.4, Chapter V, for procedures for cleaning tools, equipment, and vehicles.

2.2.6 Record Keeping

The purpose of record keeping is to be in compliance with any local, state and federal regulations, and for insurance and liability purposes.

The abatement contractor is responsible for maintaining written records of:

- Exposure monitoring
- Medical surveillance
- Medical removal

2.2.6.1 Exposure Monitoring Records

The following information should be contained in exposure monitoring records:

- o Dates, number, duration, location and results of each of the samples taken.
- o A description of the sampling procedure(s).
- o A description of the sampling and analytical methods used and evidence of their accuracy.
- o The type of respirator worn, if any.
- o Employee name, social security number, and monitored job classification.
- o Environmental variables that could affect the measurement of employee exposure.

Exposure monitoring records should be maintained for 40 years or for the duration of employment plus 20 years, whichever is longer.

2.2.6.2 Medical Surveillance Records

Medical surveillance records shall include: [12,13]

- o Employee name, social security number, and description of duties.
- o A copy of the physician's written opinions.
- o Results of any airborne exposure monitoring done for that employee and the representative exposure levels supplied to the physician.
- o Any employee medical complaints related to lead exposure. The employer or the examining physician keeps:
  - A copy of the medical exam results, including medical and work history and the description of laboratory procedures. The employer may only receive a summary of medical exam results for his records.
  - A copy of any standards/guidelines used to interpret the test results.
  - A copy of the results of any biological monitoring.

Medical surveillance records should be maintained for 40 years or for the duration of employment plus 20 years, whichever is longer.

2.2.6.3 Medical Removal Records

Medical removal records should include the name and social security number of the employee, the date on each occasion that the employee was removed from current exposure to lead, as well as the date on which the employee was returned to his or her former job status. A brief explanation of how each removal was or is being accomplished and a statement with respect to each removal indicating whether or not the reason for the removal was an elevated blood lead level. These records should be maintained for at least the duration of an employee's employment.

2.2.7 Finding Qualified Trainers, Industrial Hygienists, Health and Safety Technicians

The following are sources of information to identify qualified trainers and industrial hygienists or health and safety technicians. It is important to inquire about the person's knowledge and direct prior experience with lead hazard abatement.

- o Federal, state, and local government occupational safety and health or industrial hygiene units (see Appendix 2.4 for list of regional offices of OSHA)
- o State or local departments of health or environment
- o American Academy of Industrial Hygiene or one of its local chapters.
- o American Industrial Hygiene Association.
- o American Society of Safety Engineers.
- o Academic or university-based environmental centers.

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Chapter III - TESTING

3.1 Introduction

Thorough and accurate testing is a key part of the effort to eliminate lead-based paint hazards. Testing is performed in three phases: during random and 100 percent testing to detect lead-based paint hazards; during abatement to monitor airborne lead dust levels to determine appropriate levels of worker protection; and after abatement to determine whether abatement and cleanup is complete. This chapter presents requirements and recommendations for the following:

- o How to develop a plan for testing.
- o How to conduct testing to detect lead-based paint, including what units should be tested; what surfaces should be tested; what testing methods should be used; and how to use those methods.
- o How to conduct air monitoring during abatement.
- o How to conduct visual inspection and surface dust testing after abatement has been completed.
- o How to ensure the safety of testing personnel.
- o How to find qualified testing personnel.

The following is a checklist of actions to be taken by the inspector or testing agency during the three testing phases.

Random and 100 Percent Testing

- o Determine which units will be inspected.
- o Learn the background and goals for the inspection.
- o Fill out identifying information on survey form; sketch the dwelling in the space provided.
- o Identify surfaces to be tested.
- o Determine testing methodology(ies) to be used.
- o For XRF use:
  - Warm up and check calibration of the instrument.
  - Recheck calibration as necessary.
  - Compensate for substrate as necessary.
  - Take recommended number of readings at each sample site.
- o Take paint samples for laboratory analysis where recommended.
- o If analysis of paint samples is needed, notify an accredited laboratory that it will receive paint samples.
- o Record all test data on survey form.
- o Note conditions that can impede abatement (e.g., water leaks).
- o Determine which units and which surfaces should be abated.
- o Notify owner, occupants, and state/local agencies of inspection results (if necessary).

During Abatement

- o Take pre-abatement surface wipe samples outside areas to be abated.
- o Ensure that air monitoring equipment is in place or air monitoring firm is

on hand. Take air samples as recommended.
- o Notify laboratory that air samples will be submitted.
- o Conduct frequent work site inspections to ensure that engineering controls are in place and abatement is conducted according to the approved abatement plan, including those portions concerning worker protection.

Post-Abatement
- o Review surfaces that were found to have a lead hazard; surfaces that have been abated; and abatement methods used.
- o Perform visual inspection prior to and after repainting.
- o Notify laboratory that surface dust samples will be submitted.
- o Conduct surface wipe testing after repainting.
- o Document results of the final inspection.
- o Notify owner, occupants, and state/local agencies of results of the final inspection.

3.2 How to Develop a Comprehensive Testing Plan

A comprehensive plan for random testing (and 100 percent testing, if necessary) should be developed before testing begins. If lead-based paint is found, a plan for carrying out required testing during and after abatement must be developed as well. This section explains the roles and responsibilities of the participants in the three testing phases, and provides guidance for developing a comprehensive testing plan.

3.2.1 Roles and Responsibilities

The first step in developing a testing plan is to understand clearly the roles and responsibilities of all participants in the testing process, as described below.

3.2.1.1 Owner

The responsibilities of the building owner include the following:

- o Have properties inspected as required by federal, state, and local laws.
- o Select a laboratory to analyze samples from the properties (this can be delegated to the inspector).
- o Design or approve a system to document all information about lead paint on the properties.
- o Develop or approve a communications package for discussions with building occupants and others.
- o Select a technical advisor, if necessary, to assist in designing and monitoring the abatement work.
- o Ensure that abatement work is carried out in a safe and legal manner (e.g., ensure that air monitoring is conducted during abatement as recommended or required; ensure through frequent work site inspections by the owner or technical advisor that all plans and procedures are properly implemented).
- o Obtain the services of a qualified inspector (one trained in all aspects

of conducting the final inspection, including visual inspection and surface dust testing), industrial hygienist, or local public health official to conduct the final inspection. (See Section 3.7 for guidance in finding qualified testing personnel.)

- Ensure that abatement work is complete according to federal, state, and local regulations and guidelines.
- Notify occupants of the presence of lead paint hazards.

3.2.1.2 Testing Agency/Inspector

The responsibilities of the testing agency and inspectors who conduct random and 100 percent testing are to:

- Have a thorough knowledge of all relevant federal, state, and local regulations.
- Acquire a thorough knowledge of the required or recommended methods of testing paint, air, and surface dust and when to apply them.
- Obtain thorough training for all inspectors.
- Obtain certification and/or licensure where required.
- Accurately identify lead hazards on a property.
- Conduct testing in an honest and ethical manner.
- Thoroughly understand the use of the XRF analyzer, including possible sources of error.
- Recognize situations in which laboratory analysis of paint is recommended.
- Notify laboratories of paint, sample to be submitted, and follow laboratory instructions for sample collection and submissions.
- Fully document in a clear and unambiguous manner, the results of the testing and the location of all samples; notify owner of testing results (as well as state or local agencies if required).

As a general rule, to avoid potential conflict of interest, a testing firm should not perform abatement on the same project on which it has conducted testing for lead-based paint.

Responsibilities of testing agencies that perform monitoring during abatement include the following:

- Familiarize themselves with the abatement plan and review abatement work to ensure that it conforms with the approved abatement process plan (including procedures for containment and for worker protection).
- Be accessible to the owner, abatement contractor, and occupants to answer questions.
- Conduct air monitoring during abatement and submit samples to the laboratory.

Responsibilities of testing agencies and inspectors that conduct final inspections include the following:

- Determine if abatement was carried out according to the approved abatement plan and is complete, through visual inspection and surface dust sampling.

- Document results and notify owner (and state or local agencies if required).

To avoid potential conflict of interest, a single firm should not perform both abatement and final inspection.

3.2.1.3 Engineer/Architect/Designer

It is the responsibility of the engineer/architect/designer to prepare designs, cost estimates, and specifications for building renovations in accordance with applicable codes and test results. If abatement is done in conjunction with modernization, these persons are also responsible for sequencing the work, with particular attention to the protection of the general contractor. Engineers, architects, and designers have a responsibility to be continually aware of developments in abatement. If necessary, they may assume the role and responsibilities of the modernization director (see Section 4.2.2.1, Chapter IV).

The services of other consultants (such as trained and experienced industrial hygienists, engineers, and architects) may also be used for designing and writing the specifications for removal of lead paint identified during random and 100 percent testing. These consultant also should specify the requirements for releasing the abatement contractor, including visual inspection and surface dust testing, in accordance with applicable regulations and guidelines.

a. Qualifications

- Engineers, architects, designers, and other consultants should have experience and/or training in lead-paint abatement design. They should have references, including a list of the last five jobs undertaken and the references should be scrupulously checked. They should also be certified if required by the state.
- If the nature or scope of the abatement work is such that engineers, architects, or industrial hygienists must be utilized, these individuals should be under the supervision of registered professional engineers, registered architects, and certified industrial hygienists, respectively.

b. Sources for Locating Qualified Professionals

- State agencies that certify professionals for lead-paint abatement work usually compile a list of certified companies/individuals.
- Other building owners.
- The regional EPA laboratory.
- Inquire at the local chapter of the American Industrial Hygiene Association.

3.2.1.4 Project Manager

The project manager, as a representative of the owner, typically oversees all activities that involve construction, including lead-paint abatement. If a painted surface is involved in a planned construction or rehabilitation project, it is the project manager's responsibility to make sure that testing is conducted before the construction or rehabilitation work is designed or initiated. If lead paint is found, then a lead-paint abatement program must be established.

In most facilities, the project manager assumes the management responsibilities of the abatement program and hires a technical advisor to help design and implement the program. In larger facilities, or facilities undergoing a great deal of lead-paint abatement or other lead-paint related construction work, it may be necessary for the project manager to hire an abatement program manager. The responsibilities of the project manager are determined by the owner, who delegates either all or a portion of his/her responsibilities.

A project manager's responsibilities could include:

- o Organizing a lead-paint inspection and selecting a technical advisor or inspector.
- o Training maintenance workers to ensure that they do not inadvertently expose themselves or others to lead dust or fumes in the course of their work.
- o Documenting all lead-paint related activities, including maintenance and tenant notification programs.
- o Monitoring maintenance, renovation, and construction activities to make sure that lead paint is not improperly removed, disturbed, or disposed of.
- o Hiring technical advisors to design lead paint abatement programs.
- o Choosing a contractor to remove lead paint.
- o Coordinating all parties involved in construction activities, including tenants, contractors, and technical advisors.
- o Ensuring all lead paint abatement is accomplished in accordance with all applicable regulations.

3.2.1.5 Abatement Contractor and/or Subcontractor

The contractor and his/her subcontractors (and the Public Housing Authority [PHA], if abatement work is done in-house) are responsible for abating the lead paint in a safe manner in accordance with the specifications. See Section 4.3.3.4, Chapter IV, for specific responsibilities of the abatement contractor.

To avoid potential conflict of interest, the abatement contractor should not conduct the final inspection. This should be done by a qualified inspector, industrial hygienist, or local public health official.

3.2.1.6 Laboratories

It is recommended that PHAs locate a qualified laboratory by one of the following means:

- o Select a laboratory accredited by the American Industrial Hygiene Association (AIHA) for the analysis of metals. (This accreditation attests only to the laboratory's ability to measure the amount of metals in air samples accurately. However, it is the only accreditation for lead analysis available).
- o Select a laboratory that is a successful participant in the AIHA sponsored Proficiency Analytical Testing (PAT) program.
- o Contact state public health agencies for guidance regarding other qualified laboratories.

The method of analysis used should be reviewed by the PHA to ensure compliance with HUD or other federal, state, or local requirements. The laboratory should be able to answer the following questions about the method used:

- o What is the detection limit for the method?
- o What specific procedures will be used (e.g., specific NIOSH or ASTM methods)?
- o What are the limitations of the method, including interferences?

The laboratory should also furnish details for sample collection and submission.

3.2.1.7 State/Local Environmental Health Agencies

State and local environmental health agencies are gradually playing a larger role in lead paint abatement. In some states, allowable abatement procedures and analytical methods have been mandated. States with regulations also have enforcement capabilities. Usually, these states require advance notification of abatement projects so that enforcement agencies can systematically inspect and assure the quality of the abatement project. These agencies should be consulted prior to the initiation of a lead paint survey or abatement program.

3.2.2 Elements of a Testing Plan

In addition to establishing the roles and responsibilities of each participant in the testing process, a comprehensive testing plan should address the following:

- o How to schedule testing to comply with regulations and, when abatement is necessary, how to coordinate testing with abatement and cleanup.
- o How to select the appropriate testing methodology.
- o How to select units to be tested.

3.2.2.1 Schedule

Testing must be conducted to determine whether a lead-based paint hazard exists in all phases of a lead abatement program. Table 3.1 summarizes the type of testing recommended during each phase of the project.

Table 3.1

Recommendations for Testing

	Random and 100% Testing	Pre-abatement/ During Abatement	Post-Abatement
Paint testing with portable XRF analysis	Recommended in all cases, except as as below (see 3.3.6 and Appendix 3-3).		
Paint Testing using[1] Laboratory Analysis	Recommended in specific, limited situations (see 3.3.7 and Appendix 3-4).		
Personal Air Monitoring[2]		Recommended during abatement (see 2.2.2 and 3.4.3).	
Monitoring the Abatement Process		Recommended (see 3.4.4)	
Visual Inspection			Recommended (see 3.5.2).
Surface Wipe Testing[3]		Recommended pre-abatement outside abatement areas. Does not apply if entire unit is abated. (See 3.4.2).	Recommended (see 3.5.3 and Appendix 3-7).

1. Amount of lead to be recorded as percent by weight
2. Amount of lead to be recorded as micrograms per cubic meter
3. Amount of lead to be recorded as micrograms per square foot

Testing must be coordinated among all affected parties. For example:

- o The inspector or agency conducting the final inspection should know the approximate date the abatement and cleanup will be completed, so that visual inspection and wipe testing can be scheduled.
- o An inspector or firm using a laboratory should determine in advance how long it will take to get results. (The timing of wipe sample results, for example, will determine when the abatement contractor will need to perform additional cleanup, if necessary, and when the unit can be re occupied.)
- o The schedule for abatement activities must be clearly communicated to the testing agency performing air monitoring.

3.2.2.2 Selection of testing methodology

The testing plan will include the methodology to determine whether a lead-based paint hazard exists; the level of worker exposure to lead dust; and the effectiveness of abatement and cleanup.

3.2.2.3 Selection of units to be tested

The requirements and recommendations for selecting units to undergo testing are explained in Section 3.3.2.

3.3 Random and 100 Percent Testing

The Lead Paint Poisoning Prevention Act (LPPA) currently requires abatement of all interior and exterior surfaces in public and Indian housing with a lead content of <u>1.0 mg/cm</u>^{2} or higher. The standard was set at 1.0 mg/cm^2 partly because the portable x-ray fluorescence XRF analyzer may not reliably detect lead below that level. The law permits HUD to reduce this level when reliable technology makes it feasible to detect a lower level of lead in paint. Public housing authorities may elect to abate lead-based paint below the required abatement level of 1.0 mg/cm^2. PHAs are eligible for funding to abate paint and dust that exceed .06 percent lead (the Consumer Product Safety Commission standard for manufactured residential paint).

These Guidelines recommend an action level of 0.5% for lead in paint when the portable XRF analyzer cannot be used and laboratory analysis is obtained. There is no equivalency between the 1.0 mg/cm^2 and the 0.5% recommendation, because one expresses the lead mass per unit area and the other expresses the percent of lead in the paint by weight. However, the 0.5% action level is a reasonable and achievable level for abatement. This level is used as a standard in some cities and states (e.g., Maryland and Massachusetts). In most instances, abatement to this level will be <u>more</u> stringent than the 1.0 mg/cm^2 requirement.

Table 3.2 lists standards and recommendations for lead in paint.

Table 3.2

Statutory Requirements and Recommendations for Lead-Based Paint*

Level of lead in paint	Statutory Requirement or Recommendation	Description
1.0 mg/cm^2 abatement	Statutory Requirement	Federal Law currently requires in public housing at levels at or above 1.0 mg/cm^2, as measured by the XRF analyzer.
0.5 percent (5000 parts per million)	Recommendation	This manual recommends 0.5 percent as an action level when laboratory analysis is used.
0.06 percent	Statutory Requirement	The federal Consumer Product Safety Commission (CPSC) standard for lead in manufactured residential paint. PHAs may elect to abate lead-based paint to this level. However, abatement to a level this low is not considered feasible.

*State and local requirements may differ.

3.3.1 What Units to Test

Inspections for lead-based paint must be conducted as part of both random sampling and 100% testing.

Random Sampling

- The Lead Paint Poisoning Prevention Act (LPPPA) requires random testing of dwelling units and common areas in all public housing family projects constructed or substantially rehabilitated before 1978.
- Random sampling should be conducted prior to beginning comprehensive modernization.
- Inspection of housing not receiving CIAP assistance (Comprehensive Improvement Assistance Program) must be completed within 5 years of the completed HUD demonstration project report required under the LPPPA.
- In the absence of specific regulatory requirements, random testing should be conducted first in the oldest and, therefore, probably the most hazardous occupied units.

3.3.1.1 What is a Random Sample?

Current HUD regulations require that 10 units be tested in projects containing 20 or more units and that 6 units be tested in projects with 19 or fewer units.

The inspector can take steps to ensure that the units tested are representative of the units in a project. The following are general recommendations:

- The units selected should reflect the percentages of one-, two- and three-bedroom units in the project.
- At least one unit should be tested in each building in a project.
- Common areas and exteriors that are tested should be representative of these areas throughout the project.
- Units should be selected to represent areas of a project constructed at different times.
- Twenty percent of the units in a project are recommended to obtain a representative sample.

3.3.1.2 100% Testing

One hundred percent testing (testing of units in a project) is required whenever lead levels of 1.0 mg/cm^2 or higher are found during random testing. HUD field offices should be consulted for requirements pertaining to 100 percent testing.

3.3.2 What Surfaces to Test

All painted and varnished surfaces should be tested during random testing. Linoleum, vinyl wall coverings, etc., may be covering surfaces previously painted with lead-based paint. These should be tested, as these materials may be removed during future modernization.

Some surfaces will require more than one sample site. This will be obvious in some situations, such as when a wall is divided by a chair rail. The inspector should also be aware of situations where different areas on the same surface may have different painting histories or different amounts of paint. (For example, paint may be thicker near the edge of a wall, particularly if paint was applied with brushes.)

Multiple sample sites that reflect these differences should be selected. For example, if the inspector suspects that a very large room was two rooms at one time, he or she should select a sample site on each half of the ceiling and the larger walls. Table 3.3 presents guidelines for surfaces to be tested during random testing.

Table 3.3
Guidelines for Surfaces to be Tested during Random Testing*

INTERIOR

In each area (each room, closet, pantry, hall, part of a divided room, such as the dining area of a kitchen/dining room, etc.), test the following surfaces:

- Window: test window sash, window casing, and window sill on a representative window.
- Door: test surface of door and one side of the frame on a representative interior door in each area.
- Wall: test upper wall, lower wall, and chair rail, if wall is divided by a chair rail, in each area.
- Baseboard: test one baseboard per area
- Ceiling in each area
- Crown molding: one test in each area
- Shelf: one shelf per area
- Shelf support in each area
- Stairs: test riser, tread, stringer, newel post, railing cap, baluster.
- Floor in each area
- Radiator
- Fireplace

EXTERIOR

- Siding
- Door: test surface of door and door casing
- Window: test sill, casing, and sash of a representative window (also test cellar window unit)
- Skirt
- Cornerboard
- Trim: test upper and lower trim
- Bulkhead
- Fence
- Painted roofs

PORCH

- Floor
- Ceiling
- Support column
- Joist
- Railing cap
- Lower railing
- Stairs: test tread, riser, and handrail
- Lattice

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* Many of these surfaces are illustrated in appendix 3-2. During 100 percent testing, PHAs may test only the specific surfaces found to have lead during random testing, as indicated in Table 3.4.

Table 3.4

Guidelines for Surfaces to be Tested during 100 Percent Testing

OUTCOME OF RANDOM TESTING	ACTION TO BE TAKEN
No lead found	No further testing required
Lead found on some of a specific surface (such as some exterior doors)	Test in 100% of units. Specific surface testing may be done. For example, the PHA may test only all exterior doors in 100% of units if lead was found only on exterior doors during random testing
Lead found on all of a specific surface (such as all exterior doors)	The PHA may assume lead is present in 100% of the units on all of the specific surfaces found to have lead in the random sample (such as all exterior doors). All these specific surfaces must then be abated in 100% of the units. The PHA may assume that the remainder of the surfaces do not have lead paint; no further testing is required.
Removal/replacement of components, such as windows or gut rehabilitation scheduled	100% testing not required. (Random testing is recommended to determine if a lead hazard exists, to plan for worker protection and disposal.)

3.3.3 Using the Survey Form

- Sketch the dwelling in the space provided, identifying where north is on the diagram (using a compass or the sun). Rooms should be identified by numbers, not names; what may be a living room at the time of the survey might be converted into a bedroom in the future.
- Fill out identifying information at the top of the form before beginning the survey.
- For each sample site (a specific spot where an XRF reading or sample for laboratory analysis is taken) ensure that the room number and specific component are clearly identified. (For example, Room #2, Wall #3, Window sill).
- For each sample site, record all XRF or laboratory data obtained. Further information on using the survey form is provided in Appendix 3-1.
- Proceed clockwise around the room until the first sample site is reached.

3.3.4 Testing Methodology

The LPPPA allows use of a portable XRF analyzer, laboratory analysis using atomic absorption spectroscopy, or a comparable approved testing technique. It is recommended that portable XRF analyzers be used in all situations except those listed in 3.3.6. This method is faster and less expensive than laboratory analysis, and generally does not require destruction of surface paint. However, XRFs cannot accurately detect lead on some surfaces. XRF readings between 0.7 and 1.3 mg/cm^2 may not be reliable for determining whether the true lead concentration is above or below the 1.0 mg/cm^2 action level. Laboratory analysis is recommended for these situations as discussed in 3.3.6.

Laboratory results can be very accurate if the sample is properly collected and analyzed. When XRF results are questionable or cannot be obtained, "backup" laboratory analysis can help the PHA avoid unnecessary abatement costs, or can help avoid potential lead poisoning by identifying needed abatement.

The use of sodium sulfide for detection of lead-based paint is not recommended by the NIBS Lead-Based Paint Project Committee. Chemical spot testing using a solution of 6 to 8% sodium sulfide is sometimes used to screen painted surfaces for the presence of lead. When sodium sulfide is applied to lead-based paint, it turns gray or black. Because sodium sulfide is a qualitative rather than quantitative method, the inspector can determine that lead is probably present, but cannot determine the concentration of lead in the paint. Sodium sulfide also may turn black or gray in the presence of other metals in the paint, such as copper or iron, giving a "false positive" reading. It may also be difficult to determine whether a color change has occurred if the paint itself is very dark, or if there is varnish underneath the paint. Finally, sodium sulfide deteriorates quickly. An old solution is likely to encourage a wrong decision.

3.3.5 Using the Portable XRF Analyzer

While the portable XRF analyzer is a valuable tool for testing for lead-based paint, it also has the potential to give very inaccurate results. The inspector must understand how the instrument works, the factors that affect readings, and the proper procedures for using the XRF analyzer. Unless the instrument is used properly and its limitations recognized, the inspector can easily obtain false negatives, possibly leading to lead-poisoned children in unabated dwellings, or false positives, leading to costly but unnecessary abatement work.

Appendix 3-3 presents more detailed information on use of the XRF analyzer.

The guidance presented in Appendix 3-3 is not intended to be a substitute for comprehensive classroom and on-the-job training in the use of the XRF analyzer. Surveys using the XRF analyzer should never be conducted by an untrained operator. Section 3.7 discusses the minimum training that is necessary for developing proficiency in XRF use.

3.3.6 Laboratory Analysis of Paint Samples

It is recommended that laboratory analysis be obtained in the following situations:

- When the average XRF reading at a sample site lies in the range of 0.7 to 1.3 mg/cm^2. A paint sample for laboratory analysis should be obtained from a representative sample of surfaces reading in this range.
- When a sample site is too small or too narrow for analysis by the portable XRF (see Appendix 3-3).
- When the sample surface is otherwise unsuitable for obtaining accurate XRF readings. This may include sculptured surfaces, surfaces with grooves, and tubular surfaces. (See Appendix 3-3).

3.3.6.1 Collecting the Sample

The first step is to contact the laboratory that will perform the analysis to inquire about its requirements for sample collection and submission. Paint samples for laboratory analysis must be carefully collected in a uniform and consistent manner. It is important that the sample contain all layers of paint and varnish, down to (but not including) the bare substrate. It is also important to minimize the amount of substrate or other nonsurface coating materials in the sample since these will dilute the results. Appendix 3-4 presents recommended procedures for collecting paint samples.

3.3.6.2 Laboratory Analysis Methods

A number of laboratory methods are used to measure lead in paint. Three acceptable methods, atomic absorption spectroscopy, x-ray fluorescence, and inductively coupled plasma-atomic emission spectroscopy, are described in Appendix 3-5. Appendix 3-6 discusses laboratory quality assurance and quality control.

3.4 Testing Before and During Abatement

This section discusses pre-abatement surface dust testing, air monitoring during abatement, and monitoring of the abatement process. It also discusses health and safety precautions for personnel conducting testing during abatement.

3.4.1 Hazards during Abatement

The primary hazard during abatement is airborne dust from sanding, scraping, other manual methods of removing paint, and fumes resulting from chemical solutions and heating of lead-based paint. This is a hazard for abatement workers and anyone else who enters the vicinity of ongoing abatement work. The airborne dust may contaminate areas outside the areas undergoing abatement if proper containment measures are not used. The lead dust generated during abatement is also a hazard for the families of abatement workers if proper hygienic measures are not taken at the end of the work day. The health effects of this hazard and the precautions that must be taken to protect workers are discussed in Chapter II of this manual.

3.4.2 Pre-abatement Surface Dust Testing

Pre-abatement surface dust testing in areas that will not undergo abatement is recommended to determine whether these areas are subsequently contaminated by the contractor during the abatement process. The results of these pre-abatement surface dust tests are compared to surface dust tests taken after abatement is completed. Guidance for measuring surface dust through surface wipe testing is presented in 3.5.2 and Appendix 3-7.

3.4.3 Air Monitoring

Air monitoring during abatement is recommended as part of the worker protection plan, to determine the level of airborne lead and the respiratory protection level required. Federal, state, and local regulations regarding occupational exposure monitoring should be followed. (See Chapter II)

3.4.3.1 How to Conduct Air Monitoring

Personal samples should be collected daily from within the breathing zone (as close to the mouth as possible) of a worker, but outside the respirator. The samples are collected with a personal sampling pump which is hung from a belt around the worker's waist. A filter holder is attached to the worker's lapel or collar. The samples should be representative of the exposure of each employee. Representative personal sampling can be achieved by measuring the exposure of the employee who can reasonably be expected to have the highest exposure. This exposure level is considered representative of the rest of the employees.

3.4.3.2 Sampling apparatus

1. Sampler mixed cellulose ester filter, 0.8 micrometer pore size, 37 millimeter diameter in a 2 or 3-piece cassette filter holder. (Sampling technique should be closed face sampling.) The filter should be assembled in the cassette with a cellulose support pad.
2. Tygon tubing, 6.4 millimeter outside diameter.
3. Personal sampling pump calibrated a 2 to 4 liters per minute.
4. Pump should be calibrated before and after the sample is taken, with either a primary standard or a secondary standards, such as a rotometer, that has been calibrated with a primary standard.

NIOSH Analytical Method 7082 (Atomic Absorption Spectrophotometry) recommends a flow rate of 1 to 4 liters per minute and a total volume of 200 to 1,200 liters. Eight-hour samples are desirable to facilitate comparison with the guidelines for exposure discussed in Chapter II of this manual (30 ug/m^3 TWA). Over an 8-hour period, filters may have to be changed several times to prevent overloading. NIOSH Method 7300 (Inductively Coupled Argon Plasma-Atomic Emission Spectroscopy) can also be used.

For quality control purposes, a blank filter should be submitted with each group of samples. This filter is handled in the same way as the sample filters except no air is drawn through it. Laboratory quality control measures are described in Appendix 3-6.

3.4.4 Monitoring the Abatement Process

The PHA or technical adviser should conduct frequent work site inspections to ensure that abatement plans and procedures are properly implemented, including procedures for containment and for worker protection. See Chapters II and IV for more specific guidelines on proper abatement procedures and work practices.

3.4.5 Testing Personnel During Abatement

All personnel in the work area during abatement (including those performing air monitoring) are exposed to potentially hazardous levels of lead dust. They must conform to the requirements and recommendations for protective clothing, personal protective equipment, and safe work practices explained in Chapter II. It is also advisable for testing personnel to have blood lead monitoring done every 6 months. (This is a requirement in some states and localities). Female testing personnel of child-bearing age should be aware that blood lead levels in pregnant women as low as 10 micrograms per deciliter may affect the cognitive development of offspring.

3.5 Post-abatement Testing

While there may be some residual airborne dust, the primary post-abatement hazard is lead-contaminated surface dust. The abatement process often releases large amounts of lead (even when methods that do not release much visible dust, such as caustic paste, are used). Acceptable levels of lead in dust are only a few hundred micrograms per square foot, but abatement without proper cleanup can yield dust lead levels of several thousand micrograms per square foot. For these reasons, final inspection should include not only inspection to ensure that lead paint has been abated, but also testing of lead levels in surface dust. Chapter V presents guidelines for surface dust lead levels to be used in clearing an abated dwelling for reoccupancy.

There also will be a post abatement hazard if abatement work is not complete and lead paint remains in the dwelling. Section 3.5.2 below addresses the need for reinspection to ensure that no lead paint remains.

3.5.1 Visual Inspection

Before repainting, a thorough visual inspection should be performed to determine if the work is complete. The inspection should be conducted after plastic sheets have been taken up and after initial cleanup by vacuuming and damp mopping with a high phosphate detergent.

First, the inspector should confirm job completeness. All surfaces noted in the initial inspection should be abated according to the approved abatement plan. Special attention should be given to areas where leaded paint has been removed adjacent to paint that is intact (for example, where paint has been removed from a door frame, but non-leaded paint is left on the baseboard). Paint at this joint should be sound. Windows should be checked for paint left in hard-to-reach places.

Next, the inspector should determine if the dwelling has been adequately cleaned by examining all surfaces for dust and debris. A damp cloth should be used to collect dust from surfaces such as floors or window sills. This is a practical method for establishing that no dust is left and should not be confused with dust monitoring. If dust is found, the work area should be recleaned and the test repeated.

Visual inspection should be performed again after repainting is done. The inspector should check to see that all abated surfaces and all floors have been repainted or otherwise sealed.

3.5.2 Surface Dust Testing

Surface dust sampling is the primary method to determine the levels of lead dust that are present after cleanup. The method currently recommended is surface wipe sampling, using commercial wipes moistened with a non-alcohol wetting agent. Chapter V discusses the points during cleanup and final inspection when wipe sampling is recommended.

The inspector should be aware of all abated surfaces in the dwelling. If there is a visible accumulation of dust, wipe sampling should be deferred until a thorough cleanup has been completed. Recommended procedures for wipe sampling and recommended limits for surface lead dust are provided in Appendix 3-7. Table 3.5 below presents the recommended number and location of wipe samples, according to the type and extent of abatement.

Table 3-5

Recommended Number and Location of Surface Wipe Samples

Type of Abatement Procedure	Number and Location of Wipe Sample
On-site paint removal throughout the unit	Three wipe samples in each area*, one each from a window well, a window sill, and floor.
On-site paint removal in limited areas	Three wipe samples in each abated area, one each from a window well, a window sill, and floor and One sample outside the containment area (within 10 feet) in 20% of the abated units.**
Replacement and/or encapsulation only, throughout the unit	One wipe sample in each area, divided equally between window wells, window sills, and floors.
Replacement and/or encapsulation only, in limited areas	One wipe sample in each abated area, divided equally between window wells, window sills, and floors. and One wipe sample outside the containment area (within 10 feet) in 20% of the abated units.**
Exterior abatement	At least one wipe test on a horizontal surface in part of outdoor living area (e.g., front porch).

* An area is a room, closet, pantry, hall, portion of room (such as dining area of a kitchen/dining room), etc. If a room and its closet are both abated, they can be treated as one area for the purpose of wipe testing.

** Compare to pre-abatement wipe samples to determine if dust from the abatement process has contaminated non-abated areas. The abatement contractor will be required to clean up these areas if contamination from the abatement process occurs, or if such cleanup is otherwise in his/her scope of work.

3.6 Record Keeping, Reporting, and Notification Requirements

The LPPPA requires that a qualified inspector certify in writing the precise results of inspection for lead paint hazards in public housing. A sample inspection form is included in Appendix 3-1. The results of the completed inspection should be provided to the public housing authority, to the affected tenants, and to public health agencies as required by state and local law. Inspection firms should maintain records of all inspections conducted to detect lead paint hazards.

Final inspection and certification after abatement must be made by a qualified inspector, industrial hygienist, or local public health official. A sample form for documenting the results of surface dust testing is included in Appendix 3-8. The inspector should issue a report to the public housing authority, affected tenants, and the state/local public health agency, detailing the results of the final inspection, the inspection techniques used, and the specific abatement procedures and products used. The public housing authority should maintain records evidencing compliance with applicable federal, state, and local requirements.

3.7 Recommended Qualifications for Testing Personnel

Trained and experienced testers are essential to the lead poisoning prevention effort. Several states are considering requirements for training and certification of inspectors to meet this need. At a minimum, it is recommended that inspectors meet the following qualifications:

- Three to five days of classroom instruction, covering:
  - federal, state, and local laws and regulations;
  - use of the portable XRF analyzer (including principles of operation number of readings required, factors that affect the XRF reading
  - when laboratory analysis is recommended
  - collection of samples for laboratory analysis
  - how to conduct and document a complete inspection
  - safety requirements and precautions
  - if the inspector conducts final inspections, how to perform visual inspection, and surface dust testing.
- Thirty to sixty days of on-the-job training, working with other inspectors to identify lead paint hazards on a variety of substrates, components, and housing types, with varying lead levels.
- Ability to perform mathematical calculations.
- Some knowledge of construction.
- Periodic retraining, particularly as new methods and procedures for detecting lead hazards are developed.

The performance of inspectors should be monitored periodically to ensure the quality of inspection results.

3.7.1 Sources of Training

Instruction on the use of the portable XRF analyzers should be obtained from the manufacturer of the instrument being used.

Princeton Gamma-Tech Inc.
1200 State Road
Princeton, NJ 08540

Warrington, Inc.
2205 West Braker Lane
Austin, TX 78758

Georgia Tech Research Institute provides training in various aspects of testing, such as building survey techniques using XRFs; use and limitations of the XRF; HUD regulations regarding lead-based paint; legal considerations; case studies in identification of lead-based paint; and criteria for the final inspection of abated units.

Economic Development Laboratory/EHSD
Georgia Tech Research Institute
Atlanta, GA 30332

Employers with substantial training and experience in testing may also train their testing personnel in aspects of the testing process, such as how to conduct testing for lead-based paint, how to conduct air monitoring, and how to perform surface dust testing.

3.7.2 Support from federal, state, and local agencies

Federal: Center for Environmental Health and Injury Control
MSF 28
Centers for Disease Control
Atlanta, GA 30333

States that have regulations concerning the detection and removal of lead paint require or soon will require that contractors and/or inspectors be certified to conduct lead abatement-related work. These states may have lists of certified individuals/companies. However, before using these lists, be sure to check the criteria for compiling the lists.

3.8 State and Local Regulations

A number of states and cities have laws and regulations covering identification of lead paint hazards and selection of units to be tested. Where state and local requirements are more stringent than Federal regulations, those state and local requirements must be followed by the PHA in that state or locality. State and local requirements may address the following areas:

3.8.1 Permissible Levels of Lead in Painted Surfaces

State and local requirements may differ from the current federal requirements for public housing that paint with lead levels greater than or equal to 1.0 mg/cm^2 must be abated. For example, Massachusetts law requires abatement of painted surfaces with more than 1.2 mg/cm^2 of lead, while Maryland regulations define lead paint as paint with more than 0.7 mg/cm^2 of lead.

3.8.2 Surfaces to Be Tested

Some states and localities do not require that intact surfaces, surface higher than five feet, or non-chewable surfaces be tested. Federal requirements for testing of all intact and non-intact paint in all HUD-associated housing supersedes these state and local regulations.

3.8.3 Testing Methods

Some states or localities allow for the use of testing methods not specified in the LPPPA. For example, Massachusetts law allows testing of paint using sodium sulfide solution. Federal requirements for all HUD-associated housing, which allow only XRF analysis, atomic absorption spectroscopy, or a comparable approved testing method, supersede these state and local regulations.

3.8.4 Selection of units to be inspected

State and local regulations may specify priorities for inspection, such as: whether a dwelling unit houses a child identified as having an elevated blood lead level (EBL); whether it is in the same building as the unit that house a EBL child; whether a tenant or property owner requests an inspection of a dwelling that houses a child under the age of seven; and whether premises are to be used as a child care facility. Priorities established by federal regulations should be followed in public housing and other HUD programs (see Section 3.1.2).

3.8.5 Training and Certification of Inspectors

Several states have regulations pending regarding certification or licensure of lead inspectors, training requirement for inspectors, and procedures for monitoring the quality of work of licensed lead inspectors. These state and local requirements will apply to inspectors in public housing and other HUD programs.

3.8.6 Final Inspection

State or local regulations may specify methods for final inspection and standards for clearing an abated dwelling. These state or local requirements must be followed by PHAs.

Chapter III - BIBLIOGRAPHY

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CHAPTER IV. ABATEMENT

4.1 Introduction

The information contained in this chapter will enable contractors, public housing authorities, and others to plan for and conduct interior or exterior lead-paint abatement projects. Specifically, guidance is provided for 1) selecting appropriate methods of abatement for specific components and substrates and avoiding unacceptable methods of abatement; 2) planning for all aspects of abatement, including coordinating and scheduling work, and measures for the protection of occupants, their belongings, adjacent units and the environment; 3) implementing abatement procedures including, site preparation, containment of lead dust, and the appropriate application of abatement methods and, 4) record keeping, reporting, and notification.

This chapter does not provide detailed "how to" instructions for general construction practices. It does, however, provide details that are unique to, and necessary for, the abatement process. Futhermore, all abatement work should be done in accordance with all applicable building and fire codes. Some documents may have to be sealed and registered by the engineer/architect, designer.

The manual recognizes that repair and maintenance activities may create exposures to lead dust. It is beyond the scope of these abatement Guidelines, however, to provide detailed instructions for various types of maintenance and repair activities.

The following is a checklist of owner/PHA actions and responsibilities before, during, and after abatement in addition to those ontained in other chapters:

<u>Tasks to be done before abatement:</u>

o Develop detailed plan which specifies the following:
  - resource acquisition and allocation
  - responsibilities of all the participants
  - overall timetable and completion deadlines
  - liaison with local, state and federal agencies, contractors, and residents
  - testing before, during, and after abatement
  - methods of abatement and material storage requirements
  - measures for containment and control of lead dust
  - measures for cleanup
  - plan for relocation of residents and thei belongings
  - plan for coordinating/sequencing abatement with modernization work, if any
  - plan for on-site storage of waste prior to disposal
  - plan for worker training and protection
  - plan for disposal of waste

- Identify abatement and testing contractors
- Obtain any necessary permits for abatement and disposal of waste
- Notify occupants and residents of adjacent units
- Relocate residents and their belongings
- Satisfy any reporting requirements of federal, state and local agencies
- Conduct preconstruction conference
- Correct pre-existing conditions that would impede abatement or cause it to fail
- Implement initial procedures for environmental protection and containment of lead dust and debris
- Post warning signs
- Provide a worker changing area

Tasks to be done during abatement:

- Continuous on-site supervision
- Limit access to work area
- Ongoing maintenance of the containment system for lead dust and debris
- Daily cleanup
- Proper on-site storage of waste prior to disposal

Tasks to be done after abatement:

- Break down the containment system
- First round of final cleanup
- Notify inspectors of readiness for inspection
- Obtain approval of inspector to cover and/or seal all floors and repaint abated surfaces as needed
- Final round of cleanup
- Notification of inspector of readiness for clearance testing
- Clearance testing
- Obtain final certification
- Dispose of abatement debris
- Record keeping
  - management reports and final certification
  - testing reports and summary of abatement project and methods
  - name and address of contractor
  - reports prepared for other agencies
  - permits
  - reports associated with disposal
- Satisfy any federal, state and local reporting requirements
- Return occupants to unit

4.1.1. The Problem of Dust that Contains Lead

Any effort to remove or encapsulate lead paint or to replace components covered with lead paint can create exposure to lead dust. The problem of high lead-dust generation and/or deposition has been documented for a number of traditional and commonly used paint removal practices (gas-fired torches, sanders, heat guns, and dry scraping).[5-11] Testing data from a limited number of abatement situations suggests that post-abatement cleanup of lead dust can be difficult.[11-15]

From a health and safety perspective, lead dust must be minimized and contained during abatement activities. Persons or organizations considering any type of abatement must be cognizant of this problem and take it into account when planning and conducting abatement activity.

4.1.2 An Updated Approach to Abatement

Traditionally, abatement has been done using high dust-generating methods which include open-flame burning, sanding, and dry scraping, together with minimal containment and cleanup of lead dust and debris; inadequate worker protection; no repainting; and haphazard disposal of waste. Abatement work has generally been limited to certain surfaces in a dwelling (i.e., chipping, peeling, and flaking lead paint and intact paint on surfaces easily accessible to children).

These guidelines constitute an updated approach to abatement which addresses the deficiencies of past practices in protecting workers and others entering the work area, children, and the environment.[11,16-19,24] The aim of the approach is to provide safe and effective abatement of all interior and exterior lead-based paint and lead dust for long-term protection of humans and the environment. The most important elements of the updated approach include:

- o selection of appropriate methods of abatement
- o minimization and control of lead dust through engineering and work practices controls and cleanup
- o protection of workers and occupants and their belongings
- o post-abatement clearance testing
- o proper disposal of waste.

Additionally, floors should be treated, whether or not they are coated with lead paint. The purpose is to provide smooth, easily cleanable surfaces which enable effective post-abatement cleanup and the attainment of clearance standards.[20,21] Floor treatments may also increase the likelihood that occupants will effectively control fugitive lead tracked in from contaminated soil and other sources.[14,22]

4.1.3 Unacceptable Methods of Abatement

The following paint removal methods have been prohibited by state or federal regulations and are unacceptable due to their potential for contaminating the environment and to concerns for worker and occupant health:

- o Gas fired open-flame torches
- o Grinding or sanding without attached HEPA vacuum filtration apparatus
- o Uncontained water blasting
- o Open abrasive blasting

Dry scraping is prohibited by Maryland abatement regulations. However, it is currently allowed by HUD and other jurisdictions. According to these Guidelines, scraping should be accompanied by misting and used for limited areas to minimize dust generation.[23]

4.2. Developing and Implementing An Abatement Plan

4.2.1 Federal Sources of Advice and Funding Assistance

HUD is the source of primary regulatory directives and funding for PHA/IHAs. Other sources of advice at the federal level include the following:

- EPA for information on regulations concerning environmental protection
- OSHA for guidance on regulations regarding the working environment of the abatement personnel and how to comply

Coordination and liaison with these agencies should be documented, recording the dates, times, and places of meetings as well as topics of discussion and conclusions reached.

The following documents are required by HUD for PHA/IHAs to receive funding for lead abatement:

- preliminary application forms (HUD form 52824)
- final application forms (HUD form 52825 parts 1 & 2)
- documentation, if applicable, concerning identified EBL resident child
- documentation, if applicable, concerning any prior positive lead testing results
- updated 5 year look-ahead plan for Modernization reflecting changes due to abatement planning and work

Additionally, PHAs/IHAs may elect to fund abatement through their operating budgets or reserves.

4.2.1.2 State and Local Sources of Advice and Assistance

After reviewing these Guidelines, private property owners and PHAs should consider contacting the following agencies for local regulatory requirements and advice:

- o Department of housing and community development for information on possible special funding programs available for low-income housing
- o Department of health and environmental control for:
  - regulations and local sources of funding. The state or local jurisdiction may have more stringent regulations for abatement. The owner, by regulation, must adhere to the most stringent regulations he encounters.
  - possible assistance in testing units and environment
  - possible blood lead screening of workers and residents

- o Local department of building inspections for names of contractors with lead paint abatement experience and information on local abatement work requirements.
- o Local chapters of building and remodelling associations for names of contractors with abatement experience and for advice
- o State health and environmental control agency to assure that toxic materials generated by the abatement program are properly transported and disposed of and to assure that all protective measures associated with worker and residential health are taken and maintained throughout the abatement process.

4.2.3 Coordination with Federal, State and Local Agencies

To assure that all reporting, record keeping, and other regulatory requirements are met, contact federal, state, and local agencies to coordinate efforts in the following areas:

- o Testing so that it is done adequately
- o Selection of abatement methods - so that prohibited methods are not used
- o Selection of contractor
- o Post-abatement certification of mitigation of hazard

4.3 Roles and Responsibilities

Public Housing Authorities and property owners are responsible for understanding and complying with all federal regulations as they address testing, abatement, and disposal of waste. Monitoring HUD regulations on a continuous basis will provide for early identification of new standards and financial assistance that is or will be made available for lead-paint abatement programs for public housing.

4.3.1 PHA/IHA Roles and Responsibilities

The PHA Board of Commissioners is responsible for taking action to safeguard its residents. The Board should provide the organizational impetus to ensure that necessary action is taken for lead-based paint detection and abatement.

The PHA/IHA executive director is responsible for

- o Keeping himself and his Board informed of all .spects of the Lead paint problem
- o Recommending policy adoption to the Board
- o Carrying out Board policy by directing its imp ementation

Additionally, the executive director or the modernization director is responsible for:

- o Conducting tests for the presence of lead-based paint
- o Coordinating the acquisition of needed input to the abatement plan
- o Determining the extent of abatement, if any, required

- Selecting the methods of abatement
- Estimating costs of abatement, disposal, worker protection, cleanup and testing
- Preparing the applications for funding (see section 4.2.1.1)
- Writing the specifications for the work
- Relocating occupants and their belongings during abatement
- Getting the testing and abatement contracts out for bid and awarded
- Monitoring implementation of the testing and abatement contracts
- Assuring that clearance testing is performed and appropriate standards are met

If abatement is done in conjunction with modernization, the executive director or the modernization director is responsible for ensuring that the abatement plan includes sequencing of work to ensure protection of non-abatement workers involved in the modernization effort.

4.3.2 Responsibilities of Non-PHA/IHA entities

4.3.2.1 Private property owner

The responsibilities of a private property owners include:

- Understanding liability for harm done by his property to anyone
- Accepting and ensuring the need to safeguard property occupants
- Keeping up with new abatement requirements and regulations reported in Federal Register notices and elsewhere by contacting state and local lead poisoning prevention programs

See Section 3.2.1.1, Chapter III, for more information.

4.3.2.2 Property Managers

Property managers are responsible for the following:

- Keeping property owners informed of the status of lead paint within dwelling units and common use facilities
- Effectively planning and conducting abatement as required by published regulations

4.3.2.3 Boards and Directors of Property Management Agencies

Members of boards and directors of property management agencies should make sure that residents are notification and warned of potential hazards and take corrective action in response to published regulations.

4.3 Responsibilities of Outside Contractors

4.3.3.1 Litigation/Liability Expert or Consultant

A litigation/liability expert or consultant should be informed on lead hazard liability issues and become a part of the abatement planning and implementation process from the outset.

4.3.3.2 Abatement Coordinators

An abatement coordinator will, at the direction of the owner, assume all or part of the responsibilities of the executive director as listed in section 4.3.1.

4.3.3.3 Testers (see Section 3.2.1.2, Chapter III)

4.3.3.4 Engineers/Architects/Designers

The engineer/architect/designer prepares the cost estimates, specification, and detailed design work associated with a lead-based paint abatement project. If abatement is done in conjunction with modernization, these persons are also responsible for sequencing the work with particular attention to the protection of the workers of the general contractor and any subcontractors.

Engineers, architects, and designers have a responsibility to be continually aware of developments in abatement. By contract, they may assume the role and responsibilities of the modernization director.

4.3.3.5 Abatement contractors

The abatement contractor has the following responsibilities:

- Being fully knowledgeable of general renovation techniques
- Ensuring that the particular requirements of a specific abatement project are met
- Training, or arranging for training, of workers and supervisors in the special techniques and work practices relating to abatement and impressing upon them the importance of adherence to these special practices.
- Ensuring the safety of workers and preparing the worker protection plan
- Implementing all contractual requirements

4.3.3.6 Abatement Work Crew Supervisor

The work crew supervisor should understand his/her responsibilities for the proper implementation of abatement methods and work practices and for worker safety. The supervisor must enforce work practices related to safety and the control of dust produced during abatement.

4.4 Abatement Strategies and Criteria for Selection of Specific Methods

The three general strategies for lead paint abatement are:

- Replacement
- Encapsulation
- Paint removal

A planner should understand the advantages, disadvantages, and costs of each and consider all of them in planning for abatement. In many instances, it may be necessary to use more than one of these strategies in a single housing unit. (See Table 4.1 below for comparison of the three general strategies.)

TABLE 4.1: Comparison of Lead-Paint Abatement Strategies

ABATEMENT STRATEGIES	ADVANTAGES	DISADVANTAGES	APPROPRIATE APPLICATIONS
Replacement	Permanent solution, Allows for upgrade, Can be integrated with Modernization, No lead residue left behind on surfaces, Low risk of failing to meet clearance standards	Replacement component may be lesser quality than original. Replaced components may be high volume and considered hazardous waste Certain installation requires skilled labor.	Many interior or exterior components. Deteriorated components. Highly recommended for windows, doors, and easily removed building components
Encapsulation	Low dust if surface preparation is minimal. May be faster than some other methods	May not provide long-term protection Requires routine inspection. May require routine maintenance. Quality installation critical for durability.	Exterior trim, walls, floors; Interior floors, walls, ceilings, pipes; Balustrades
Paint removal on-site	Low-level of skill required. Allows for restoration.	High dust generated. Lead residue may remain on substrate and may be difficult to remove. Potential difficulty n meeting clearance standards and in protecting workers. Stripping agents are hazardous & require more precautions.	Should generally be used on limited surface areas. When replacement, encapsulation and off-site removal is impractical. Chemical removers work best on metal substrates
Paint removal off-site	Allows for restoration, Better finished product generally than on-site paint stripping	Lead residue may remain on substrate which may be difficult to remove. Damage may occur during removal and reinstallation. Swelling of wood, glass breakage and loss of glues and fillers may occur. Hardware left on components may be damaged	Restoration projects, especially doors, mantels, easily removed trim Metal railings

INAPPROPRIATE APPLICATIONS	COMMENTS
Restoration projects When historic trust requirements apply. Most walls, ceilings and floors	Non-standard replacement components may need to be ordered in advance Demolition may damage adjacent surfaces. May result in increased energy efficiency e.g. if windows are replaced.
When encapsulant is not appropriate for substrate and substrate condition. See comments	Must be durable, seams must be sealed to prevent escape of lead dust. Safe, effective and aesthetic encapsulants for interior trim components need to be developed and tested. Repainting leaded surfaces and the use of contact paper and paper wall coverings should not be considered for abatement.
Generally should not be done on large surface areas. Check with manufacturer regarding recommendations for use on various types of wood and metal substrates.	The following are unacceptable methods: -gas fired open-flame burning -grinding or sanding without HEPA filtration -dry scraping without misting -uncontained water blasting -open abrasive blasting See section 4.1.3 for more information.
Check with stripping contractor regarding recommendations for metal substrates	Check with stripping company for timing of work, and procedures for neutralizing and washing components. See section 4.4.1.1.c

4.4.1 Replacement

Replacement means the removal of components such as windows, doors, and trim that have lead-painted surfaces and installing new components free of lead-containing paint. Removal without reinstallation of new components may be an option for certain components (e.g., shelving). The removal phase has the greatest potential for generation of lead dust and debris and will require close attention to worker health and safety.

Replacement can be done on many exterior and interior components except for most walls, ceilings, and floors. Replacement has the advantage of allowing for a permanent solution. It is also beneficial for the following reasons:

- Ease of meeting post-abatement clearance standards
- May integrate well with renovation and modernization projects
- Increased energy efficiency, for example if replacement windows are more energy efficient than the original windows
- May be the easiest and quickest way to perform abatement on doors, windows, and trim
- Allows for the upgrading of components.

The following aspects of replacement efforts should be kept in mind:

- Replacement may damage adjacent surfaces (e.g., plaster walls when baseboards are removed)
  reinstallation of certain components requires labor skilled in carpentry
- A large volume of solid waste may be created which may or may not be considered hazardous waste (see Chapter VI)
- Nonstandard replacement parts may require special orders which may require additional ordering time

Replacement is not the strategy of choice when it is prohibited by local, state, or federal requirements for the historic preservation of older housing. Similarly, replacement is not an appropriate strategy for restoration projects that aim to preserve original components and surfaces. Replacement may not be appropriate for buildings that will be demolished or otherwise removed from the housing stock in the near future.

4.4.2 Encapsulation

Encapsulation means making lead paint inaccessible by covering or sealing painted surfaces. This strategy is best if it provides relatively long-term protection and does not require routine maintenance to ensure the integrity of the encapsulant. Encapsulation usually requires the sealing or otherwise closing of seams to prevent the escape of lead paint and dust.

Encapsulation should be considered for interior and exterior walls, ceilings and floors because 1) these surfaces cannot be easily replaced and 2) on-site paint removal methods should not be used to abate large surface areas because they generate large quantities of lead dust. Encapsulation is appropriate for pipes and exterior wood trim. Current technology does not provide an easy, effective, and aesthetically appealing method of encapsulating interior trim.

Unlike paint removal methods, encapsulation generates relatively little lead dust and debris and, therefore, poses less of a cleanup and waste disposal problem. It is a particularly advantageous strategy for large surfaces such as walls, ceilings, and floors due to the potential ease of containment, cleanup, and protection of adjacent units and the environment.

The durability of some encapsulating materials such as gypsum dry wall and exterior siding is well known. To get maximum durability, quality installation is required. Documentation of encapsulation sites is critical because of the potential for exposures to underlying lead-based paint during maintenance and future renovation activities. Encapsulated lead paint can be detected by on-site X-ray fluorescence testing methods.

The following materials should not be used as encapsulants:

- o A new coat of paint or primer
- o Paper wall coverings
- o Contact paper
- o Any similar nondurable material

4.4.3 Paint Removal

Paint removal means stripping the lead paint from the surfaces of components. There are two types of paint removal: on-site and off-site. Off-site removal is the preferred method. On-site removal is recommended when replacement, encapsulation, or off-site paint removal cannot be done. It can be used on limited surface areas (e.g., jambs, balustrades, and decorative or ornate items).

4.4.3.1 Off-site Paint Removal

For the purposes of these Guidelines, off-site chemical removal means the stripping of lead paint from a building component at the facilities of a professional paint-stripping operation. The stripping is done in special chemical tanks.

Off-site paint removal is:

- o Appropriate for easily removable components
- o Potentially safer for workers than on-site paint removal methods
- o Usually effective in stripping all paint layers

Three potential problems of off-site methods are:

- o Damage to components or adjacent surfaces during removal of the component
- o Lead dust/residue left behind on stripped surfaces
- o Worker exposure to lead dust/residue when reinstalling stripped

components. Arrangements should be made to assure that stripped components are washed thoroughly before they are returned to the work site.

4.4.3.2 On-site Paint Removal

Heat guns and caustic chemicals can leave behind lead laden dust and residue which testing suggests can be difficult to remove.[13,22] Furthermore, limited testing of surface dust after caustic chemicals have been used and surfaces repainted suggests that exposure to lead persists.[22]

The various paint stripping methods/materials are themselves hazardous as noted below and they should be used with great care.

- Solvent based chemical strippers are flammable and require ventilation and may contain methylene-chloride which is a central nervous system depressant that causes liver and kidney damage at high concentrations and is a probable human carcinogen. When solvent-based strippers which do not contain methylene chloride are used, organic vapor filters must be added to respirators. When strippers contain methylene chloride, supplied air respirators should be used.[23]
- Caustic chemical strippers have a very high pH which can cause severe skin and eye injuries.
- Heat guns pose a potential fire hazard.

4.5 Factors Influencing Selection of Strategies

4.5.1 Overall Housing Condition

Anyone planning to undertake lead-based paint abatement must also take into consideration the overall condition of the housing (e.g., grossly substandard, substandard, or well maintained).

Replacement is the strategy of choice for deteriorated housing if the building components are not salvageable. In substandard housing, substrates may be too deteriorated to support encapsulation or enable paint removal. For example, a wall that is structurally unsound may not support an encapsulating system that uses framing or direct bonding agents. Furthermore, there is no point in removing paint from nonfunctioning nonrepairable components (e.g., dry rotted window sashes) or from deteriorated substrates that do not provide smooth, easily cleanable surfaces.

4.5.1.1 Components, Substrate Materials and their Conditions

In some cases, the specific component and its state of repair will dictate the abatement method. For example, large wall surfaces will generally be encapsulated since paint removal on large surfaces generates high levels of lead dust. If a window is deteriorated and nonfunctioning, replacement should be the abatement method. An analysis of the condition and type of substrate material in a dwelling unit is particularly important for selection of removal and encapsulation methods. For example, a very deteriorated wall could not be effectively encapsulated with fiberglass materials if the new fiberglass is to be attached directly to the wall surface. Caustic chemicals would not be a good choice for removal if the lead-based paint is on an aluminum substrate.

4.5.2 Context of Abatement

The second consideration in selecting strategies is the reason for and context of abatement. When abatement is done in conjunction with modernization or renovation, replacement has obvious advantages because many of the same activities (i.e., window replacement) would already be planned and the only additional costs would be for containment and worker protection. Outside the context of modernization or renovation, however (i.e., when abatement is done in the dwelling of an EBL child), the PHA or owner may or may not decide to undertake renovation in conjunction with abatement. High dust generating methods are particularly disadvantageous when doing abatement in common areas of multifamily units and multifamily units themselves due to the problem of lead dispersal.

4.5.3 Criteria for Selecting Specific Methods

In many instances, it may be necessary to use more than one of the general strategies for any given abatement job. The planner should also consider the criteria for selection of specific methods of abatement that are described below.

4.5.3.1 Dust, Mist, and Fume Generated

Whenever possible, preference should be given to methods that create the least amount of dust, fume, or mist. If on-site paint removal methods are used, choose a removal method most appropriate for the substrate and the thickness of the paint layers (see Table 4.3). Next, consider any additional measures beyond the basic measures to contain dust and protect workers, adjacent units, and the environment.

4.5.3.2 Worker Protection Measures

Of the three basic abatement strategies, paint removal and demolition prior to replacement generally require the most stringent worker protection measures. In addition to protection from lead exposure, workers must be protected from the hazards of stripping agents (e.g., caustics, methylene chloride, solvents, and possible fires) and injuries resulting from t e use of heat guns and scrapers.

4.5.3.3 Protection of Occupants and Adj·cent Units

High dust generating methods will require the most stringent measures to protect adjacent units. For example, vacuum blasting of exterior surfaces will require more containment than the encapsulation o· lead paint on exterior surfaces. Whenever wind conditions exceed 15 miles per hour or whenever there is visible movement of debris beyond the containment area, shrouding should be constructed for vacuum blasting.

4.5.3.4 Containment of Lead Debris and Dust

Whether generated from interior or exterior abatement, liquid waste and fine airborne particles are the most difficult wastes to contain. Note that when liquid waste dries, very fine lead-containing particles remain. Caustic paint removal methods and hydroblasting methods generate varying quantities of liquid waste.

4.5.3.5 Type and Quantity of Waste

All abatements generate waste. Liquid wastes are the most difficult to contain and dispose of. The type and quantity must be considered in selecting a particular abatement method and in planning for both containment and disposal. See Chapter VI for guidance on disposal requirements for specific types of wastes. Disposal costs, as well as the costs of all other aspects of abatement, will influence the selection of abatement methods.

4.5.3.3 Cost Analysis

Once the methods of abatement have been selected, the cost of the abatement work only can be estimated using techniques for estimating construction work. In addition, other costs to be considered include temporary relocation of residents and their belongings, the containment of dust and debris, worker protection, and the disposal of waste. Abatement will often include many steps that would otherwise be part of comprehensive modernization. Where this is the case, abatement costs should be the costs of what needs to be done above and beyond usual modernization work (e.g., costs of worker protection and disposal).

In determining the "best" method of abatement of a given surface, least cost will certainly be a factor. Any of the better construction and renovation cost estimating guides provide adequate cost guidance for installation. However, factors other than first-cost should be considered. For instance, if existing lead-painted wood trim is of a simple design and could be aesthetically replaced with a standard shape instead of a milled shape, removal of the existing trim may be the least costly method. If the trim is large and ornate and aesthetically desirable, then paint removal may be the least costly method.

Another factor to be considered is the cost of waste disposal. Encapsulation of lead paint avoids some of the costs of waste disposal. However, the costs of special handling in the future must be considered if a need arises for major renovation involving the breaking of encapsulated surfaces.

4.6 Developing the Abatement Plan

An owner must develop a plan of action to address the problem of lead paint in his/her residential property. In the case of abatement done in conjunction with modernization, the owner should consider consulting with an architect or engineer to sequence the modernization and abatement work so that both abatement and non-abatement workers are protected from lead exposure. Organizational policy makers (e.g., corporate board of directors, PHA board of commissioners) must be alerted to and kept informed of the problem of lead paint and the necessity to develop a plan.

The steps outlined below, are in many cases, to be conducted concurrently. For example, if an emergency response plan to abate the residence of a lead-poisoned child does not exist, and the PHA is developing plans for abatement activity during modernization, the plans should be developed concurrently.

PHAs and other entities planning a large abatement project (e.g., 20 or more units) might consider conducting a pilot program in the initial units. This pilot program would yield more realistic costs and information on alternative abatement methods. The owners and their consultants could then revise abatement plans for future units.

The abatement plan must take into account previous lead-based paint testing and also any prior known elevated blood lead conditions of either abatement workers or residents, especially children and pregnant women. For example, information on an elevated blood lead level in a resident child should be considered in setting priorities for abatement. Pre-abatement test results (random and 100 percent) will dictate the need for abatement on the various interior and exterior surfaces.

4.6.1 Purpose of the Plan

A workable abatement plan does the following:

- o Provides for the necessary organization
- o Clearly establishes relationships among the owner, designer, abatement contractor, testing contractor, disposal contractor, and general contractor.
- o Fixes all responsibilities for testing, training, abatement, cleanup, disposal, and record keeping and reporting
- o Establishes priorities for units to be abated
- o Establishes completion deadlines for all interrelated portions of the plan based on lead abatement regulatory deadlines. Use of a time-based project management method is recommended.

4.6.2 Plan Elements

The essential considerations of an abatement plan are:

- o Awareness training on the hazards of lead for all employees
- o An overall timetable
- o Liaison with:

  - local, state, and/or federal agencies
  - contractors performing supporting services
  - the residential population
- o Resource acquisition and allocation
- o Inspection and Testing
  - before abatement
  - during abatement
  - after abatement
- o Specification of abatement methods
  - demolition requirements
  - replacement and encapsulation requirements
  - paint removal requirements
  - material storage
- o Containment and control of lead dust and debris
- o Cleanup during and after abatement
- o Resident and environmental protection
  - temporary relocation of resident population
  - protection of occupants' belongings
  - waste storage on-site prior to disposal
- o Worker protection
  - worker safety, health and training
  - requirements for special protective equipment
- o Disposal of abatement waste
  - specification of type and quantity of waste
  - obtaining any necessary permits
- o Record keeping and notifications
  - test results
  - abatement certification
  - disposal
  - notifications to residents

4.6.3 Step-by-Step Preplanning

The first step for the planner is to determine if there is an actual need to abate lead paint. These pre-planning steps are as follows:

1. The owner should develop a system of recording and monitoring all actions taken and information received vis-a-vis lead paint abatement on a unit-by-unit basis. This should be in written form, continuously modified as circumstances warrant and circulated to all affected departments.

2. The PHA should become familiar with HUD's regulations pertaining to lead paint as published in the Federal Register and PIH notices and determine if any of the owner's housing was built prior to 1978. If so, the owner should proceed on the assumption that a potential hazard exists until it is proven that this is not true. The HUD abatement program is restricted to pre-1978 construction because lead-based paint was commonly used then it does not take into consideration the illegal use of lead-based paint in units constructed during 1978 or later.

3. Since the required response time for action is so short in a case where a lead-poisoned resident is identified, the owner should immediately develop an emergency response plan for this eventuality. HUD should be contacted by the PHA for possible emergency abatement funding assistance. The owner should realize, however, that he is responsible for immediate action in the event of the identification of a lead-poisoned child. Action must be taken even if the methods and funding sources have not been determined. The owner may have to fund actions from available resources. It is vital that the developer of this emergency response plan be conversant with the regulations pertaining to abatement and procedures involving an EBL child, and develop a plan for the immediate relocation of the family of the EBL child. This plan should be prepared concurrently with the steps that follow.

4. Notify the Board that there is at least the possibility of lead-paint hazards in the housing stock and promote awareness of the hazard among supervisors, staff, maintenance personnel, and residents.

5. Notify the residents, as prescribed by regulation (see Chapter 1), of the possibility of lead hazards in their units (see Appendix 4.1).

6. Notify and document notification to maintenance employees of the possibility of lead-paint hazards in the units and caution them that, until further notice, they should perform maintenance in a manner that minimizes the generation of dust and debris.

   The PHA should consider consulting with a qualified trainer, industrial hygienist, or health and safety technician. Workers should be instructed on proper containment and cleanup procedures as described in these Guidelines. Individual protective equipment such, as respirators and disposable clothing, should be provided and workers instructed in their use. (See Section 2.2, Chapter II, for information on worker education and training.)

7. The owner should plan to offer, upon request, blood lead testing to any maintenance employee and should develop a policy for abatement workers to include mandatory pre-employment medical examinations and blood testing for lead as well as periodic retesting during the abatement process.

8. The owner should report information from the local health department, in writing, about the existence of a lead-poisoning prevention program in the area. The health department may be able to provide blood screening for residents and abatement workers and machine and laboratory services for testing for lead hazards in and around units. It is recommended that children under six years of age be tested prior to and after abatement. If children have elevated lead blood levels they should be referred to the local health department or program for official follow-up. The local health department may also be able to advise the owner of state and local regulations concerning lead hazards and the disposal of leaded waste.

9. The owner (PHA/IHA) should contact its local HUD field office, in writing, informing them of what the owner has done and asking for additional advice and clarification on regulations as needed.

10. If the local health department cannot test for lead in the units, it will be necessary to conduct random testing (see chapter III) using some other means. The owner should consult with the local HUD field office for funding information as well as sources for testing services. Random, and then complete, testing of the units will disclose the extent of abatement required.

The following steps of the plan, with the exception of record keeping, should be applied only if lead-based paint is found during testing.

11. The owner should set priorities and determine how to perform the abatement required. The local or state health department or department of environment should again be contacted, in writing, for advice on both of these facets of the plan. The owner must acquire or develop his/her own expertise to determine the methods of abatement and projected costs. The owner should consider consulting with an engineer/architect//designer. Representative samples of the debris generated by various possible abatement techniques should also be tested to determine disposal requirements.

In setting priorities for units to be abated, consider the following factors:

- elevated blood level in children under 7 years of age
- the number of children under 6 years of age
- information on blood lead levels of residents
- the number of surfaces coated with lead-based paint
- the condition of the lead painted surfaces
- overall condition of unit
- the modernization plans, if any

12. The owner should perform an on-site assessment of lead-painted surfaces identified in the testing report (see Chapter III).

13. The owner must decide whether the abatement should be done on a contract or Force Account (self-performance) basis. The use of Force Account (see Appendix 4.1) allows greater flexibility to modify the work as regulations change. The HUD field office may set requirements in this area.

14. The owner should consult with the local HUD field office about the owner's abatement plan, the availability of funding for abatement, and advice, if needed, to begin the application process for CIAP funding.

15 Upon receipt of approval and funding, the owner should proceed with the planned abatement and be prepared to certify the abatement as adequate based on successful clearance testing (see Chapter III).

4.6.3.1 Testing

See Chapter III for information on qualifications that should be sought in testers, when to conduct random and 100 percent testing, and information that should be considered in evaluating contractor testing costs.

The contract should specify the following to assure adequacy of cleanup:

- methods of cleanup to be used at each stage of the contract work
- testing methods and permissible lead levels of these tests after cleanup
- chain of custody for all test samples taken

See Chapter V for guidance on performance standards for post-abatement clearance levels of lead in surface dust. Post-abatement clearance testing results will indicate the adequacy of abatement and cleanup and allow the return of residents and the certification of abatement.

4.6.4 Abatement Administration

4.6.4.1 Coordination and Scheduling

When renovation and abatement are to be combined, the abatement contractor's work must be done first. To ensure protection of the general contractor's workers, the abatement contractor must cleanup by thorough HEPA vacuuming of all horizontal and vertical surfaces (see chapter V). The contractor should also consider air lead monitoring to ensure that air lead levels are within OSHA standards (see Section 2.2.2, Chapter 11).

If abatement does not constitute complete removal of lead from the work site, careful work specification, sequencing, and coordination are required to ensure that the renovation contractor does not re-expose the hazard. Clearance testing must be performed at the end of the abatement/renovation job. If the renovation contractor's work will re-expose the lead hazard, then the renovation workers must be trained and protected.

In the case of split work contracts, the abatement contractor performs the containment, demolition or removal, encapsulation work, and cleanup. Following this abatement activity, the renovation contractor does the renovation and replacement work. Coordination is important to assure the protection of the workers of the general contractor. The abatement contractor returns at the end of the project for final cleanup prior to clearance testing.

If the owner is considering performing the work, see Appendix 4.1 for work design for Force Account. For owners contracting out the work, any reference book on renovation will outline the usual sequence of types of work involved in a renovation project. This should help in scheduling.

4.6.4.2 Pre-abatement Conference

Pre-abatement conferences should be held by the owner and the abatement contractor to discuss the particular requirements of the abatement work. If abatement is done in conjunction with modernization work, the pre-abatement and pre-construction conferences should be held jointly and include the general contractor for a review of the sequencing of the work and any measures needed to protect the workers of the general contractor.

4.6.4.3 Contract Supervision

Supervision of an abatement contract requires special knowledge of the following:

- The consequences of nonadherence to requirements
- The threat of lead poisoning to both workers and residents
- The methods of abatement and cleanup selected
- Clearance testing measures and requirements
- Technical requirements for disposal of debris and toxic waste

The supervisors of abatement should understand the methods of abatement, each method's potential for creating additional lead hazard, and the ways to avoid creating more hazards. Supervisors should also be familiar with the requirements and means for protecting personnel.

The owner should emphasize the following points to the contractor:

- The need for direct on-site supervision for the successful completion of abatement because abatement depends on the process, and not just the appearance of the work
- Lead dust and debris must be contained and controlled during abatement
- The importance of enforcing compliance with worker protection measures
- The importance of frequent inspection of the application of encapsulation materials to ensure long term viability of protection from exposure
- The importance of continuous enforcement and supervision of cleanup during and after abatement

4.6.4.4 Ensuring Adequacy of Supervision

The basic measure of supervision is the results of the exposure monitoring and blood lead monitoring of workers during abatement and during surface dust tests done after abatement. If 1) air lead levels are in the expected range during abatement, 2) worker's blood lead levels do not rise significantly above their beginning levels and, 3) post-cleanup levels are within permissible clearance standards, the supervision may be deemed to be adequate.

4.7 Site Preparation and Maintenance

4.7.1 Repair Work Prior to Abatement

Typical pre-existing conditions that can impede abatement or cause it to fail include the following:

- water leaks of all types - roof, plumbing, window
- lack of heat in all or parts of dwelling
- lack of electricity and water

Water leaks must be corrected prior to abatement regardless of the method of abatement. Uncorrected water leaks can cause future exposures when encapsulating materials fail and underlying lead paint deteriorates. Moisture can also cause paint on stripped surfaces to fail, exposing occupants to lead residue that may have remained on the substrate after stripping by heat, caustic chemicals, solvents, and scraping. Inadequate heat after abatement may lead to failure of encapsulants and paint. Therefore, heating systems must be repaired prior to occupancy.

Prior to abatement, forced air systems should be shut down and sealed to prevent lead contamination of abatement and other areas. Radiators that have been protected/covered prior to abatement may not be usable during abatement. Chemical stripping processes are slowed at low temperatures, therefore, provisions should be made for other methods of providing heat. Contractors should consider use of electric heaters. Adequate ventilation must be provided if portable flame heaters are brought onto the work site. Volatile organic paint removal chemicals should not be used near portable flame heaters. A lack of electricity on the site can slow work because of inadequate lighting and limit the methods available for on-site paint removal. Owners should have the electricity restored or ask the contractor to provide generators.

On-site running water is necessary for the personal hygiene of workers, cleanup during and after abatement, and certain abatement methods (e.g., caustic chemical). If water service has been cut off and cannot be restored, water should be brought to the site.

4.7.2 Procedures to Minimize, Control, and Contain Lead Dust

If the abatement plan necessitates the breaking or disturbing of lead-painted surfaces and therefore the generation of lead dust, site preparation prior to abatement should consist of the following basic steps:

- o Post warning signs at entrances and exits to work area (see Section 2.1, Chapter II)
- o Remove all belongings and furnishings of occupants
- o Correct conditions that can impede abatement
- o Correct conditions that can cause abatement to fail
- o Initiate procedures to protect surfaces and contain and control lead dust and debris as follows:

  - cover all nonmovable objects with 6 mil polyethylene sheeting
  - cover floors with 6-mil polyethylene sheeting
  - shut down forced air heating and air conditioning systems and seal all air intake and exhaust points of these systems

take measures to contain liquid and dry waste generated in exterior as well as interior work areas

Additional measures to control lead dust produced during abatement are discussed in section 4.7.4.5.

If abatement does not break or disturb lead-painted surfaces, containment measures should be used only as needed to protect surfaces, furniture, and personal possessions from damage. An example of an abatement that might not break lead-painted surfaces would be a job that consisted only of the removal and replacement of interior doors whose hinges and pins were not painted with lead-based paints.

4.7.3 Removal of Belongings and Furnishings

Field practice has shown that it is nearly impossible to perform effective lead-paint abatement while the occupant's furniture and belongings are in the area to be abated. All furniture, including wall-to-wall carpeting, draperies, and other belongings should be moved to a lead-safe environment before the abatement begins. For exterior abatements only, if it is possible to seal the interior environment adequately and provide safe entrance and egress, the owner may not need to relocate residents and remove personal possessions.

Furnishings, carpets, and belongings may already be contaminated with lead dust. Therefore, these things should be cleaned or replaced just before abatement, if they can be protected against contamination, or after abatement.

4.7.4 Containment

A safe and complete abatement job cannot be done without containing all lead within the work area so that lead is not dispersed to adjacent areas/units and the outside environment. Keep in mind that lead fumes and dust are actually more dangerous than large paint chips. By taking the steps outlined in this section, contractors will keep lead dust, debris, and fumes from spreading outside the work area. These steps will also protect surfaces from lead dust and damage from abatement procedures and make cleanup of the work area much easier.

4.7.4.1 Containment Materials

- o Polyethylene (plastic) sheets at least 6 mil thick.
- o Heavy duty tape (e.g,. duct tape) to fasten plastic sheets
- o Staple gun with heavy duty staples for fastening plastic sheets

Alternate products include:

- polyethylene spray instead of plastic sheeting.(The dry film can be removed later by peeling).
- spray glue in aerosol can for fastening plastic sheets

4.7.4.2 Interior Procedures

After all movable objects have been removed from the work area, it must be sealed from non-work areas. If the work area is a room or group of rooms within the unit, it must be sealed off from all other portions of the unit. If the work area consists of multiple unit(s) within a building, the unit(s) must be sealed off from the rest of the building. Under certain circumstances of limited abatement, movable objects may be removed to non-work areas in the unit.

Work areas can be sealed off by 6-mil polyethylene sheeting attached to framing, if necessary. Effective barriers at openings between work and non-work areas can be created by using two layers of 6-mil plastic sheeting. One sheet is attached to the top of the opening and one side. The second is attached at the top and the opposite side, creating an "s" shaped entryway which helps deter the dispersion of lead dust.

After sealing off the work area, the contractor should do the following in the work area:

- o Cover all non-movable objects
- o Cover floors
- o Shut down forced air heating and air conditioning systems and seal all air intake and exhaust points of these systems

Polyethylene sheets 6 mils thick are used to cover all nonmovable objects (including radiators, refrigerators, shelves, cabinets, built-in furniture, and stoves), floors, and forced air ventilation points. It is important to fasten the plastic securely with heavy duty tape and/or heavy duty staples, making sure that surfaces are not damaged. Before applying plastic to floors, it may be necessary to use a HEPA vacuum to remove debris which can tear or puncture plastic sheeting.

The abatement contractor should consider applying a second or a third layer of plastic sheeting. Additional layers enable easy removal and cleanup of debris at different points in time during the abatement process without losing the integrity of the floor containment system.

Certain methods may require additional measures to protect adjacent surfaces. Particular attention needs to be paid to surfaces adjacent to areas abated on-site using heat gun, chemical, and caustic stripping methods. Masking with tape and plastic can be used to help protect surfaces from chemical or caustic strippers. It may be difficult, however, to protect adjacent painted surfaces or wall paper adequately while using a heat gun.

a. Common Areas

If a common area is an abatement work area, and there are no alternative entrances and egresses that are located outside of the work area, then the contractor should create a protected passage through the common area.

For example, in the case of a common hallway, one side should be designated as the work area and the other the safe passage area. Safe passage areas are created by building frames and attaching 6-mil polyethylene sheets.

If a safe passage cannot be created and alternative entrances and exits do not exist, then abatement in common areas should be conducted between established and posted hours and the work area should be cleaned with a HEPA vacuum at the end of each working day until all surfaces are free of all visible dust and debris. Occupants should be provided with disposable shoe coves for use while in common areas.

See Section 4.9.2 for other measures to protect occupants of multifamily dwelling.

4.7.4.3 Exterior Procedures

Exterior abatements may generate large quantities of liquid and/or dry waste. If precautions are not taken, this lead waste can directly contaminate the outside environment and adjacent units. For this reason, uncontained water blasting and open abrasive blasting are unacceptable. See Tables 4.2 and 4.3 for abatement options.

Lead in soil is a known contributor to lead poisoning in children. Contractors who do not take proper containment measures may be required to:

- o Test, abate, and dispose of soil contaminated with lead as a direct result of proper or improper abatement.
- o Test, cleanup, and dispose of lead dust and debris dispersed to the interior environments of adjacent units.

Before beginning to abate lead paint in an exterior work area, a contractor should use the following procedures:

a. For Liquid Waste

- o Place polyethylene plastic sheeting (6 mils thick) as close to the building foundation as possible.
- o Extend the edge of the sheets a sufficient distance to contain the runoff and raise the outside edge of the sheets (e.g., with two by fours) to trap liquid waste
- o Have available appropriate containers to hold liquid waste for later transfer and disposal (see Chapter VI)
- o Where seams occur, they must be sealed with tape and edges must be raised (e.g., with two by four framing) and a new section of plastic sheeting and framing should be added as needed
- o Liquid waste can be pumped, vacuumed or bailed for transfer to disposal facility (see Chapter VI).

b. For Dry Waste

- Place polyethylene plastic sheeting (6 mils thick) as close to the building foundation as possible.
- Extend the sheeting out from the foundation a distance of three feet per story being abated with a minimum of five feet and a maximum of 20 feet. (It may not be possible to not extend sheeting beyond the edge of the nearest sidewalk).
- Weight the sheeting at the foundation and along edges and seams.
- Erect vertical shrouds if constant wind speed exceeds 15 mph or there is visible movement of debris.

c. On-site Storage of Liquid and Solid Waste

The contractor must make provisions for the safe storage of waste on-site prior to disposal. For security reasons, waste storage areas must be treated as abatement areas and access restricted. Liquid waste should be collected in 55-gallon drums or smaller and held on-site in a designated secure area such as a room in the work area. Large quantities of solid waste should be stored in covered dumpsters with appropriate hazard labels. Smaller quantities of solid waste should be collected and bagged in 6-mil or double 4-mil plastic bags and stored in designated secure storage area. Hazardous and nonhazardous waste, as determined by prior testing, should be separated. (See Section 6.4, Chapter VI, for arranging for safe disposal of waste.)

4.7.4.5 Maintenance of Containment System

The goal is to keep the containment system intact for as long as it is needed, thereby limiting the dispersal of lead. All tears and breaks in the containment system should be repaired as they occur, otherwise all the benefits of containment are lost, including easier cleanup. The abatement contractor is responsible for inspecting the containment system on a daily basis or more often as needed to ensure its integrity.

Damaged floor sheeting should be covered with new layers and not removed. Damaged shrouding may need to be replaced.

4.7.5 Controlling Off-site Dispersal

The above sections describe practices for containing lead dust and debris within the work area. But, unless additional control measures are taken by the contractor, this contained lead dust and debris will be dispersed to non-work areas, adjacent units, the outside environment, and be transferred to workers' cars and homes.

Basic control measures to minimize the dispersal of lead dust and debris from the work area are:

- Control and limit access to the abatement work areas
- Limit tracking of dust and debris
- Implement a program of ongoing cleanup

One area of future research is the costs and benefits of the use of negative pressure air filtration systems with high particulate air (HEPA) filters during abatement. This system may help protect against large scale release of dust to surrounding areas and may reduce worker exposure by lowering the concentration of lead dust in the work area.

4.7.5.1 Limiting Access

To avoid unnecessary exposures to lead and limit the tracking of lead dust and debris, the abatement contractor must limit access of nonworkers to abatement work areas. The abatement work crew supervisor is responsible for enforcing this limited access. Only the persons included in the following list should enter the work area prior to satisfactory clearance testing.

- The owner of the unit and his/her designee
- The contractor and his employees
- State, county, or local enforcement officials or their designees.
- An inspector who represents a lender with a security interest in the building
- A federal, state, or local official or his/her designee engaged in research on lead

4.7.5.2 Limiting Tracking of Dust and Debris

All persons entering a work area during a lead-abatement project that involves breaking or disturbing lead-painted surfaces must wear disposable shoe covers which should be removed upon leaving the work area (see Section 2.2.5.2, Chapter II) and placed with abatement waste. Any persons entering a work area during lead paint removal activity (e.g., by heat gun, scraping with misting, HEPA sander, or chemical) or during replacement should also wear appropriate respirator protection (see Section 2.2.5.1, Chapter II).

4.7.5.3 Program of Ongoing Cleanup

An important part of the control of lead dust and debris is implementing a program of ongoing cleanup in the work area. The frequency and intensity of cleaning will be the greatest with on-site paint removal methods and methods that create a lot of construction debris (See Chapter V). Ongoing cleanup should include the regular cleaning of all tools, equipment, and worker protection gear to minimize worker exposure and the risk of transferring lead to other job sites.

4.8 Selection of Abatement Procedures

After consideration of the relative merits of replacement, encapsulation, and paint removal strategies; the overall condition of the dwelling; and the context of the abatement; one must choose specific abatement methods or combinations of methods for lead painted components.

Much of the information needed to aid in the selection of specific methods of abatement is contained in Tables 4.2 and 4.3 below. These tables reflect the current state-of-the-art in abatement technology. In most cases, more than one option is provided for abating any given component to accommodate various contexts and practical considerations.

Table 4.2 gives the abatement strategies of choice for both interior and exterior components. It also provides references to information on specific abatement methods of choice found in Table 4.3. Table 4.3 includes a listing of the most commonly used and most useful encapsulating materials. Under no circumstances should paint be used as, or in lieu of, a durable encapsulant.

Table 4.3 provides information on advantages and disadvantages, appropriate and inappropriate applications, and general comments for interior and exterior methods of abatement. This table also matches specific encapsulants with specific components. Information on appropriate and inappropriate applications includes mention of specific substrate materials. General comments include information on special tools and equipment and safety concerns.

If abatement is to be done on substrates not found in these tables, refer to recommended abatement methods for substrates with similar characteristics. For example, if abatement is to be done on glass brick, then consider methods appropriate for metal (i.e., non-porous smooth) substrates, taking into account the potential for damage to the substrate.

HOW TO USE THE TABLES

CAUTION: Do not apply the abatement methods listed in these tables without reading all of Section 4.8.1

1. Start with Table 4.2
2. Note that the table is organized according to abatement strategy across the top and by component down the left side
3. Locate the component of interest on Table 4.2
4. Read across the columns to find the abatement methods of choice available for this particular type of component
5. The superscripted numbers provide a reference to information on specific methods of abatement found in Table 4.3
6. Locate the information in Table 4.3 by number
7. Read information on the advantages, disadvantages, appropriate and inappropriate applications, general comments, and skill level.

EXAMPLE:

1. The component of interest is a door.
2. Locate the entry for doors on Table 4.2
3. Read across the columns and note that replacement and off-site paint removal are the recommended options for abatement
4. Note that the entry for off-site paint remova is X^{20}
5. The number 20 refers to a specific method of abatement listed in Table 4.3
6. Locate abatement method 20 on Table 4.3

7. Read the information provided on off-site paint removal (advantages, disadvantages, appropriate and inappropriate applications)
8. Note that information is given for appropriate and inappropriate substrates

Table 4.3 also lists methods appropriate for limited use only. They are as follows:

- carpeting alone without underlayment
- plaster veneer with bonding agents
- heat gun
- scraping with misting
- HEPA sander
- chemical strippers (solvent and caustic).

Carpeting alone without underlayment should be considered as a temporary abatement measure only. Plaster veneer with bonding agents is appropriate only for small surface areas because durability is questionable. See Section 4.4.3.2 for information on the on-site paint removal methods

Table 4.2: Preferred Abatement Strategies and Methods of Choice by Component (numbers refer to methods listed in Table 4.3)

INTERIOR COMPONENT	REPLACE	ENCAP-SULATE	REMOVE PAINT on-site ***	REMOVE PAINT off-site ****
WALLS		X[1-7]		
CEILINGS		X[1,2,5,6]		
FLOORS		X[4,14-16]		
DOORS	X			X[20]
WINDOW UNITS	X			**
WINDOW COMPONENTS				
sashes	X		X[17-19,24]	X[20]
jambs		X[8,12,13]	X[17-19,24]	
sill	X		X[17-19,24]	X[20]
well		X[12,13]	X[17-19,24]	
stop/parting beads	X		*17-19,24	
TRIM	X		***	X[20]
baseboards	X		X[17-19,24]	X[20]
door frames	X		X[17-19,24]	X[20]
window frames	X		X[17-19,24]	X[20]
plain molding	X		X[17-19,24]	X[20]
decorative			X[18]	X[20]
balustrades	X	X[1,8]	X[17-19,24]	X[20]
railings	X		X[17-19,24]	X[20]
newel posts	X		X[17-19,24]	X[20]
columns		X[1,6]	X[18]	
mantles	X			X[20]
door jambs		X[8]	X[17-19,21,24]	
RADIATORS	X		X[18,19]	X[20]
CABINETS	X			X[20]
METAL PIPES		X[1,6,8]	X[18]	
STAIR TREADS		X[14]	X[17-19,21,24]	
STAIR RISERS		X[8,14]	X[17-19,24]	
GRILLES	X			X[20]

* If the substrate is metal only; ** See entry for sashes, sills; *** Should generally be used for limited surface areas; may be used when other strategies are impractical. **** Means stripping of paint in chemical tanks at the facilities of a professional paint stripping operation

Table 4.2, (continued)

EXTERIOR COMPONENT	REPLACE	ENCAP-SULATE	REMOVE PAINT on-site ***	REMOVE PAINT off-site ****
WALLS		X[8,10,11]	X[22,23]	
CEILINGS		X[8]		
FLOORS	X	X[4,8]	*18,19	
DOORS	X		*18,19	X[20]
WINDOW UNITS	X			**
WINDOW COMPONENTS				
sashes	X		X[17-19,24]	X[20]
jambs		X[12,13]	X[17-19,21,24]	
sill	X	X[12,13]	X[17-19,21,24]	
well		X[12,13]	X[17-19,21,24]	
stop/parting beads	X		*17-19,24	
TRIM				
door frames		X[12,13]	X[17-19,21,24]	X[20]
window frames		X[13]	X[17-19,21,24]	X[20]
balustrades	X		X[17-19,24]	X[20]
railings	X		X[17-19,24]	X[20]
newel posts	X		X[17-19,24]	X[20]
columns	X	X[8,13]	X[17-19,21,24]	
door jambs		X[12,13]	X[17-19,21,24]	
METAL PIPES	X			
STAIR TREADS	X	X[8,14]	X[17-19,21,24]	
STAIR RISERS	X	X[8,14]	X[17-19,24]	
GRILLES	X			X[20]
SOFFITS		X[8,13]		
OTHER flashing, gutters, downspouts	X			

* If the substrate is metal only; ** See entry for sashes, sills; *** Should generally be used for limited surface areas; may be used when other strategies are impractical. **** Means stripping of paint in chemical tanks at the facilities of a professional paint stripping operation

Table 4.3: Methods of Lead-Paint Abatement - CAUTION: DO NOT apply these methods without reviewing Section 4.8.1.

METHODS	ADVANTAGES	DISADVANTAGES	APPROPRIATE APPLICATIONS
Encapsulation Materials			
1 Gypsum Dry Wall	durable, compatible with modernization and trim abatement	quality finishing work needed, Trim must be removed	Any interior wall or ceiling balusters, pipes partitions, only option for deteriorated walls and ceilings
2 Melamine Coated Hardwood	easily cleanable, serviceable, prefinished, preformed strips cover vertical seams	needs proper installation for durability	walls & ceilings in bathrooms, kitchens, vestibules/foyers, and skylights
3 Plywood Paneling	quick installation, prefinished surface	may not meet fire codes, needs proper installation for durability	interior walls
4 Tile - Ceramic Stone	durable, easily cleanable, compatible with modernization	Experienced installer needed	bathrooms, kitchen walls, interior and exterior floors
5 Plaster Veneer with bonding agent	None	quality finish needed durability unknown anc questionable	Limited use on interior walls and ceilings in good conditions
6 Fiberglass: matt, fabric & water soluble casting wrap	quick installation; easy to handle; may not need painting	may need maintenance; some surface preparation needed	interior walls & ceiling if substrate is in good condition; paint should be generally intact; wrap appropriate for pipes
7 Vinyl coated fabric, prepasted wallpaper	quick installation; easy to handle	durability questionable; some surface preparation needed; may need maintenance	interior walls in good condition with intact paint
8 Wood/Plywood	durable		door jambs, exterior porch ceilings, boxing in of columns, balusters, pipes, exterior walls & floor underlayment
9 Jute Fabric/gypsum		questionable washability and resistance to abrasion; may need maintenance	well maintained building; tight paint; substrate in good condition

INAPPROPRIATE APPLICATIONS	COMMENTS	SKILL LEVEL	RELATIVE COST
limited surface areas and wood trim	encapsulant of choice for for interior walls, ceilings	High	Medium
all applications but kitchens & bathrooms	sealing of seams necessary for dust control	Medium	Medium
kitchens, bathrooms	sealing of seams necessary for dust control	Low	Low
		High	High
exterior		High	
walls & ceilings with deteriorated substrate or paint; trim, floors and exterior surfaces	different rigidity & thickness available; special adhesive must be used; water soluble casting wrap for pipes should be coated	Low	Low
walls with deteriorated substrate or paint; exterior walls	material may act as a vapor barrier	Low-medium	Medium
encapsulation of all other trim	certain types of paneling release formaldehyde gases and use should be limited	Medium	Low
poorly maintained building; kitchens, bathrooms		Medium	

Table 4.3, continued... CAUTION: DO NOT apply these methods without reviewing Section 4.4.1.

METHODS	ADVANTAGES	DISADVANTAGES	APPROPRIATE APPLICATIONS
10 Stucco	durable		exterior walls brick, cement
11 Exterior siding	compatible with modernization; quick installation durable, adds insulation, low maintenance	may require maintenance	exterior walls
12 Rigid vinyl	durable		window tracks, jambs
13 Aluminum or other metals	durable		exterior wood trim, all jambs, metal door frames, window tracks
14 vinyl: tiles & sheets, treads	easily cleanable, durable if quality product is used.		floors, stairs
15 Carpeting		not easily cleanable, collects dust	install over underlayment
16 Wood floor coverings: strip, parquet parquet	easily cleanable, durable		install over underlayment
PAINT REMOVAL			
17 Heat Gun		produces lead dust; potential fire hazard; must have adequate power; possible glass breakage.	limit use to small areas; or when replacement, encapsulation and off-site methods are impractical; thick paint layers on flat surfaces

INAPPROPRIATE APPLICATIONS	COMMENTS	SKILL LEVEL	RELATIVE COST
interior surfaces		Medium	
interior surfaces	consider use of breathable membrane barrier or sheathing under aluminum or other siding	High	High
		Medium	
interior wood trim	consider use of breathable membrane barrier or sheathing under aluminum or other siding	Medium	
	subflooring must be in good condition or replaced	Medium	Medium
installation directly over lead-painted surface	temporary measure only if installed directly over lead-painted surface	Low	
' '*chens, bathrooms		Medium	High
thin paint layer on ornate surfaces, large areas, walls, floors, ceilings	do not use sanding as final step; specialized attachments available;	Low	

Table 4.3, continued... CAUTION: DO NOT apply these methods without reviewing Section 4.4.1.

METHODS	ADVANTAGES	DISADVANTAGES	APPROPRIATE APPLICATIONS
18 On-site caustic stripper	can strip ornate, decorative surfaces	liquid waste; potential disposal problem; large quantities of residual lead left on surfaces, neutralization needed; chemical burns of skin, eyes	ornate & flat metal substrates; plaster; hard wood substrates; limited surface areas or when replacement, encapsulation and off-site methods are impractical
19 On-site organic solvents		special worker protection needed;potential fire hazard	limited surface areas; touch up work; metal substrate; thin paint; or when replacement, encapsulation & off-site methods are impractical layers
20 Off-site paint removal	completeness of paint removal	must wash surface to remove residue	trim, windows, doors, grilles both metal & wood substrates
21 Sander with HEPA filtration		useful only on certain flat surfaces	flat surfaces; jambs only
22 Abrasive vacuum blasting	contains & separates waste	potential damage to surface;	exterior surfaces
23 Water blasting		high volume of liquid waste produced; difficult to contain & collect liquid waste	exterior surfaces
24 Scraping with misting		produces lead dust; may damage substrate	wood trim; limited surface areas; when replacement, encapsulation & off-site methods are impractical

<u>DO NOT USE:</u>
Open-flame torch
Dry Scraping without misting
Grinding or Sanding without HEPA Filtration
Uncontained water blasting
Open Abrasive blasting

<u>LIMITED USE METHODS:</u>
Drop Ceilings
Carpeting alone
HEPA Sander
Solvents
Scraping with misting
Heat Gun
Plaster Veneer with bonding agent
Caustic chemicals

INAPPROPRIATE APPLICATIONS	COMMENTS	SKILL LEVEL	RELATIVE COST
aluminum & soft wood substrates; walls & other large surface areas	very difficult to remove leaded residue; worker experience critical for success; may contain methylene chloride - a suspected neurotoxin	Low	Medium
walls, thick paint layers; large surface areas.	may contain methylene chloride - a central nervous system depressant; need adequate ventilation; don't sand after	Low	
fixed components; where removal or reinstallation of component would be difficult	See Table 4.1 Arrange for stripping company to wash surfaces	Medium	
narrow, ornate surfaces	potential for production of fine particulate as not all dust is vacuumed into filter; may need air compressor.	Low	
interior surfaces	specialized equipment needed - attachments must match surface configurations.	Medium	
interior surfaces	waste must be contained; collected treated and disposed of; specialized equipment needed.	Medium	
large surface areas such as walls, floor, ceilings	do not use sanding as finishing step	Low	

4.8.1. Removal Methods

As previously explained, the on-site use of the following paint removal methods should be restricted to limited surface areas:

- heat gun
- sanders equipped with HEPA vacuum filtration
- caustic chemical and solvent-based strippers
- scraping with misting

Generally, chemical paint removal methods work best on metal substrates. (Caustics are not recommended for use on aluminum.) Metal substrates also may make cleanup of residual lead easier, since their surfaces are usually smooth and nonporous.

All substrates abated by paint removal methods should be repainted and sealed. Compared to flat paint, high gloss lead-free paint makes it easier to control dust it provides a smoother, easier surface to clean.

4.8.1.1 Heat-Based Removal Methods

High levels of airborne lead can be produced and dispersed by heat guns, therefore, respirator protection is required.[8,24] At the temperatures expected to occur during paint removal operations with most currently available heat guns, some leaad is likely to be volatilized. Considerable lead is volatilized and lead fumes are released at approximately 700 F degrees.[24] Heat guns able to reach temperatures in excess of 700 F degrees should not be operated in that temperature range.

Other less commonly used heat-based methods such as heat plates and heat lamps are not included in Table 4.3 because they are less versatile or more difficult to operate.

4.8.1.2 On-site Chemical Removal Methods

On-site chemical removal methods may require multiple applications depending on the number of layers of paint. Caustic and solvent-based chemicals should not be allowed to dry on the lead-painted surface. If drying occurs, paint removal will not be satisfactory and the potentia for creating lead dust in the process will be increased. In particular, caustic chemicals that require a plastic covering are difficult to rehydrate without creating lead dust because the plastic covering must first be removed. When the plastic covering is applied, care should be taken to cover and seal the edges and ends to prevent drying.

The process of washing and neutralizing substrates on which caustic chemicals have been used can create large quantities of lead-bearing liquid waste [14]. Any surfaces that have contact with this liquid waste should be cleaned by wet washing until there is no visible residue.

The use of organic solvents presents a potential fire hazard from flammable vapors. Organic solvents may contain methylene chloride, which is a probable human carcinogen and a known neurotoxin. Supplied air respirators are recommended by the U.S. Consumer Product Safety Commission to protect workers from exposure to methylene chloride because filters for organics do not protect against this hazard.

4.8.1.3 Off-site Chemical Removal Methods

For the purposes of these Guidelines, off-site chemical removal means the stripping of lead-paint from building component parts at the facilities of a professional paint stripping operation, where stripping of the paint takes place in chemical tanks. Components should be removed carefully to minimize damage to the parts themselves and surrounding surfaces. Prior to abatement, contractors should:

- Determine size limitations of the dipping tanks
- Arrange for same-day service for components needed for the units'security
- Discuss with the dipping subcontractor the procedures for washing components to remove any lead residues left behind on stripped surfaces
- Label all components with punch marks or other permanent marking systems to facilitate reinstallation

Even after the stripped components are washed, worker protection measures should continue to be implemented during handling and reinstallation to protect workers from exposure to any lead dust that remains on surfaces.

4.8.1.4 Mechanical Removal Methods

Scraping should be performed with misting to reduce exposure to fine air-borne particulate. Sanding without a HEPA filtered vacuum should not be used as a finishing method after scraping or any other method of abatement.

When using a sander equipped with a HEPA filtered vacuum, follow the manufacturer's operating instructions and instructions for care and maintenance (see Section 5.3.1.1, Chapter V). The potential for production of lead dust increases when the sanding disk is wider than the surface being abated (e.g., a door stop) because the sanding shroud is not always in contact with the surface. The HEPA sander is recommended only for limited surface areas. Its use is most appropriate on flat surfaces such as jambs/stair risers.

Similarly, when using abrasive blasting with vacuum on exterior surfaces, care should be taken that the configuration of the heads on the blasting nozzle match the configuration of the substrate so that the vacuum is effective in containing debris.

4.8.2 Replacement of Components

In performing removal work prior to the installation of new components, workers will generate lead dust. One method of dust control is misting or wet spraying of components and surrounding areas before removal work is started. Whenever a new component is installed, the contractor should seal seams and gaps with caulking.

4.8.3 Encapsulation of Components

Well prepared surfaces are important to the durability and integrity of the encapsulating system. For example, peeling lead paint on walls should be removed by wet scraping prior to encapsulation. Surfactants (wetting agents) may be added to the water to facilitate cleanup.

To prevent a bellows effect, panelling should be glued as well as nailed to the substrate. All seams must be sealed or caulked to prevent the escape of lead dust. It is a common construction practice to glue and then nail gypsum drywall. Flexible wall coverings should be installed with invisible seams and tight enough to be child pick-proof. For very high wear areas pregrouted 4 ft x 4 ft panels of tile are appropriate encapsulants. Contractors should consider the use of breathable membrane barriers or sheathing when encapsulating exterior surfaces with aluminum siding.

An effective encapsulant for floors is underlayment that is glued and fastened with screws to the lead painted floor. Carpeting can then be installed as a finishing step over the underlayment.

Contractors and owners may want to consider encapsulating wall and baseboard surfaces that are difficult to reach. These surfaces are frequently found in kitchens and bathrooms where plumbing and fixtures make access to surfaces difficult.

To inform future maintenance workers and renovators, warning labels should be affixed to the lead-painted surfaces prior to encapsulation and the existence of encapsulated lead-painted surfaces should also be noted in appropriate records of the PHA/owner.

Owners should be aware of the need to inspect and maintain encapsulating systems to ensure continued protection from lead exposure.

4.8.2 Maintenance and Repair

Maintenance and repair activities that break or disturb lead-painted surfaces create lead exposures for workers and residents. Therefore, the information on containment, cleanup, occupant and worker protection in these Guidelines should also be applied as appropriate, considering the scope, duration, and potential for dust generation of the maintenance and repair activity.

4.9 Occupant Protection Measures

4.9.1 Occupants of An Abated Unit

If the surface of lead paint is to be broken as part of a lead abatement project, under most circumstances occupants and their belongings must be temporarily relocated. This is the responsibility of the owner or PHA.

Relocation of occupants and their belongings may not be necessary if all of the following conditions exist:

- Abatement work is of very limited scope (e.g., limited work in one room)
- Abatement work can be accomplished in one 8 hour working day,
- The unit is still habitable in a practical sense (e.g. family has safe access to bathrooms and kitchen)
- The work area can be sealed.

In the case of an abatement exclusively on the exterior of a building, residents and their belongings may not need to be relocated if the interior environment can be adequately sealed to assure that no lead dust enters the interior and safe entrance and egress can be assured.

Every resident who has received prior notice is responsible for placing all personal items in closed, easily handled containers. Before a contractor starts a lead abatement project, he/she should check to make sure that the owner has moved all furnishings and containers with personal items from the work area. Occupants and their belongings can be returned to the abated unit only after the unit has successfully met post-abatement clearance standards.

4.9.2 Other Occupants of Multifamily Units

Whenever units and or common areas within an occupied multifamily dwelling are being abated, the owner must notify all residents within the building. The notice should consist of the following:

- Start-up date
- Areas to be abated
- A warning to heed caution signs

The warning sign should read as follows:

" CAUTION LEAD HAZARD - DO NOT ENTER WORK AREA UNLESS AUTHORIZED"

4.10 Record Keeping, Reporting and Notification Requirements

4.10.1 Requirements for PHA/IHAs

4.10.1.1 PHA/IHA Record Keeping Requirements

The records for each abated unit should clearly describe in nontechnical language where the lead was found and how it was abated. Files that will effectively document the abatement process include the following:

- All test reports
- Management records

- Reports prepared for other agencies
- Reports associated with disposal of abatement waste

PHAs should retain these records for the life of the annual contribution contract or contact their local HUD Office for guidance on record retention.

4.10.1.2 PHA/IHA Reporting Requirements

PHAs should report the following information to HUD in the final certification:

- Complete identification of units receiving abatement
- Results of random and 100 percent testing
- General description of abatement methods
- Results of abatement clearance tests
- Chronology of all project specific abatement from beginning of planning through final clearance testing and reoccupancy
- Pertinent federal, state, and local requirements under which abatement was undertaken

4.10.1.3 PHA/IHA Notification Requirements

PHAs should provide the following notification to HUD when all units have been tested for lead paint:

- Complete identification of units receiving testing
- Results of random and 100 percent testing
- Description of testing methods
- Identification of testing firm

PHA/IHAs must notify tenants of the existence of lead paint as per regulations at the time a lease is signed. A letter format as suggested by HUD in early lead paint regulations, with modifications to indicate the hazards of lead dust as well as lead paint, is suitable for a PHA/IHA (see Appendix 4.2). For private owners, state regulations may prescribe the notification procedure.

4.10.2 Record Keeping by Private Property Owners

Record keeping recommendations for private property owners are the same as those for PHAs. Reporting requirements should be checked with state and local health and environmental agencies.

4.10.2.1 Notification Requirements for Private Owners

Notification required by state and local agencies must be determined by direct coordination with these agencies prior to initiation of the abatement program. Coordination must be carefully conducted and recorded to assure that all requirements are met. It is suggested that memoranda be prepared reflecting all coordination initiatives that address report requirements. All aspects of disposal requirements should be documented simila·ly.

4.10.3 Standard Record Keeping

For suggested format to record XRF test methods and results, see Chapter III Appendices.

For suggested format to record surface dust test methods and results, see Chapter III Appendices.

A suggested format to assist in recording the management of work in progress is given below in table form.

The table shows the user where any given phase of the abatement job is on a given day. The top row consists of apartment or house numbers. The second row is the heading for the workday (i.e., the first day (1) on the job, the second day (2), etc.) of the job to be entered below. The column below the word BLOCK indicates the separate phases of the job. The numbers on either side of the slash (/) are workdays of the job on which the phase at the left of each row began in/ the unit and finished /out of the unit.

For example, presuming the overall job begins on January 10, the below record shows that cleanup began in unit 2 on January 21 and ended in unit 2 on January 22. (Add the number in the column to the day of the month the work began or ended. This gives the day of the month the work started or ended.)

Example:

UNIT #	1	2	3	4	5	6
WORKDAY #	in/out	in/out	in/out	in/out	in/out	in/out
BLOCK						
Demolition	1/2	3/4	5/6	7/8	9/10	11/12
Plumbing	3/4	5/6	7/8	9/10	11/12	13/14
Carp. Ph.1	5/6	7/8	9/10	11/12	13/14	15/16
Carp. Ph.2	7/8	9/10	11/12	13/14	15/16	17/18
Cleanup	9/10	11/12	13/14	15/16	17/18	19/20

See Appendix 4.1 for additional information.

For suggested documentation to record the characteristics of debris generated, how it is handled and disposed of, see Chapter VI.

For a suggested post-abatement certification form, see Chapter III Appendices.

For documenting worker blood lead test results, see Section 2.2.6.2, Chapter II.

4.11 Finding Qualified Lead-based Paint Abaters

Currently, few places in the United States have contractors that are qualified and certified to do lead paint abatement and few states have certification, licensing, or training requirements for abatement contractors. In attempting to find qualified or certified contractors, owners should contact the following:

- local HUD Office or other PHA
- local and state departments of health and/or environment
- local chapters of building and renovation contractors

4.11.1. General Qualifications

All abatement personnel should be familiar with the threat of lead poisoning in children and workers, the health effects of exposure, and ways to minimize exposure. They also will need basic construction skills to perform various abatement jobs such as:

- demolition (e.g., removal of old windows)
- carpentry (e.g., installation of new wood component parts)
- painting
- dry wall finishing
- floor installation

4.11.2 Contractor Requirements

Abatement contractors must have wide experience in building renovation and restoration procedures and be familiar with the contents of these Guidelines. Contractors must also be aware of all applicable local, state, and federal regulations pertaining to lead abatement work and any relevant licensing requirements. Owners and contractors should check with state and local health and environmental departments and state licensing boards for specific requirements in their area.

4.11.2.1 Contractor Insurance Coverage

Contractors performing abatement services should be covered with comprehensive liability insurance. The "occurrence" type is preferable to the "claims made" type. However, occurrence type liability insurance is expensive and may not be readily available. Insurance should be documented and placed in the permanent files of the PHA/owner to provide protection against possible future claims.

4.11.2.2 Requirements of Contractor Personnel

Contractor personnel must agree to submit to a pre-abatement medical examination and periodic follow-up testing during abatement before they are allowed to perform abatement. In addition they must attend a worker training course.

4.11.2.3 Training and Experience of the PHA/IHA

The contractee (PHA/IHA) should attend the worker training course outlined in Section 2.2.1, Chapter II, to become familiar with the methods and hazards of abatement and the health effects of lead. The contractee should be able to recognize unacceptable deviations from specified procedures which can adversely affect residents, workers, and the environment.

4.11.3 Staff Training and Experience

PHA/IHA staff should have experience in the planning and supervision of general renovation and construction work and have a basic knowledge of testing techniques, including their appropriate applications, limitations, and relative costs. This basic knowledge can be obtained by:

- Becoming familiar with the material in Chapter III on testing
- Attending a manufacturer's course in testing using an XRF analyzer
- Attending seminars on testing techniques sponsored by public or private organizations

4.11.4.1 Staff Qualifications for Administering the Contract

PHA/IHA staff qualifications to administer the abatement contract effectively include the following:

- Past successful contract administration
- Knowledge of the abatement requirements and procedures of the contractor
- Past success at imparting specialized knowledge necessary to a contractor

4.12 Sources of Training

Training resources that might be acquired at the state and local levels for PHA/IHA personnel include the following:

- Local and state health department seminars and training courses
- Local and state environmental department seminars and training courses
- Private organizations that offer training
- Academic centers
- PHAs with experience in lead-paint abatement

The following types of help might be obtained from other PHA/IHAs on lead paint testing and abatement:

- testing by using other PHA owned XRF equipment
- planning for abatement
- assistance in finding qualified abatement and testing contractors

Universities and academic centers have offered in the past and may continue to offer in the future full day and multi-day workshops that cover all aspects of the lead-paint abatement problem in housing.

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CHAPTER V - Cleanup

5.1 Introduction

The goal of any lead-paint abatement project is to provide an environment relatively free of lead contamination. The following checklist is a summary that should be consulted prior to a cleanup associated with LBP abatement. The remainder of the chapter addresses each item in detail.

- o Do you understand the critical importance of cleanup in a lead paint abatement project?
- o Have you scheduled both the daily and final cleanups properly and coordinated them with the other actors involved in the abatement process?
- o Have you obtained the necessary equipment (e.g. HEPA Vacuum, etc.) and materials (e.g. High Phosphate Detergent, etc.) to be able to clean most effectively?
- o Do you know how to operate and maintain special cleaning equipment and have you followed the directions for the proper use of cleaning materials?
- o Have you carefully studied the step-by-step procedures for both the daily and final cleanup?
- o Have you made sure your workers are properly protected during the cleanup processes?
- o Have you arranged for surface dust testing at the proper times and for related visual inspections?
- o Have you made provisions to contain and store potentially hazardous debris properly?
- o Have you properly painted or otherwise sealed all appropriate surfaces?
- o Have you met the appropriate clearance criteria?
- o Have you kept appropriate records to document your role in the abatement project?
- o Have you and your workers been trained and certified (if required by local/state regulations) for lead paint abatement work?

5.2 Developing a Comprehensive Plan for Cleaning and Clearance

Cleaning is an integral part of the entire lead paint abatement process. Consequently, users of this manual should be sensitive to cleanup from initial testing and specification preparation to final inspection and clearance certification.

5.2.1. Roles and Responsibilities

It is important that all the major entities with an interest in cleanup be aware of their roles and responsibilities, as detailed below:

5.2.1.1. Owner

He/she must understand the importance of cleaning in the LBP abatement process and communicate that importance to the testing agency, the designer/consultant, the abatement contractor, and the occupant.

5.2.1.2. Testing Agency/Inspector

Both must realize that the goal of any lead paint abatement project is a clean living environment and consequently it must carry out its testing program in a scientific and comprehensive way so as to be able to certify the achievement of that goal.

5.2.1.3. Designer/Consultant

They must prepare clear specifications with regard to cleaning in accordance with the methods and procedures outlined in these Guidelines.

5.2.1.4. Abatement Contractor

He/she must carefully follow the cleaning specifications provided by the designer/consultant.

5.2.1.5. Occupant

Occupant must understand the importance of regular housekeeping and maintenance in ensuring the long-term efficacy of a lead-paint abatement project.

5.2.2. Scheduling

The proper scheduling of the daily and final cleanups ensures that the cleaning is done at the most effective time in the process. Detailed below are the recommended times for both the daily and final cleanups.

5.2.2.1. Daily Cleanup

Most of the abatement methods recommended for use today generate lead dust as a by-product. It is important for the safety of workers as well as the effectiveness of the entire abatement process to minimize the impact of this dust. Its' early removal from the work area will reduce the potential for recontaminating the property. Consequently, it is important that the work area in which active abatement is taking place is cleaned daily during the entire abatement process. The daily cleanup activity should be scheduled for the same time at the end of each work day, after active abatement has ceased and enough time must be allowed for a thorough and complete cleanup. Under no circumstances should active abatement be proceeding while the daily cleanup is in process. By insisting upon these daily cleanups, problems with the final cleanup process will be minimized.

5.2.2.2. Final Cleanup

The process of lead paint abatement causes lead dust to be generated and become airborne. Once airborne, it has a tendency to settle rather slowly over time. To give any airborne lead time to settle, the final cleanup process should be scheduled to start no sooner than 24 hours after active abatement has ceased. This is a minimum waiting period. If abatement methods have been particularly invasive and aggressive, it may be necessary to wait an additional period before starting final cleanup. Use of negative air machines during abatement may shorten the minimum waiting period.

Note that for the purpose of these guidelines the last step of active abatement is the removal of all material, equipment and debris, including any and all protective plastic sheeting, from the abatement area.

5.2.3. Coordination

Cleanup is interrelated to all other main parts of the process and because of this, coordination must take place among all persons/firms conducting separate abatement activities in a dwelling. Detailed below are the ways in which the cleanup should be coordinated among abatement participants.

5.2.3.1. Testing

Final or clearance testing (Section 5.4) determines whether or not the premises are clean enough to be reoccupied after the completion of a lead paint abatement project. Consequently, the scheduling of final testing needs to be coordinated with the final cleanup to ensure that the testing results provide a valid final cleanliness level. It is also possible that the owner/consultant involved in a project may need to conduct air monitoring during the abatement process. Consequently, it is important that he knows the schedules for the daily and final cleanups in case he wishes to monitor at those particular times. (See Chapter II, Section 2.2.2.)

5.2.3.2. Waste Disposal

As detailed in Chapter VI, regulations governing hazardous waste storage, transportation, and disposal impact on both the daily and final cleanups. The abatement contractor needs to coordinate such things as the selection of containers, storage areas and debris pick-ups with the disposal contractor to assure that all relevant regulations are met.

5.3 Cleanup Methods and Procedures

As the market develops for lead paint abatement contractors many of the firms who will enter this new industry will be general/home improvement contractors. Many of the special cleaning methods and procedures detailed later in this chapter will not be normal procedures for these firms. That being the case, it is important for them to follow the recommended methods and procedures exactly, even though some may appear to be redundant and unnecessary. Experience has shown that modifying the methods or skipping steps in the procedure adversely affects the efficacy of the entire lead paint abatement project.

5.3.1. Special Methods

Research and field studies have shown that there are two basic cleaning methods which, when used concurrently, have proven most effective in lead paint abatement projects. The dry cleaning method involves the use of a High Efficiency Particle Air (HEPA) Vacuum, to clean all the surfaces of a dwelling unit at the conclusion of an LBP abatement project. The wet cleaning method involves the use of a high phosphate detergent to wash all the surfaces of a dwelling unit at the conclusion of an LBP abatement project.

5.3.1.1. HEPA Vacuum

HEPA vacuums differ from conventional vacuums in that they contain high efficiency filters which are designed to trap extremely small, micron-sized particles. These filters are capable of filtering out particles of 0.3 microns or greater from a body of air at 99.97% efficiency or greater. (Recent research and development has resulted in the production of an Ultra Low Penetration Air, or ULPA filter capable of filtering out particles of 0.13 microns or greater from a body of air at 99.9995% efficiency. These ULPA filters are only slightly more expensive, but may be less available than HEPA filters.)

As mentioned earlier, lead dust tends to break down into extremely fine, micron-sized particles. Vacuuming by conventional means is unacceptable in a lead paint abatement final cleanup because much of the fine lead dust will simply be exhausted back into the environment. Consequently, the use of a HEPA vacuum is required. Following are procedures for its proper use.

a. Read Operating Instructions

There are a number of different manufacturers of HEPA vacuums. Although these HEPA vacuums operate on the same general principle, they may vary considerably in applicability. Operators should be sure that the machine they plan to use is the best suited for the purpose. It is important that operators carefully follow the operating instructions provided by the manufacturer of the machine they are using. If possible, training sessions should be arranged with the manufacturer's representative.

b. Special Attachments Needed

Since the HEPA vacuum will be used to vacuum surfaces other than just floors, it is important for operators to have appropriate attachments for use on unusual surfaces. Attachments such as various sized brushes, crevice tools and angular tools should be procured along with the HEPA vacuum. Using these attachments properly will enhance the quality of the HEPA vacuuming process.

c. HEPA Vacuuming Procedures

At the conclusion of the active abatement process and according to the schedule indicated earlier in this chapter, all surfaces potentially affected by the abatement process should be thoroughly and completely HEPA vacuumed. These surfaces include but are not limited to ceilings, walls, floors, windows (sash, sill, well), doors, fixtures of any kind (light, bathroom, kitchen), built-in cabinets, and appliances. These surfaces include abated surfaces and unabated surfaces exposed to lead dust generated by the abatement process. All rooms of the property should be included in this HEPA process except for rooms which were found free of lead paint and lead dust before the abatement process began, were properly sealed before the abatement process began and were never entered during the process. Rooms should be vacuumed, starting with the ceilings and working down to the floors.

d. Maintenance of HEPA Vacuum

HEPA vacuums must be properly maintained in accordance with manufacturer's instructions. Extreme caution should be taken any time the HEPA Vacuum is opened for filter replacement or debris removal due to the high potential for accidental release of accumulated lead dust into the environment. This can occur if the vacuum's seal has been broken and the removal of the vacuum's bag is disturbed. Operators should wear a full set of protective clothing and equipment, including appropriate respirators, when performing this maintenance function. (See Chapter II, Section 2.2.5.) Used HEPA filters and vacuumed debris are potentially hazardous and should be treated accordingly. (See Chapter VI - 6.4.1.)

5.3.1.2. High Phosphate Wash

Detergents with a high phosphate content (i.e. containing at least 5% tri-sodium phosphate) have been found to be most effective when used as part of the final cleanup process in a lead paint abatement project. The phosphate bonds with the lead in the dust to create a compound that is easier to remove from surfaces than is the product of washing with nonphosphate detergents. Because of concern for its impact on the environment some states have regulated the use of high phosphate detergents. Consequently, some manufacturers have eliminated phosphates from their household detergents. The proper name for the chemical involved in trisodium phosphate, which is available in chain grocery stores and hardware stores. Following are procedures for proper use of this product:

a. Read Manufacturer's Instructions

Users of high phosphate detergents should careful y follow the specific manufacturer's instructions for the proper use of the product, especially the dilution ratio recommended. Even diluted, trisodium phosphate should be used only with waterproof gloves as it is very irritating to the skin.

b. Cleaning Equipment

Since high phosphate detergent mixture is used to wash down various types of surfaces, the user should be sure he has the appropriate application equipment, such as wringer buckets, mops, squeegee sponge mops, various sized hand sponges, and rags. Using the proper equipment on the appropriate surface will enhance the quality of the high-phosphate wash process.

c. Wet Cleaning Procedures

At the conclusion of the active abatement process and after the first HEPA vacuuming, all surfaces should be thoroughly and completely washed with a high phosphate solution. These surfaces include but are not limited to ceilings, walls, floors, windows (sash, sill, well), doors, fixtures of any kind (light, bathroom, kitchen), built-in cabinets, and appliances. These surfaces include surfaces actually abated as well as those that were not, but possibly exposed to lead dust generated by the abatement process. All rooms of the property should be included in this high phosphate wash process except for rooms that were found free of lead paint and lead dust before the abatement process began, were properly sealed before the abatement process began and were never entered during the process. Rooms should be washed by starting with the ceilings and working down to the floors.

d. Change Cleaning Mixture Regularly

Many manufacturers of high phosphate cleaners will indicate the surface area that their cleaning mixture will cover. To guard against the recontamination of the area by continued use of overly dirty water, users should carefully follow the surface area limits provided by the manufacturer and change the cleaning mixture accordingly. In cases where the manufacturer does not indicate surface area limits, the cleaning mixture should be changed at least after each room has been washed. Care should be taken by the user each time the cleaning mixture is changed to ensure that the dirty water is not allowed to recontaminate the environment. This dirty water is potentially hazardous and should be treated accordingly. (See Chapter VI, Section 6.4.1.)

5.3.2. Special Procedures

Following, in chronological order, are the special procedures to be followed in the cleanup of a lead-paint abatement project. Field studies have demonstrated that skipping steps in the process or carelessly addressing any of these steps may result in the failure to meet post-abatement cleanliness standards, thereby requiring re-cleaning which adds to both time and cost.

5.3.2.1. Pre-Abatement Actions

The proper pre-abatement preparation of the area helps to enhance the effectiveness of the entire abatement project. Specifically, there are two pre-abatement actions which should be considered that relate to cleanup: initial testing and initial site preparation.

For initial testing, see Chapter III, Section 3.5.3, for recommendations concerning pre-abatement surface dust testing as well as for specific protocols and procedures.

For initial site preparation, see Chapter IV, Section 4.3.2.1, for recommendations concerning the moving and cleaning of furniture, etc.

5.3.2.2. Actions During Abatement

The following actions, when performed regularly during abatement, help to minimize problems during final cleanup and limit the potential exposure of abatement workers to lead dust throughout the abatement process.

a. Daily Cleanups

As stated in paragraph 5.2.2.1., a thorough cleanup of the entire area under active abatement should occur daily during the entire abatement process. This daily cleanup should consist of the following:

(1) Large Debris

Large demolition or removal type debris, e.g., doors, windows, trim, should be wrapped in 6-mil plastic, sealed with tape and moved to the area designated for trash storage on the property. (Since lead-contaminated debris is a potentially hazardous waste, it should never be stored outside while awaiting removal/disposal. Consequently, an area inside the property needs to be designated as a temporary trash storage area.)

(2) Small Debris

Small debris should be swept up, collected, and disposed of properly. However, before any sweeping occurs, the affected surfaces should be sprayed with a fine mist of water. Spraying before sweeping helps to keep surface dust from becoming airborne and potentially contaminating other areas of the property and abatement workers. Dry sweeping should be prohibited. This swept debris should then be placed in double 4-mil thick or single 6-mil thick plastic bags, properly sealed, and moved to the designated trash storage area. Care should be taken not to overload trash bags , which otherwise may rupture or puncture during handling and transport.

b. Exterior Cleanup

As described in Chapter IV, 4.7.3, areas potentially affected by exterior abatements should be protected. Because weather can adversely affect the efficacy of exterior containment, the surface plastic should be removed at the end of each workday. On a daily basis as well as during final cleanup, the immediate environs should be examined visually to assure that no lead debris escaped containment. Any such debris should be raked or swept and placed in single 6-mil or double 4-mil plastic bags, which should then be stored along with other contaminated debris.

c. Worker Protection Measures

General worker protection measures have been discussed in Chapter II. However, field practice has shown that it is during daily cleanup activities, especially while sweeping, that workers may be exposed to high levels of airborne lead dust. That being the case, it is important that workers wear protective clothing and equipment, especially appropriate respirators during daily cleanup activities.

d. Confinement of Dust

It is important to maintain the integrity of the plastic sheeting used to contain lead debris in a lead-paint abatement project. Abatement workers should note, during their daily cleanup activities, any areas of the plastic requiring repair and perform same by patching holes and tears with 6-mil plastic and duct tape immediately after cleaning to ensure a proper seal for the next day's work.

5.3.2.3. Post-Abatement Actions

The need to approach lead-paint abatements in a comprehensive and methodical manner is especially critical when planning the final cleanup. If followed carefully and completely, the steps that follow, combined with the other procedures discussed in these Guidelines, should result in a lead safe environment for the abated property.

The serial cleaning process described in this section is specified in Regulation #5 of the Housing Code of Baltimore City and Regulation #26.02.07 of the Department of the Environment, State of Maryland.

a. Preliminary Final Cleanup

Following are the steps to be taken in the preliminary final cleanup phase.

(1) Removal of Plastic Sheeting

Before final cleanup can begin, the plastic sheeting used for containment must be removed. Great care should be taken in the removal and disposal of this contaminated plastic sheeting. Before removal it should be sprayed and swept as detailed earlier in this chapter. It should then be folded carefully from the corners/ends to the middle to trap any remaining lead dust and placed into double 4-mil or single 6-mil plastic bags, sealed and removed from the premises. (As was the case with daily cleanups, this plastic removal process requires the use of protective equipment, especially appropriate respirators.

Plastic sheets used to isolate contaminated rooms from non-contaminated rooms should <u>not</u> be removed at this time. These sheets should remain until after the preliminary final cleanup is complete and then be carefully removed as described.

The entire affected area should then be HEPA vacuumed as detailed in 5.3.1.1.

The entire affected area should then be washed down with a high phosphate solution as detailed in 5.3.1.2.

The entire affected area should then be HEPA vacuumed again.

b. Interim Final Inspection

After the preliminary final cleanup effort is completed, an interim final inspection should be done, as follows:

(1) Visual Inspection

The entire affected area should be visually inspected by an inspector to ensure that all surfaces requiring abatement have been addressed and all visible dust and debris have been removed. (See Chapter III, Section 3.5.2).

(2) Unsatisfactory Results

If the results of the visual inspection are unsatisfactory, affected surfaces must be re-abated and/or recleaned until satisfactory results are achieved.

c. Painting/Sealing

Painting or otherwise sealing abated surfaces and all interior floors is actually the final step of the cleaning process. Sealed surfaces are much easier to clean and maintain over time than those that are not sealed.

(1) Abated Surfaces

All abated surfaces including walls, ceilings, and woodwork should be primed with an appropriate primer. Particularly problematic areas, such as window sills and wells, should be painted with a final coat of high gloss enamel.

(2) Floors

Wooden floors should be sealed with a clear polyurethane or painted with a polyurethane-based paint. Tile or other similar floors should be sealed with an appropriate wax. Concrete floors should be sealed with a concrete sealer.

d. Final Cleanup

After painting/sealing is complete, the final cleanup can take place. It consists of the following:

The entire affected area should be HEPA vacuumed again.

The entire affected area should then be washed down with a high phosphate solution again.

The entire affected area should then be HEPA vacuumed again.

e. Final Inspection

After the final cleanup is done, the final inspection should take place. It consists of the following:

(1) Visual Inspection

The entire affected area should be visually inspected by an inspector to ensure that all abated surfaces and all floors have been painted or otherwise sealed.

(2) Surface Dust Testing

Surface dust testing should be performed as described in Chapter III, Section 3.5.3.

5.3.2.4. Cleaning of Workers, Tools, Equipment, and Vehicles

Special attention should be given to the following activities to ensure that family members, other workers, and subsequent properties are not being contaminated.

(a) Personal Hygiene

Workers should carefully follow the personal hygiene procedures outlined in Chapter II, Section 2.2.1.3.

(b) Supplies

Consumable/disposable supplies such as mop heads, sponges, and rags should be replaced regularly, at least at the end of each abatement project or monthly, whichever comes first. Soiled items should be treated as contaminated debris. (See Chapter VI, Section 6.4.1.)

(c) Equipment

Durable equipment such as power and hand tools, generators and vehicles, etc., should be cleaned, at least at the end of each abatement project or monthly, whichever comes first. This cleaning should consist of a thorough HEPA vacuuming and washing with a high phosphate solution.

5.4 Clearance Criteria

In a lead-paint abatement project, clearance criteria refers to criteria used in "clearing" an abated property for reoccupancy. In addition to results of the various visual inspections detailed earlier, one testing method currently in use is applicable to this clearance process. It is surface dust testing.

5.4.1. Surface Dust Testing

Specific protocols and procedures used in surface dust testing are detailed in Chapter III, Section 3.5.3.

5.4.1.1. Standards (See Appendix 5-1)

Although there are no Federal standards governing the level of lead in house dust at this time, some states, most notably Maryland and Massachusetts, have established standards for specific interior surfaces. The standards, which are based on a test that measures bio-available lead and not total lead, are the same for the two states:

Floors -- 200 micrograms of lead/square foot
Window Sills -- 500 micrograms of lead/square foot
Window Wells -- 800 micrograms of lead/square foot

Since there are no applicable federal standards, it is recommended that these standards be used as clearance criteria until such time as they can be refined or replaced through additional research.

5.4.1.2. Applicability in Clearance Process

Because dust tends to settle as opposed to remaining airborne, surface dust testing, specifically wipe sampling, is currently the most reasonable method for measuring the cleanliness of the property for clearance purposes.

5.4.1.3. Schedule/Protocol

Where surface dust testing is being used for clearance purposes, dust sampling should take place no sooner than 24 hours after the completion of post-abatement cleanup to give any airborne dust time to settle. Sampling should be done as described in Chapter III, Section 3.5.3.

5.5. Reporting and Documenting the Cleanup

Since cleanup is an integral part of the whole lead-paint abatement process, reporting and documenting the cleanup should not be done separately but as a part of the reporting/documentation of the whole project. The previous Chapter (Section 4.6) goes to great length in its discussion of recommended reporting and documentation procedures.

Great care should be taken in maintaining all records relating to clearance testing. These records should include all results of all surface and air dust testing performed before, during, and after abatement.

5.6 How to Find Qualified Firms (See Appendix 5-1)

The recommended qualifications for a cleanup contractor are the same as for the abatement contractor since it is likely that they will be one and the same. Chapter IV, Section 4.7, discusses these qualifications in great detail and they should equally apply to cleanup as well as abatement workers.

5.7 Post Clearance Notice to Occupant (See Appendix 5-2)

Upon moving back into a cleared property after lead-paint abatement, the occupant of the property should be provided with a fact sheet which, among other things, describes in general the lead hazards that were found, the methods that were used to abate these hazards, and the cleaning methods used in final cleanup. It should also identify those areas of the property (e.g., window sills and window wells) that may present future problems and require special cleaning attention and describe in general the cleaning methods that the occupant should use to maintain a safe level of cleanliness in the property.

Chapter VI - DISPOSAL

6.1 Introduction

Proper disposal of the waste generated during lead-based paint abatement is an integral part of a safe and effective abatement process. Steps must be taken to ensure that these wastes do not harm human health or the environment. Federal, state, and local requirements for disposal of wastes must be followed.

The information contained in this chapter will enable building owners, abatement contractors, and others to plan for and ensure the safe and legal disposal of the wastes generated. It covers the regulations that govern the disposal of wastes; the types of wastes generated during abatement; guidelines for developing a disposal plan; and procedures for testing and arranging for safe disposal of wastes.

The following is a checklist of actions that must be taken to ensure proper disposal:

o Contact regional EPA, state, and local authorities to determine disposal requirements (call the EPA hotline at 1-800-424-9346 for questions regarding federal requirements).

o Choose a qualified laboratory to perform testing and discuss sampling procedures in advance.

o Have testing performed on representative samples of each waste to determine whether it is nonhazardous or hazardous waste (see Appendix 6-1 and Section 6.5.1).

o Determine the type (hazardous or nonhazardous) and quantity of wastes that will be generated (see Appendix 6-1 and Sections 6.3.1 and 6.5.3).

o Establish a standard procedure for bagging and handling the wastes.

o Clean waste containers before they are removed from the work area and dispose of wash waters in accordance with applicable EPA, state, or local disposal requirements.

o Establish an appropriate time and pathway for removal of wastes.

o Secure and post warning signs on any temporary storage areas.

o Transport nonhazardous solid wastes in covered vehicles to a permitted landfill.

o For hazardous wastes, obtain an EPA identification number; arrange for services of an authorized transporter; place wastes in appropriate labeled containers; include the EPA manifest form.

o Establish procedures for protection of workers and residents during disposal operations.

6.2 Regulations and Standards for Waste Disposal

Federal, state, and local regulations govern the disposal of wastes associated with lead-based paint abatement and cleanup. Some of these wastes may be regulated as hazardous. EPA regulates the disposal of all wastes (both hazardous and nonhazardous) under the Resource Conservation and Recovery Act (RCRA) (see Appendix 6-1). Many states and some localities also have disposal regulations in place. Contractors involved in lead abatement programs should consult state and local authorities and regional EPA representatives to determine what regulations apply in their area. A listing of EPA regional offices is provided in Appendix 6-2. Lists of state waste agencies are provided in Appendices 6-3 and 6-4.

6.2.1 Solid and Hazardous Waste Regulations

Hazardous wastes are a subcategory of solid wastes. Solid wastes include such diverse wastes as household trash, sewage sludge, and discarded industrial materials. Solid wastes, however, are not necessarily solid; they may be liquid, semisolid, or gaseous.

The Resource Conservation and Recovery Act Subtitle C sets minimum technical requirements for hazardous waste disposal facilities (see Appendix 6-1). Individual states regulate the disposal of nonhazardous solid wastes under Subtitle D. Approximately one-half of the states have EPA-approved solid waste disposal plans in place. A state's plan outlines the steps it will take to ensure that the solid waste within its borders is managed safely. <u>Check with state solid waste authorities to determine if your state has a solid waste plan and what the plan's requirements are</u> (see Appendix 6-4).

A waste is hazardous if it is ignitable, corrosive, reactive, or toxic or if it contains a listed hazardous waste. (See Appendix 6-1 for definition of these four characteristics and for the legal definitions of solid and hazardous wastes.) Hazardous waste must be handled and disposed of according to RCRA Subtitle C regulations or state regulations, if they are more stringent. <u>Contact your state hazardous waste agency (Appendix 6-3) for information regarding regulations in your state</u>.

6.3 Classification of Abatement Wastes

6.3.1 Hazardous Wastes

Wastes associated with lead-based paint abatement must be tested to determine if they are hazardous (see Chapter V, Section 6.5.1). Wastes deemed hazardous may include, but are not limited to, the following:

- Lead paint chips.
- Lead dust.
- Old woodwork, plaster, windows, doors, and other components removed from the building.
- Plastic sheets and tape used to cover floors and other surfaces during lead paint removal.
- Solvents and caustics used during the stripping process.
- Sludge from paint removers used in the job.
- Liquid waste, such as wash water used to decontaminate surfaces after solvents have been used, or from general cleanup, and liquid waste from exterior water blasting.
- Rags, sponges, mops, HEPA filters, air monitoring cartridges, scrapers and other materials used for testing, abatement, and cleanup.
- Disposable work clothes and respirator filters.
- Any other items contaminated with lead-based paint.
- Any combination of the above wastes.
- Any solid, nonhazardous waste, contaminated or mixed with a hazardous waste.

6.3.2 Relationship of Abatement Procedures to Waste Generated

Different abatement procedures generate different types and quantities of waste. For example, replacement, encapsulation, and paint removal off-site generate lower dust levels than paint removal on-site, but may create larger quantities of debris for disposal. Replaced components (such as doors and window frames and sills), stripping agents, and the residues from paint removal on site may be hazardous wastes. In general, liquid wastes, many of which are hazardous, are the most difficult to contain and dispose of. See Chapter IV for a detailed discussion of abatement procedures and the types, characteristics, and quantities of waste each procedure is likely to generate.

6.4 Arranging for Safe Disposal of Waste

Most of the wastes generated in a lead-abatement project will be regulated as solid, nonhazardous wastes. Even if the wastes are not hazardous under the law, they will still contain lead, which is potentially harmful to human health and the environment. Proper management and disposal of all wastes associated with lead-based paint are therefore essential.

The following steps should be followed to ensure the proper handling and disposal of wastes during and after abatement activities:

- Contact your EPA regional office (Appendix 6-2) as well as state and local authorities (Appendices 6-3 and 6-4) to determine what disposal requirements and sampling methods must be followed.

- Choose a qualified laboratory to perform testing of wastes. (Contact regional EPA or state hazardous waste authorities for assistance in locating a qualified laboratory.) Discuss sampling procedures with the laboratory.

- Determine whether the wastes are nonhazardous or hazardous wastes. Where possible, this should be done before abatement begins so that non-hazardous and hazardous wastes can be handled separately. Wastes generated by lead-based paint remediation efforts may be complex mixtures of both hazardous and nonhazardous components; once combined, the entire mixture is regulated as hazardous waste. By segregating nonhazardous wastes (such as doors or windows containing minimal amounts of lead-based paint) from hazardous wastes, one can avoid the high disposal costs and additional handling procedures associated with hazardous waste regulation. Procedures for determining whether wastes are hazardous are described in Section 6.5.1.

- Make sure that abatement procedures adequately control the generation and distribution of debris and dust. This is an important step in ensuring proper disposal of the wastes generated during abatement. Follow proper containment measures for both interior and exterior abatement. (See Chapter IV, Section 4.3.2, for more detailed guidance.)

- If bags of waste are stored temporarily on the property (e.g., in a trailer), the storage area should be locked and warning signs should be posted.

6.4.1 Disposing of Nonhazardous Solid Wastes

Nonhazardous waste should be disposed of in the following manner:

6.4.1.1 Transporting Nonhazardous Waste

The wastes should be transported by responsible contractors in covered vehicles to a landfill, preferably a lined landfill. Waste from a lead abatement project should not be disposed of through regular residential or commercial trash collection unless this has been approved by state authorities. It is recommended that the waste not go to an incinerator, and that regular residential or commercial trash collection or dumpster services that deliver to incinerators not be used.

If a dumpster service is used, the company removing the dumpster and disposing of the waste should be warned that the waste contains lead and that the dumpster should be covered for transport. In addition, the dumpster service should dispose of the waste in a manner that prevents lead from becoming airborne. All lead waste, whether hazardous or nonhazardous according to RCRA definitions, should be properly transported it does not contaminate the environment.

6.4.1.2 Standard Procedure for Bagging and Handling Wastes.

Place lead paint chips, debris, and lead dust in double 4-mil or single 6-mil polyethylene bags that are airtight and puncture-resistant. Pieces of wood that don't fit into plastic bags can be wrapped in plastic and labeled "Danger, Lead Dust" (or other appropriate warning). Do not wash lead dust down the drain or flush it down the toilet.

All disposable cleaning materials, such as sponges, mopheads, filters, disposable clothing, and brooms should be placed in double 4-mil or single 6-mil thick plastic bags that are sealed with tape.

Once large debris has been bagged, and initial cleanup performed, remove plastic cloths and tape from covered surfaces. Lightly mist top of cloths to keep dust down and fold inward to form tight bundles to bag for disposal. If a second layer is below the first, mist and fold in the same way. Place all plastic cloths in double 4-mil or single 6-mil thick plastic bags and seal.

Bag and seal vacuum bags and filters in double 4-mil or single 6-mil thick plastic bags.

Place all clothing or clothing covers used during abatement and cleanup in plastic bags for disposal.

Place solvent residues and residues from caustic strippers in drums made out of materials that cannot be dissolved or corroded by the chemicals. The solvents and caustics used in the abatement effort may be listed as hazardous wastes (40 CFR 261.31). If not, they should be tested to determine if they are hazardous (see Section 6.5.1). Any hazardous solvents or caustics should be disposed according to the guidelines in Section 6.4.2.

Contain and properly dispose of all liquid wastes, including lead-dust contaminated washwater. Do not wash this liquid into storm sewers or sanitary sewers.

6.4.1.3 Removing Waste from the Site

While in the work area, the exterior of the waste containers should be HEPA-vacuumed. Before leaving the work area, and in a location close to the exit, the containers should be wet wiped to ensure that there is no residual contamination. Immediately afterward, the containers should be moved out of the area. If plastic bags are used, they should be bagged (using single 6-mil or double 4-mil bags) as they come out of the work area.

Waste should be removed from work areas at times when tenant use of building hallways and staircases (in multi-family dwellings) is low. This precaution minimizes tenant exposure should a container fall or break open. The path from the work area to truck or dumpster should be planned ahead of time to minimize tenant contact with this process and to ensure access to freight elevators or loading docks.

Containers should be moved and packed into the truck or dumpster with care. When possible, hand trucks, dollies, or pull carts should be used. Ramps or trucks with lift gates should also be used. These procedures will help minimize container breakage and subsequent tenant and contractor employee exposure.

Solid waste should be covered when transported to prevent lead from becoming airborne. Section 6.5.6 describes precautions to be taken during transport and at the disposal site.

6.4.2 Disposing of Hazardous Wastes

If testing determines that any of the wastes generated are hazardous, the following steps should be taken:

- o Obtain an EPA identification number (Section 6.5.4.) and arrange for an authorized transporter to take the wastes to a permitted hazardous waste treatment, storage, or disposal facility.

- o Place any hazardous wastes in containers approved by DOT (U.S. Department of Transportation). (See Section 6.5.5.).

- o Label the containers "Hazardous Waste." Once full, date the containers.

- o Include an EPA manifest form (Section 6.6.2.2) when transporting the waste. Keep the original copy of the manifest and the completed copy (returned by the owner of the treatment, storage, or disposal facility) for at least 3 years.

- o Comply with all applicable (and possibly more stringent) state and local regulations.

6.4.3 The "don'ts" of disposal

When disposing of the waste collected in a lead-paint abatement project, follow these general rules:

- o DON'T leave lead debris in the yard or on nearby property.

- o DON'T incinerate debris. Fumes from lead that is burned will contaminate the air and expose workers to dangerous levels of lead.

- o DON'T dump wastes by the road or in a nearby unauthorized dumpster. Appropriate disposal is at a Subtitle D landfill (nonhazardous waste) or permitted Subtitle C disposal facility (hazardous waste).

o DON'T wash lead-contaminated water into storm sewers or sanitary sewers.

6.5 Managing Hazardous Waste

Although most wastes generated during lead abatement will not be considered hazardous by federal law, it is important for the contractor to be familiar with the requirements that must be followed for testing and disposing of hazardous waste.

6.5.1 Testing for Hazardous Waste

To determine if wastes are hazardous, tests must be applied to representative samples of the types of waste generated. Standard testing methods are specified by EPA at 40 CFR, part 261.

6.5.1.1 The EP Toxicity Test

The extraction procedure test (EP Toxicity Test Method 1310) is used to determine if a waste is likely to leach certain metals or pesticides into ground water. The test must be performed by a qualified laboratory, which extracts constituents from the waste in a manner designed to simulate the leaching actions that occur in landfills. The extract is then analyzed to determine if it possesses any of the toxic contaminants listed in Appendix 6-5

If the concentration of the contaminants in the extract equals or exceeds the amounts listed in this table, the waste is classified as hazardous and must be disposed of according to federal RCRA regulations (or state or local regulations, if they are more stringent). For lead-based paint wastes, the waste is hazardous if the leached lead concentration exceeds 5 ppm (5 mg/liter. Leachable lead may be found in bagged debris, paint chips, and dust. Lead wastes may also contain other toxic materials, such as chromium and cadmium. The concentration limits for these contaminants are also listed in Appendix 6-5.

Testing may be affected by two regulatory changes the EPA is considering. First, another testing procedure, the Toxicity Characteristic Leaching Procedure (TCLP Method 1311), has been proposed to take the place of the EP Toxicity Test (Method 1310). This test would analyze for more contaminants including organics (volatiles and semivolatiles) and is generally considered to be as stringent a test as the EP Toxicity Test for metals.

Second, EPA may lower the drinking water standard for lead. If it is lowered, EPA will reevaluate the limit of 5 ppm set for leachable lead using the EP Toxicity Test. EPA should be contacted for the latest applicable levels before testing.

6.5.1.2 Testing of Typical Wastes

In general, the EP Toxicity Test should be performed by a qualified laboratory on any residue produced from abatement, including residues from caustic removers, scrapings, dipping residues, sanding dust, and painted debris such as wood trim. The following wastes should be tested as indicated.

(a) Solvents

Solvents should be checked to see if they are listed as hazardous wastes (40 CFR Part 261.31) under RCRA. If they are not listed, solvents should be treated as solid wastes and tested using the EP Toxicity Test to determine if they are hazardous.

(b) Wastewater

Filtered wastewater from lead-based paint abatement activities is likely to contain a very low concentration of lead or other hazardous substances. Check with your state or local authorities to determine applicable disposal requirements.

(c) Intact Building Components

Building components (such as doors and windows) are unlikely to fail the EP Toxicity Test unless there is a very high concentration of lead in the paint. For large-scale abatement projects, it is advisable to test a cross-section of building components to be disposed of.

(d) Lead Paint Chips and Dust

Lead paint chips and highly concentrated lead dust, such as that found in HEPA filters, should be tested using the EP Toxicity Test.

6.5.2 Handlers of Hazardous Waste

Three categories of handlers of hazardous waste must comply with RCRA hazardous waste regulations: generators; transporters, and treatment, storage, and disposal (TSD) facilities.

Not all lead-based paint remediation actions generate hazardous waste. For example, encapsulation may not generate hazardous waste. However, any company or persons involved in removing lead-based paint or building components may be a <u>generator</u> of hazardous waste. It is the responsibility of the individual or company producing the waste to determine whether he/it is a "generator." In some cases, the "generator" will be the owner or manager of the building(s) who has contracted only for abatement and not for removal of wastes from the site. In other cases, the generator will be the contractor who is conducting the abatement and who is taking responsibility for transporting the wastes from the site to a disposal facility. (In this case, the contractor and owner are actually cogenerators, and both are legally responsible for proper disposal.) Hazardous waste generators must comply with all appropriate regulations and must send the waste to a permitted facility.

<u>Transporters</u> pick up hazardous waste from generators and transport it to TSD

facilities. Treatment facilities use various processes to destroy hazardous waste or render it harmless. Storage facilities temporarily hold hazardous waste until it is treated or disposed of. Disposal facilities are the permanent depositories for hazardous wastes.

6.5.3. Exemptions for Hazardous Waste

The following exemptions may apply to individuals or companies involved in lead-based paint abatement:

o Many of the companies involved in lead-based paint abatement will generate small quantities of hazardous wastes. According to RCRA, companies or individuals generating less than 100 kilograms of hazardous waste (from all jobs) in any calendar month are "conditionally exempt" from the regulations. Many small projects or projects where shavings or sanding dust are the primary residue may be covered by this exemption. However, some states do not make any exemptions for small-quantity generators. Check with the hazardous waste authorities in your state (Appendix 6-2) to determine if this exemption is applicable in your jurisdiction.

o Homeowners and landlords who do their own deleading are exempt from regulation because of RCRA's household hazardous waste exc.usion. This exclusion states that any material derived from a household (including single and multiple residences) is not considered a hazardous waste. However,some states do not make any exemptions for small-quantity generators. Check with the hazardous waste authorities in your state (Appendix 6-2) to determine if this exemption is applicable in your jurisdiction.

o The homeowners and landlords exemption states that any material derived from a household (including single and multiple resiuences) is not considered hazardous waste, per se, regardless of quantity However, if it is found to be hazardous, it must be disposed of according to hazardous waste regulations.

6.5.4 EPA Identification Number

If more than 100 kilograms of hazardous waste will be generated from the abatement process during a calendar month, the generator must apply for an EPA identification number (an EPA identification number must be obtained for each site.) This can be done in one of two ways:

1. Contact the regional EPA office (Appendix 6-2) or state hazardous waste agency (Appendix 6-3) and request form 8700-12. Complete the form and mail it back to EPA. The form will be forwarded to the EPA regional office and a permanent identification number will be assigned, usually within 3 to 6 weeks.

2. Request a temporary identification number from the regional EPA Office (Appendix 6-2) or state hazardous waste agency (Appendix 6-3) based on a one-time emergency situation. Each request will be evaluated individually.

6.5.5 Requirements and Recommendations for Waste Containers

All waste collected in the abatement process must be disposed of off-site. The waste must be transported from the abated area to the disposal site in appropriate containers. EPA and the Department of Transportation (DOT) have established criteria for appropriate containers for solid and hazardous wastes. These criteria have been adopted by EPA and are described in 49 CFR, Parts 100-199.

In general, containers should be:

- o In good condition (not leaking or damaged).

- o Compatible with the waste so that the ability of the container to hold the waste through transport, handling, and perhaps storage is not impaired.

- o Handled properly to prevent ruptures, leaks, and mixing of incompatible wastes during both normal transport conditions and in potentially dangerous situations, such as when a drum falls out of a truck.

- o Appropriately labeled to ensure that transport workers, disposal site workers, EPA and state regulatory authorities, and emergency service personnel know what type of waste is inside a container and how the waste should be handled in case of an emergency.

- o Periodically inspected during transport to ensure they remain in good condition.

Some states and localities may have more stringent criteria for containers, especially those intended to carry solid or hazardous wastes over public highways. Abatement contractors should contact their state authorities to check on container requirements. The DOT can also be contacted for more information on packaging requirements and containers.

6.5.6 Hazardous Waste Transportation

Transporters are the critical link between the generator and the ultimate off-site disposal, treatment, or storage of wastes. Call your state hazardous waste agency (Appendix 6-3) if you need assistance in locating a transporter. The U.S. Department of Transportation (DOT) may be contacted for information on waste transportation. Many states also have regulations on transport of solid and hazardous wastes, so check with the appropriate authorities.

If the waste is transported by truck, the truck should be lined with one layer of 6-mil polyethylene. Duct tape should be used to secure the sheets of polyethylene. The polyethylene will ensure additional containment of the waste and will provide for easier cleanup should a container split open or spill.

Once the waste truck arrives at the landfill, the transporter should approach the disposal location as closely as possible for unloading of the waste materials. Bags should then be taken out of the drums along with the other waste components. They should be inspected as they are off-loaded. In the event a bag or container has been damaged, the material should be repacked as appropriate. Waste bags should be placed on the ground at the disposal site, not pushed or dropped out of the trucks. The weight of the material could rupture the containers.

6.6 Developing and Implementing a Disposal Plan

The first step in developing and implementing a disposal plan is ensuring that all individuals participating in the generation, transport, and disposal of wastes understand their responsibilities and requirements, as described below.

6.6.1 Defining Roles and Responsibilities

6.6.1.1 Building Owners

Owners are ultimately responsible for lead paint-related problems in their buildings. Signing a contract for abatement work does not relieve the building owner of responsibility for proper abatement and disposal. The building owner is responsible for ensuring that all wastes generated during abatement and cleanup are properly handled and disposed of. The owner must ensure compliance with all applicable federal, state, and local regulations. These regulations change frequently, so it is essential that building owners be aware of regulatory updates to the rules.

6.6.1.2 Abatement Contractors

The abatement contractor and his/her subcontractors are responsible for removing, handling, transporting, and disposing of the lead paint wastes in a safe and legal manner. Among other things, the contractor also is responsible for the following items:

- Determine if any of the generated wastes are hazardous.

- Package the wastes in appropriate containers for transport.

- Select responsible, qualified transporters to transport the wastes from the abatement site.

- Select a permitted disposal facility (hazardous waste) or landfill (nonhazardous waste) to receive the wastes.

- Comply with all applicable regulations (federal, state, and local) regarding transport and disposal of the wastes.

- Comply with all record keeping requirements, including obtaining an EPA identification number and complying with the manifest system if any of the generated wastes are hazardous.

6.6.1.3 Laboratories

Qualified laboratories should perform the EP Toxicity Test on representative samples of the wastes generated to determine whether or not they are hazardous. Laboratories can also recommend appropriate sampling procedures and equipment. The regional EPA, state hazardous waste agency, or state public health department may assist in locating qualified laboratories. (See Appendices 6-2 and 6-3.)

6.6.1.4 Engineers/Architects/Designers

These people may have a role in determining the acceptable disposal methods for lead-contaminated wastes.

6.6.1.5 Transport Firms

The transporter accepts the lead paint wastes from the generator and delivers them to a designated landfill or hazardous waste disposal facility. A transporter of hazardous waste must comply with DOT and EPA regulations, including: 1) obtaining an EPA ID number, 2) complying with the manifest system, and 3) dealing with hazardous waste spills or accidental releases. In addition, more stringent state and local requirements for waste transportation may apply.

Transporters should be trained in correct waste handling procedures, including loading and unloading and what to do in an emergency. The transporter is also responsible for retaining all dump receipts, trip tickets, transportation manifests, or other documentation of disposal. These documents should be given to the owners for their records and the contractor should make a copy for his or her records.

6.6.1.6 Disposal Firms

a. Nonhazardous Solid Waste Facilities

Firms that handle nonhazardous solid waste will take most of the waste generated by lead-based paint abatement projects. Some disposal firms will not accept large quantities of bulky items such as windows, doors, and moldings. Consult the firms considered to see if the estimated volume of bulky debris will be accepted.

Wastes that contain lead paint should be properly disposed according to applicable federal, state, and local regulations. This means that firms cannot transform the waste through methods that might release lead into the air or ground water, threatening human health or the environment. Incineration, in particular, should not be used to dispose of lead-containing wastes. Lined landfills are the most appropriate disposal facilities for lead-based paint wastes.

b. Hazardous Waste Facilities

Like generators and transporters, hazardous waste disposal facilities must obtain an EPA ID number. In addition, they must obtain a permit to operate. Hazardous waste facilities must also develop a contingency plan to respond to fires, explosions, or dangerous releases of hazardous substances into the environment.

The hazardous waste disposal firm can advise the abatement contractor on packaging the hazardous waste for proper disposal. For example, if the disposal firm is a landfill operation, the contractor must be warned that landfills cannot accept liquid wastes since RCRA bans these wastes from land disposal. The disposal firm also may be able to advise the contractor on how to have liquid removed from the wastes.

6.6.2 Record Keeping,

Generators, transporters, and disposal facility operators are responsible for keeping a number of records. A list of record keeping requirements for all participants in the generation and disposal of hazardous waste is shown in Appendix 6-6.

6.6.2.1 Nonhazardous Solid Waste

Many waste materials collected in a lead-abatement program will be nonhazardous waste, and thus subject only to solid waste regulations. Some states may have requirements for record keeping, so check with the appropriate authorities. Abatement contractors should alert transporters, disposal workers, and disposal facility operators that the wastes do contain some lead, even if in low concentrations. Wastes should be disposed of properly, and should not be placed in areas where they might affect human health or the environment, such as in dumpsters in residential areas.

6.6.2.2 Hazardous Waste

Hazardous wastes are subject to RCRA regulations regarding record keeping, chain of custody, and reporting.

a. Manifest System

A manifest form must accompany the hazardous waste whenever it travels. A sample manifest form is shown in Appendix 6-7. The generator keeps one copy of the manifest. At each leg of the journey, a copy of the manifest will be signed and dated by the responsible party and returned to the generator. In this way, the generator can track the progress of the waste and note any delays that may affect the disposal schedule.

b. Records of Activity

All generators, transporters, and treatment, storage, and disposal facilities are required under RCRA regulations to keep all data pertaining to the waste and its handling. This includes construction, design, material, and other records of activity. Information must be kept in an operating record until the operation is closed. Records of each hazardous waste that is generated, received, transported, stored, or disposed should include:

o Description of the waste by its common name and all applicable EPA hazardous waste numbers.

o Physical form (liquid, sludge, solid, or contained gas) of the waste.

o Estimated or manifest report weight of the waste, or volumetric density; and the method and date of treatment, storage, or disposal.

c. Biennial Reports

The generator must make biennial reports to EPA, which give the EPA identification number and name of each transporter, storage, and disposal facility used in the disposal of its hazardous wastes each year, and the quantities and nature of that waste.

d. Manifest Exception Reports

Generators must also submit a manifest exception report to the EPA or the authorized state authorities if the hazardous waste does not arrive at the designated facility within 45 days from the date the transporter accepted the waste. This report must describe efforts to locate the waste and the results of these efforts.

e. Discharge Reports

Transporters must also file reports of any hazardous waste discharge during transport. These reports must describe the nature of the accident, the kind and volume of waste discharged, and action taken to clean up the waste.

6.7 Worker and Occupant Safety Measures

Since abatement wastes will contain lead (even if in small concentrations), precautions must be taken to protect building occupants and workers who dispose of the waste. See Chapter II for detailed information on worker protection.

6.7.1 Safety of Building Occupants

By following the procedures outlined in Section 6.4 for arranging for the safe disposal of wastes, building occupants will have minimal contact with the generated wastes, thereby ensuring their safety.

6.7.2 Protection of Disposal Firm and Employees

Wastes generated by lead-based paint abatement activities should be handled with care. Special waste handling training should be provided to all workers involved in this aspect of the abatement process. If hazardous waste is being disposed of, the disposal facility personnel off-loading the containers of wastes should wear proper protective equipment, including head, body, and foot protection. Also, minimum respiratory protection requirements should include the use of half-face, air-purifying, dual-cartridge respirators equipped with high-efficiency filters. Organic cartridges or cartridges for caustics may also be necessary. The disposal facility personnel should have their own personal protective equipment; this is not the responsibility of the lead abatement contractor or transporter.

6.8 Finding Qualified Waste Disposal Contractors

It is important to locate qualified disposal facilities to receive wastes generated during lead-based paint abatements; RCRA regulations specify that generators must use only permitted facilities when disposing of hazardous waste. Even if the waste generated is not hazardous, it will still contain lead and must be disposed of safely and responsibly at a solid waste landfill.

6.8.1 Determining Disposal Requirements

Regulations governing solid and hazardous waste management are constantly changing - especially at the state and local levels. Regional EPA or state hazardous and solid waste offices can provide information on the latest regulations and advice on conforming to regulations. The RCRA Hotline (1-800-424-9346 or 202-382-3000 in Washington, D.C.) also can answer questions on regulations or direct the caller to appropriate sources.

6.8.2 Locating Community Disposal Experts

At this time, there is no national certification program for hazardous waste transporters, storers, or disposers. However, some states and local communities have certification programs.

The following sources may be useful in locating community disposal experts:

- State hazardous waste offices, as listed in Appendix 6-3, may be able to provide lists of reputable transporters, storage firms, and disposal companies.

- State environmental agencies may have lists of private contractors for transport, testing, and disposal.

- State and county health officials can provide names of companies whose workers have completed training or have experience in lead-based paint abatement and disposal. They may also provide the names of state- certified laboratories for testing the wastes generated, if such a certification program exists.

- o EPA regional offices, as listed in Appendix 6-2, may be able to help identify state or local lead-based paint disposal experts.

- o A directory that may be helpful is the Hazardous Materials Control Directory, which is produced annually by the Hazardous Materials Control Research Institute in Silver Spring, Maryland. It contains the names, addresses, and specialty areas of about 5,000 companies involved in various aspects of hazardous waste management. Companies are listed alphabetically, geographically, and by areas of specialty.

6.8.3 Disposal Firm Qualifications and Capabilities

The hazardous waste industry has expanded rapidly in response to environmental regulations over the past decade. Many disposal companies without proven track records in the field of lead-based paint abatement have been started during this period to respond to the market demands fostered by these requirements. To assess the qualifications of a disposal firm, the following questions, among others, should be asked:

- o How long has the firm been in the business of d sposing of solid or hazardous waste?

- o Can the firm provide for both hazardous and nonhazardous waste? In what volumes over what time periods?

- o Does the firm have a reputation in the community and the profession for quality work and integrity? (Check the firm's credentials with client references provided by the firm, the EPA, and state and local agencies. Also, visit the firm's office to get a feel for its level of professionalism.)

- o Has the disposal firm successfully completed other, similar projects to the satisfaction of the client? (Review previous disposal operations. Visit the disposal site in operation to find out about its worker protection, its emergency facilities, and its security.)

6.8.4. Contracts

A written contract should be prepared and signed by the disposal/transport firm and the waste generator. It should include, but not be limited to, contain specifics on:

- o The tasks to be performed (such as disposal of lead-paint contaminated wastes, and disposal of bulky material).

- o How the wastes will be tested at the disposal site.

- o How the generator will be notified if testing of the wastes at the disposal site shows inconsistencies with estimates and testing at the abatement site before transport.

- A schedule, including how delays will be handled.
- Expected charges for estimated volumes of various kinds of wastes, including how to handle cost overruns.
- A description of how payment will be made.
- Rights of the contractor to visit the disposal site or ask questions.
- How liability and responsibility for claims will be handled. Remember, the generator has the ultimate responsibility for ensuring that wastes are disposed of properly.

Contracts for waste disposal, transportation, and treatment services are often written by the companies providing the services. They contain "boiler plate" provisions written in their favor. They should be studied carefully by legal advisors to be sure they meet generator's needs as well. A good consultant may be able to advise on these issues.

APPENDIX 1

GLOSSARY

ABATEMENT - A comprehensive process of eliminating exposure or potential exposure to lead paint and lead dust which must include testing, and measures for worker protection, containment of dust and debris, cleanup and disposal of waste, and clearance testing.

ACCURACY - The degree to which a measurement process determines a known amount of lead or other component in a particular reference material.

ACTION LEVEL - The point at which something needs to be done to correct or eliminate the presence of lead.

ADMINISTRATIVE REMOVAL - The temporary removal of workers prior to their reaching blood lead levels requiring medical removal. This provides additional protection to both workers and employers.

BIENNIAL REPORT - A report (EPA Form 8700-13A) submitted to generators of hazardous waste to the Regional Administrator due March 1 of each even-numbered year. The report includes information on the generator's activities during the previous calendar year. The owner or operator of a treatment, storage, and disposal facility must also prepare and submit a biennial report using EPA Form 8700-1313.

BIOLOGICAL MONITORING - The analysis of a person's blood and/or urine, to determine the level of lead contamination in the body.

BLANK - A nonexposed sample of the medium used for testing, such as a wipe or filter, which is analyzed like other samples to determine whether (1) samples are contaminated with lead before samples are collected (e.g., at the factory, or at the testing site), (2) the samples are contaminated after sample collection (e.g., during transportation to the laboratory or in the laboratory).

CFR - The Code of Federal Regulations, a document containing all finalized regulations.

CHARACTERISTICS - EPA has identified four characteristics of a hazardous waste: Ignitability; Corrosivity; Reactivity; and EP Toxicity. Any solid waste that exhibits one or more of these characteristics is classified as a hazardous waste under RCRA.

CONTAINER - Any portable device in which material is stored, transported, treated, disposed of, or otherwise handled.

COMMON AREA - A room or area that is accessible to all tenants in a project (e.g., hallway, boiler room). Generally, any that are not kept locked can be considered common areas.

CONTAINMENT - A process for protecting both workers and the environment by controlling exposures to lead dust and debris created during abatement.

CONTINGENCY PLAN - A document setting out an organized, planned, and coordinated course of action to be followed in case of a fire or explosion or a release of hazardous waste or hazardous waste constituents from a treatment, storage, or disposal facility that could threaten human health or the environment.

CONTRACTOR - Any business entity, public unit, or person performing the actual abatement for a lead abatement project.

CRITICAL PATH METHOD - A method of scheduling in a detailed manner the various steps that must be taken by each trade from the start to the completion of a construction project.

DETECTION LIMIT - The minimum amount of a component that a method can reliably measure.

DISCHARGE or HAZARDOUS WASTE DISCHARGE - The accidental or intentional spilling, hazardous waste leaking, pumping, pouring, emitting, discharge emptying, or dumping of hazardous wastes onto any land or water.

DISPOSAL - The discharge, deposit, injection, dumping, spilling, leaking, or placing of any solid waste or hazardous waste into or on any land or water so that any constituent thereof may enter the environment or be emitted into the air or discharged in any waters, including ground waters.

DISPOSAL FACILITY - A facility or part of a facility at which hazardous waste is intentionally placed into or on any land or water, and at which waste will remain after closure.

ENCAPSULATION - A strategy of abatement which involves resurfacing or covering surfaces, and to seal or caulk with durable materials to prevent or control chalking, flaking lead-containing substances from becoming part of house dust or accessible to children.

ENGINEERING CONTROLS - Measures implemented at the work site to contain, control, and or otherwise reduce exposure to lead dust and debris.

EPA IDENTIFICATION - The unique number assigned by EPA to each number generator or transporter of hazardous waste, and each treatment, storage, or disposal facility.

EP TOXICITY - A test, called the extraction procedure, that is designed to identify wastes likely to leach hazardous concentrations of particular toxic constituents into the ground water as a result of improper management.

Leaching is a characteristic of some hazardous waste.

EXPOSURE MONITORING - The personal air monitoring of an employee's breathing zone to dermine the amount of contaminant (e.g., lead) to which he/she is exposed.

EXTERIOR WORK AREA - An outdoor porch, stairway, or other element of trim or walls on the exterior of a building.

FACILITY - All contiguous land, structures, other appurtenances, and improvements on the land, used for treating, storing, or disposing of hazardous waste. A facility may consist of several treatment, storage, or disposal operational units, e.g., one or more landfills, surface impoundments, or a combination of them.

FEDERAL REGISTER - A document published daily by the federal government that contains either proposed or final regulations.

FINAL INSPECTION - Inspection by a qualified inspector, industrial hygienist, or local public health official to determine whether abatement and cleanup are complete.

FORCE ACCOUNT - A term used to descibe a PHAs performance of modernization work by the use of employees as opposed to performance by a contractor.

GENERATOR - Any person who first creates a hazardous waste, or any person who first makes the waste subject to the Subtitle C regulation (e.g., imports a hazardous waste, initiates a shipment of a hazardous waste from a TSD, or mixes hazardous wastes of different DOT shipping descriptions by placing them into a single container).

GROUND WATER - Water below the land surface in a zone of saturation.

HAZARDOUS WASTE - As defined in RCRA the term "hazardous waste" means a solid waste, or combination of solid wastes, which because of its quantity, concentration, or physical, chemical, or infectious characteristics may

A) cause, or significantly contribute to an increase in mortality or an increase in serious irreversible, or incapacitating reversible, illness; or

B) pose a substantial present or potential hazard to human health or the environment when improperly treated, stored, transported, or disposed of, or otherwise managed.

As defined in the regulations, a solid waste is hazardous if it meets one of four conditions:

1) Exhibits a characteristic of a hazardous waste (40 CFR Sections 261.20 through 262.24).

2) Has been listed as hazardous (40 CFR Section 261.31 through 261.33).

3) Is a mixture containing a listed hazardous waste and a non-hazardous solid waste (unless the mixture is specifically excluded or no longer exhibits any of the characteristics of hazardous waste).

4) Is not excluded from regulation as a hazardous waste.

HEPA (High Efficiency Particle Air) filter is a filter capable of filtering out particles of 0.3 microns or greater from a body of air at 99.97% efficiency or greater.

HIGH PHOSPHATE DETERGENT - Detergent which contains at least 5% trisodium phosphate.

INCINERATOR - Any enclosed device using controlled flame combustion that neither meets the criteria for classification as a boiler or is listed as an industrial furnace.

INDUSTRIAL HYGIENIST - A person certified by the American Board of Hygiene or an industrial hygienist in training, or an individual with equivalent education or experience.

INITIAL SURVEY - A systematic inspection of a dwelling unit by a qualified inspector, using a portable XRF analyzer, atomic absorption spectroscopy, or other approved testing techniques, to determine whether a lead-based paint hazard is present.

INTERIOR WORK AREA - A hallway, room, or group of rooms in which an abatement takes place on the inside of a building.

LANDFILL - A disposal facility or part of a facility where hazardous waste is placed in or on land and which is not a land treatment facility, a surface impoundment, or an injection well.

LANDFILL LINER - A continuous layer of natural or man-made materials, beneath or on the sides of a surface impoundment, landfill, or landfill cell, which restricts the downward or lateral escape of hazardous waste, hazardous waste constituents, or leachate.

LISTED - Hazardous wastes that have been placed on one of three lists developed by EPA: Non-specific source wastes; Specific source wastes; Commercial chemical products. These lists were developed by examining different types of waste and chemical products to see if they exhibit one of the four characteristics, meet the statutory definition of hazardous waste, are acutely toxic or acutely hazardous, or are otherwise toxic.

LOGBOOK - A notebook that accompanies each XRF analyzer, to record such information as daily performance, maintenance problems, and average reading time.

MANIFEST - The shipping document, EPA form 8700-22, used for identifying the quantity, composition, origin, routing, and destination of hazardous waste during its transportation from the point of general to the point of treatment, storage, or disposal.

MEAN - The arithmetic average of data values. The algebraic sum of the data values divided by the number of data values. When using an XRF, the mean is the average of a series of numerical readings reported by the XRF.

MEDICAL REMOVAL - The temporary removal of workers due to elevated blood lead levels as defined in current worker protection standards.

MICROGRAMS - One millionth of a gram: 453 grams in a pound, 28,310,000 micrograms in one ounce.

OWNER - A person, firm, corporation, guardian, conservator, receiver, trustee, executor or other judicial officer, who, alone or jointly or severally with others, owns, holds, or controls the whole or any part of the freehold or leasehold title to any property, with or without accompanying actual possession of it, and shall include in addition to the holder of legal title, any vendee in possession of it, but may not include a mortgagee or an owner of a reversionary interest under a ground rent lease.

PAINT REMOVAL - A strategy of abatement which entails stripping lead paint from surfaces of components.

100 PERCENT TESTING - The process of performing an initial survey in all units in a project (after lead-based paint hazards have been found during random testing).

PERMIT - An authorization, license, or equivalent control document issued by EPA or an authorized State to implement the regulatory requirements of Subtitle C Parts 264 and 265 for TSDs.

PERSONAL SAMPLES (for sampling lead dust) - Air samples collected from within the breathing zone of a worker, but outside the respirator. The samples are collected with a personal sampling pump, pulling 1 to 4 liters/minute of air.

PRECISION - The degree of repeatability of a series of successive measurements.

RANDOM TESTING - The process of performing an initial survey in a representative sampling of units in a project.

RCRA - Resource Conservation and Recovery Act of 1976. What we commonly refer to as RCRA is an amendment to the first piece of federal solid waste legislation called the Solid Waste Disposal Act of 1965. RCRA was amended in 1980 and most recently on November 8, 1984, by HSWA.

REGULATION - The legal mechanism that spells out how a statute's broad policy directives are to be carried out. Regulations are published in the Federal Register and then codified in the Code of Federal Regulations.

REPLACEMENT - A strategy of abatement that entails the removal of components such as windows, doors, and trim that have lead painted surfaces and installing new components free of lead paint.

REPRESENTATIVE SAMPLE - A sample of a universe or whole (e.g., waste sample pile, lagoon, ground water, or waste stream) which can be expected to exhibit the average properties of the universe or whole.

SAMPLE SITE - A specific spot on a surface being tested for lead concentration through portable XRF or laboratory analysis.

SITE - The land or water area where any facility or activity is physically located or conducted, including adjacent land used in connection with the facility or activity.

SMALL QUANTITY - A generator who produces less than 100 kg of hazardous waste per month (or accumulates less than 100 kg at any one time) or one who produces less than 1 kg of acutely hazardous waste per month (or accumulates less than 1 kg of acutely hazardous waste at any one time).

SOLID WASTE - As defined in RCRA the term "solid waste" means any garbage; refuse; sludge from a waste treatment plant, water supply treatment plant, or air pollution control facility; and other discarded material, including solid, liquid, semisolid, or contained gaseous material resulting from industrial, commercial, mining, and agricultural operations, and from community activities, but does not include solid or dissolved material in domestic sewage, or solid or dissolved materials in irrigation return flows, or industrial discharges which are point sources subject to permits under the Clean Water Act, or special nuclear or byproduct material as defined by the Atomic Energy Act of 1954.

STANDARD - Used in two ways in this manual: (a) levels established by law or regulation, such as 1.0 mg/cm^2 (b) materials to which known quantities of lead have been applied; used to evaluate the accuracy and performance of the XRF analyzer.

STANDARD DEVIATION - A measure of the precision of the readings, the average deviation of the deviations from the mean. The smaller and standard deviation, the more precise the analysis, and the less variation there is when an analysis is repeated. The standard deviation is calculated by first obtaining the mean (arithmetic average) of all of the readings on a surface. A formula is then used to calculate how much the values vary from the mean (standard deviation = the square root of the arithmetic average of the squares of the deviation from the mean). Many hand calculators have an automatic standard deviation function.

STORAGE - The holding of hazardous waste for a temporary period, at the end of which the hazardous waste is treated, disposed of, or stored elsewhere.

SUBSTRATE - A surface upon which paint or varnish has been or may be applied. Examples of substrates include wood, plaster, metal, and drywall.

SUBSTRATE EFFECT - The returning of x-rays from the substrate to the XRF analyzer. These x-rays may be counted as lead x-rays by the instrument, so that the inspector may have to compensate for this effect when taking readings on the painted substrate.

TRANSPORTER - Any person engaged in the off-site transportation of hazardous waste within the United States, by air, rail, highway, or water, if such transportation requires a manifest under 40 CFR Part 262.

TREATMENT - Any method, technique or process, including neutralization, designed to change the physical, chemical, or biological character or composition of any hazardous waste so as to neutralize it; or render it non-hazardous or less hazardous; or to recover it, make it safer to transport, store, or dispose of; or amenable for recovery, storage, or volume reduction.

TSD - Acronym for treatment, storage, or disposal facility.

Ug - the symbol for a microgram, one millionth of a gram: 453 grams in a pound, 28,310,000 micrograms in one ounce.

ULPA or Ultra Low Penetration Air/Filter - A filter capable of filtering out particles of 0.13 microns or greater from a body of air at 99.9995 % efficiency or greater.

WORK PRACTICE CONTROL - See definition of engineering control.

XRF ANALYZER - An instrument that determines lead concentration in milligrams per square centimeter (mg/cm^2) using the principal of x-ray fluorescence.

APPENDIX 2

Items to Support Chapter 2

2.1 Selected Element of Guidelines on Implementing the Hazard Communication Standard

2.2 Medical Surveillance of Lead-Exposed Workers for Occupational Exposure to Lead

2.3 OSHA List of Laboratories Approved for Blood Lead Analysis [8/1987]

2.4 List of OSHA Regional Offices

Appendix 2.1 - Sources Of Chemical Hazard Information

AIHA Hygiene Guide
Publications Office
American Industrial Hygiene Assoc.
475 Wolf Ledges Parkway
Akron, OH 44311-1087

Chemical Hazard of the Workplace
Nick H. Proctor & James P. Hughes
J.P. Lippincott Company
6 Winchester Terrace
New York, NY 10022

Clinical Toxicology of Commercial Products, 4th Ed.
Gleason, Gosselin and Hodge
The Williams and Williams Co.
Baltimore, MD

Condensed Chemical Dictionary
Van Nostrand Reinhold Co.
135 W. 50th Street
New York, NY 10020

Dangerous Properties of Industrial Material, 6th Ed.
Irvin Sax
Van Nostrand Reinhold Co.
135 West 50th Street
New York, NY 10020

Handbook of Organic Industrial Solvents, 5th Ed.
Alliance of American Insurers
Loss Control Dept.
20 N. Wacker Dr.
Chicago, IL 60707

Industrial Hygiene & Toxicology by F.A. Patty
John Wiley & Sons, Inc.
New York, NY (five volumes)

NIOSH/OSHA Pocket Guide to Chemical Hazards
NIOSH Pub. No. 78-210
The Superintendent of Documents
U.S. Government Printing Office
Washington, D.C. 20402

Occupational Health Guidelines
NIOSH/OSHA (NIOSH Pub. No. 81-123)
Available from the Supt. of Doc
U.S. Gov. Printing Office
Washington, D.C. 20402

Recognition of Health Hazards in Industry
William A. Burgess
John Wiley and Sons
605 Third Avenue
New York, NY 10158

Registry of Toxic Effects of Chemical Sub.
U.S. Dept. of Health & Human Services, Public Health Service
Centers for Disease Control
National Inst. for Occupational Safety and Health
(NIOSH Pub. No. 80-102)

The Industrial Environment - its Evaluation and Control
U.S.Dept.of Health & Human Srvs.
Public Health Service
Centers for Disease Control
National Inst. for Occupational Safety and Health
(NIOSH Pub. No. 74-117)

Threshold Limit Values for Chemical Substan. & Phys. Agents in the Workroom Environment with Intended Changes
American Conf. of Governmental Industrial Hygienists
6500 Glenway Ave., Bldg. D-5
Cincinnati, OH 45211

Washington Adm. Code General Occupational Health Standards Chapter 296-62 WAC
Department of Labor & Industries
Div. of Industrial Safety & Health
P.O. Box 207
Olympia, WA 98504

Medical Surveillance of Lead-Exposed Workers

James P. Keogh, M.D.

For decades physicians responsible for the health of workers occupationally exposed to lead have used biologic monitoring to prevent morbidity. The accuracy and simplicity of the tests available have increased dramatically, and monitoring has become mandatory in many settings since the promulgation of the Occupational Safety and Health Administration (OSHA) Lead Standard in 1978.[1,2] This standard mandates that each employer designate a physician responsible for the medical surveillance program. While the standard provides some minimum guidelines for frequency of monitoring and when to remove workers from exposure, it relies heavily on the physician's expertise. As compliance with the standard has become more widespread, many more doctors, most of whom have had little clinical experience with lead poisoning, have been called on to supervise medical surveillance of exposed populations. Success in their endeavors will require not only an ability to recognize the symptoms of plumbism, but also an understanding of the link between surveillance and intervention.

Recent reviews have provided an updated look at the clinical presentation of lead poisoning.[3,4] The physician undertaking the responsibility of a surveillance program also ought to review some of the classic descriptions of industrial lead poisoning to gain a feel for the subtle symptoms that can warn of a gradually increasing lead burden.[5] He should become familiar with the technical requirements of the OSHA standard, especially the responsibilities it delegates to physicians.

DECISIONS IN SURVEILLANCE

While the ability to recognize and diagnose clinical lead poisoning is basic to the physician's role, it is by no means sufficient. The intent of a surveillance program is to minimize the need for such diagnostic acumen. This discussion hopes to assist the physician in deciding: who needs to be put under surveillance, when and how often to evaluate, what tests to use, how to assess an abnormal lead level, how to assess a rising lead level, how to decide if symptoms are related to lead, when to remove individuals from exposure, when to permit a return to exposure, when to institute or refer for treatment.

UNDERSTANDING AND USING THE LEAD STANDARD

Surveillance of lead-exposed workers in the United States must be discussed within the context of the Lead Standard promulgated by OSHA in 1978. Perhaps the most "complete" standard issued by OSHA, it provides explicit rules relating to monitoring for lead in air, worker education, work practices, respiratory protection, medical surveillance, removal of workers from exposure, financial protection for poisoned workers, and access to independent medical advice. Phased in gradually to minimize the economic impact on the worst case industries, subject to court battles, and weak-

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ened by a policy of granting exemptions, the standard has nevertheless stood out as a success, with widespread compliance. The physician involved in medical surveillance of lead-exposed workers ought to be familiar with the principal provisions of the standard as they impact on his role. Because of the critical role of the physician as health educator, he also needs to make sure that the individuals under his care understand their rights regarding the standard. OSHA published appendices to the Lead Standard in 1979 that explain the hazards of lead (Appendix A), provide an explanation of the standard for exposed workers (Appendix B), and outline the requirements for medical surveillance (Appendix C).

The standard has sections that describe precisely what the employer must do to comply with its provisions for medical surveillance and medical removal. At the same time broad latitude and responsibility is delegated to the physician. OSHA states, "The examining physician, therefore, is given broad flexibility to tailor specific protective procedures to the needs of individual employees" and ". . the employer must implement these recommendations."

It is unlikely that OSHA enforcement could effectively assess or regulate the appropriateness of the medical decisions the physician makes in this setting. The standard does provide employees with the right to get a second medical opinion and as long as this was offered by the employer, it is unlikely that any mistake or misjudgment by the doctor could result in OSHA sanctions. However, by taking on responsibility within the surveillance program (as the standard requires) the physician may be exposing himself to malpractice liability for any failings of the program, and at the same time shielding the employer. Accordingly, the physician must make sure that all aspects of the surveillance program meet not only OSHA's standards, but his own. He ought to be very sure that the right individuals are under surveillance, and that workers are being given access to medical advice at the right time. His decisions about removal and return to exposure must take into account all the relevant medical information and not only the results of blood lead testing. The physician who thinks he need only perform the required medical exams and can safely entrust the scheduling to personnel and the education to safety may be in for an unpleasant surprise.

WHO NEEDS TO BE UNDER MEDICAL SURVEILLANCE?

The OSHA standard prescribes that anyone exposed at or above the action level of 30 mcg/m³ of lead in air needs blood lead monitoring every six months. Because surface contamination and subsequent exposure can play a role even in the absence of high air levels, it may be appropriate to include some workers in medical monitoring when their personal air monitoring results are below the action level. In practice, it is wise to draw a larger rather than a smaller circle around potential sources of lead exposure.

Monitoring strategy needs to take into consideration the stability of the workforce, of working conditions, and of work practices. In a relatively unchanging factory setting it may be possible to define a subpopulation of exposed workers by reviewing personal sampling of air levels and wipe samples of the environment. The separation of individuals and job classifications into exposed and not exposed groups once achieved might be expected to remain valid over time. On the other hand, if processes, layout, or personnel change frequently, it may be necessary regularly to reassess who is currently exposed.

Exposures in construction and demolition work provide the extreme example of variation. In such settings monitoring results provide warnings about who must be included in surveillance, but cannot be relied on exclusively to decide who can safely be excluded.

Variability over time must also be taken into consideration. The replacement of more senior personnel with newer workers or of nonsmokers with smokers might serve to increase exposures related to work practices, even if air levels were unchanged. Paradoxically, stability in a workforce can sometimes increase exposure. In some plants entry-level positions may have the highest exposure. If hiring slows down for a time, certain workers may settle into high exposure entry-level jobs that in times of higher turnover they would have moved through in a matter of months.

It should also be remembered that most routine inhouse industrial hygiene measurements will have been conducted when no problems were known to have existed with any of the protective systems. If spills are commonplace, if ventilation systems malfunction, if the plant is "buttoned up" for the winter in a way that decreases make-up air for the exhaust systems, the available monitoring data may not reflect really typical exposure conditions.

It is prudent to consider how situations are likely to vary from those under which monitoring was done and modify medical surveillance strategy accordingly. Biologic monitoring ought to function as a secondary "safety-net," layer of surveillance. To do so it ought always to be spread a little wider than seems at first to be necessary.

HOW OFTEN SHOULD MEDICAL EVALUATIONS BE REPEATED?

As noted above, the OSHA standard requires that workers exposed above the action level of 30 mcg/m³ have blood-lead and zinc protoporphyrin (ZPP) testing every six months. Those whose blood-lead levels are at or above 40mcg/dl are to be offered repeat testing at least every two months until the levels are again below 40. Those workers who are removed from work because of elevated lead levels are to receive repeat determinations at least monthly. The standard further requires medical evaluation be offered annually to all individuals whose blood lead levels are above 40 mcg/dl and to each worker before assignment to an area where he will be exposed above the action level. In addition, an exposed employee may request a medical examination whenever he develops any symptoms that might be related to lead poisoning and whenever the employee wishes to discuss reproductive hazards or has trouble using a negative pressure respirator. The standard discusses medical evaluation and surveillance with blood tests (biological monitoring) separately, but in practice both need to be integrated under the direct supervision of the responsible doctor.

The physician needs to take charge of the program, making sure that all appropriate employees are included, personally participating in the accompanying health education, and assessing the results of all laboratory tests in the context of the individual's previous results and medical condition. None of this can safely be delegated to nonprofessionals.

Even today, some employers conduct the blood lead surveillance with minimal input from the physician who is legally responsible, with personnel or safety responsible for organizing the program and interpreting the results. In such situations the physician becomes directly involved only with the exposed workers at those times when blood levels exceed values that mandate removal from exposure, and only after the decisions about removal have been made. This practice is risky both for the exposed worker, who may get less than optimal surveillance, and for the physician who is legally responsible for the outcome.

The intervals between monitoring laid out in the standard need to be recognized as minimums. Repeat blood testing and physical examination ought to be done as frequently as needed to keep an eye on each individual employee's lead absorption. Newly-assigned workers may deserve more frequent monitoring for a time, even in a work area where other workers blood values have been stable. Because work practices can make an enormous difference in absorption, an inexperienced worker may be at particular risk for some time.

The same blood lead and protoporphyrin values in two different workers may stimulate very different responses. A value of 35mcg/dl in one worker might be evidence of a reassuring decline, while in another it might represent a dramatic increase and require that the physician make a concerted effort to identify the cause of the increased absorption. Waiting six months to repeat the value in the second patient, or failing to recognize the need to interview and examine the patient could prove disastrous.

ASSESSING THE HEALTH OF THE LEAD EXPOSED WORKER

The physician conducting surveillance uses his history, physical, and laboratory data to assess the dose of lead the worker or patient has absorbed, to look for evidence of systemic toxicity and end-organ damage, and give his advice about future exposure and treatment. To do so requires an understanding of the value and limitations of the tests used to measure dose, a knowledge of the common symptoms of lead poisoning, and an awareness of the potential long-term effects of exposure.

Measuring Dose

In using blood lead to measure the dose of lead absorbed by a patient, the physician should keep the test's limitations firmly in mind. There is no substitute for knowing the blood-lead level, and in many exposure situations blood lead may provide the most reliable measure of total body burden and the best predictor of symptoms. Blood lead rises relatively rapidly after exposure and continues to rise as intake of lead exceeds that which can be excreted. If exposure is interrupted, blood lead falls more rapidly than predicted by the excretion of lead in urine alone. This fall results from the ongoing process of redistribution of lead into other tissues, particularly bone. Blood lead reflects recent absorption (or during periods of net excretion, recent mobilization from stores) better than it does total body burden. Looking at blood lead levels alone can be clinically misleading, particularly in situations where exposure has been intermittent, has continued at a relatively low level for a long time, or has been interrupted some time before monitoring.

Use of a second test can often provide a better sense of total dose. The accumulation of protoporphyrins in red cells, in reality a measure of end-organ damage, has been shown to correlate well with body burden or "internal dose" of lead.[6,7] This is usually measured as free erythrocyte protoporphyrin (FEP) or zinc protoporphyrin (ZPP). The latter, a measurement of that largest part of the protoporphyrins that are bound to zinc, has the advantage of being measurable directly by fluorescence in a simple test. FEP and ZPP are also elevated by iron deficiency. As the dose of lead seen by the bone marrow increases, production of hemoglobin is inhibited and protoporphyrins begin to rise. This process takes time and the rise of FEP or ZPP in peripheral blood is further delayed by the time it takes

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for cells in the marrow to be released into the circulation. Since any particular blood specimen contains red cells of varying ages, there is a delaying and summarizing effect to the FEP and ZPP as they rise and fall.

When the blood lead and FEP or ZPP are interpreted in the context of the worker's history of exposure over time, the physician can often get a good functional idea of the extent of absorption that has taken place.[8,9] Occasionally it may be appropriate to assess body burden more accurately. For example, the question of the value of chelation therapy may arise in a patient who is some months removed from his most intense exposure and whose blood lead and FEP may have returned to only slightly elevated levels. The measurement of urinary excretion of lead after a challenge dose of EDTA provides the best way to estimate body stores in such a situation.

Because tracking of laboratory values will have great importance in surveillance, the physician should take particular care in making sure the values are accurate. Use of a laboratory on the Centers for Disease Control list of approved laboratories is required by the standard. Because of the technical difficulties of blood lead determinations, and particularly because some labs may not be running specimens frequently, particular care ought to be taken to assure quality control. Familiarizing oneself with the quality-control scheme the lab uses is a wise idea, as is regularly checking the reproducibility of results by sending split specimens on an unannounced basis.

LOOKING FOR TOXICITY

A careful history is the clinician's primary tool in detecting evidence of toxicity from lead. Physical signs of lead poisoning or end-organ damage (for example, gingival lead line, frank wrist drop) have become quite rare in the United States. Early warnings of systemic poisoning may elude a hurried or careless interviewer.

Early symptoms of poisoning are nonspecific and are often thought by the patient to be manifestations of a viral illness, stress, or even part of the aging process. In noting a change in the patient's personality and behavior, family members may attribute it to psychologic rather than physical factors. Arthralgia and myalgia are often thought to be secondary to arthritis which some patients are willing to accept as a natural part of growing older. In evaluating the lead-exposed patient, the physician needs to listen for any subtle change in overall sense of well-being, in sleep pattern, and in diet. Very nonspecific gastrointestinal symptoms, arthralgia and myalgias, or general tiredness, may emerge only when the doctor asks open-ended questions about the patient and his life.[3,5] Soft neurologic symptoms, perhaps the most common finding in early lead poisoning, are often the hardest to elicit unless family members are questioned. The physician involved in surveillance has a challenging task, but one enormously easier than that of the primary physician in such situations, since he is alerted to the possibility of lead toxicity and has at hand a record of the patient's absorption in the past.

Physical examination will rarely show evidence of lead-related problems, and is of principal value in looking for evidence of other disease. A careful neurologic exam may show subtle evidence of peripheral nerve problem in an otherwise relatively asymptomatic patient. Tests for nerve entrapment (Phalen's, Tinnel's) ought to be included, especially in workers doing vigorous or repetitive manual work.

The standard requires assessment of hemoglobin, hematocrit, red cell morphology, blood urea nitrogen, and creatinine. Other surveillance of end-organ function through laboratory tests is left to the discretion of the physician. It is important to remember that while lead may depress the hemoglobin, frank anemia in most working populations will be rare. The physician ought again to keep an eye on trends as well as absolute values. In thinking about possible renal effects, one must remember that lead is principally a tubular toxin, and that the usual clinical tests (BUN, creatinine) are relatively insensitive to tubular dysfunction. Keeping an eye on uric acid is wise, since lead appears to cause saturnine gout by its effects on excretion.

Tests of peripheral and central nervous function may soon provide useful tools for surveillance, as work progresses to find a simply administered battery. Relatively little work has been done on the clinical aspects of lead's reproductive effects. For the present, semen analysis, with attention to changes in count, motility, and morphology, is the only clinically available test.[10-14]

KEEPING TRACK OF THE INFORMATION GATHERED

As any surveillance scheme progresses, the amount of data collected will grow and may become unmanageable unless care is taken to keep it organized. Because it is so important to keep track of the trends in each individual's lab data, the physician should resist the temptation to review lab slips in aggregate and focus only on the "abnormal" values. While this may work well for clinical data in an office practice it can cause serious oversights in a surveillance program.

As a practical measure the physician should have all lab results entered into a tabular and graphic record for each individual. Review of the graphs created will provide an immediate visual impression of the rising values. In addition to individual graphs, it may be valuable to superimpose the individual graphs to create graphs for departments, shifts, or the entire workforce. It may also be useful to look at levels of seniority or date of hire in those workforces whose exposures in the past were much higher than current exposure. Separating the data of smokers from non-smokers may also be helpful when breakdown in housekeeping and hygiene is suspected.

HOW TO RESPOND TO RISING OR ABNORMAL TEST RESULTS

A rising blood lead may be a sign of a patient who needs medical help, or a work environment that needs improvement, or both. Judgement and adequate information are necessary to shape the appropriate response in each situation. A rise in blood lead from 15 to 35 mcg/dl may merit careful investigation, while a level of 40 in a patient with chronically elevated leads may not. An increase of lead level for a newly assigned worker in an area where other workers levels have been declining may focus attention on that individual's job assignments and work habits. On the other hand, if the overall trend of lead levels in a department is up, it may be more appropriate to ask for remonitoring of air levels than to give a lecture about personal hygiene. Biological monitoring is first and foremost information about the health of individuals. Taken in aggregate, it is also invaluable information about the healthfulness of the work environment. The physician needs to think about it in both ways.

When a patient's blood lead is rising, the physician needs to warn the patient and take immediate steps to reduce absorption. This may be accomplished by changing the work environment or the worker's habits while allowing the individual to continue at the same assignment. In such a situation it is important to frequently repeat blood testing. At other times it may be more judicious to remove the worker from exposure entirely. The physician is not limited in his obligation to recommend removal from exposure by the specific guidelines of the standard. Even if blood lead is still well below the "pull" level the physician can recommend removal from exposure when that is the most appropriate response. In general, the higher the lead and FEP (remembering the temporal response of both tests to increased absorption), and the faster the rate of rise, the wiser it is to get the patient out of exposure while assessing what went wrong. Unless the problem is largely one of personal habits, removal doesn't solve the problem. The worker now asked to replace the patient may be equally at risk, and attention still needs to be focused on the risk of absorption in the specific job.

The presence of symptoms may also be a reason to take vigorous steps, sometimes including removal from exposure, to stop absorption. The physician needs to take care not to attribute symptoms to lead poisoning without considering the possibility of other disease being present. At the same time he should take care not to give the patient the impression he is looking for excuses not to diagnose lead toxicity. In a worker who has been absorbing lead, the most likely explanation for typical symptoms is lead poisoning.

Before returning a symptomatic patient to potential exposure, the physician should wait for resolution of symptoms and a return of lead and FEP or ZPP values to normal. Using the standard's guidelines of a blood lead level of 40 mcg/dl is not appropriate for an individual who has been symptomatic.[4]

KEEPING AN EYE ON THE FOREST

The goal of any surveillance program is to minimize any adverse effects the work environment may have on those who work there. In dealing with the day to day problems of individual workers, the responsible physician should not miss the forest for the trees. Because of the slow phase-in of the Lead Standard and the use of differing "pull" levels for blood lead, it is possible to become confused about what is an "acceptable" level of lead burden.

Moreover, many individuals working in lead industries continue to have elevated lead and erythrocyte protoporphyrin levels that they developed during the years before the Lead Standard imposed its controls on exposure. The results of surveillance on these individuals may reflect the legacy of the past as well as current exposures.

The physician responsible for a surveillance program needs to remain cognizant of the increasing amount of research showing evidence of lead's toxicity at levels thought to be safe even a decade ago. Since the OSHA standard was promulgated evidence has mounted that some of its assumptions about dose and biological response need revision. In years past, many authors stated categorically that symptomatic lead poisoning never occurred when the lead level was below some given number, often 80. In preparing the standard the federal government reviewed the then current literature and sought expert advice about the issue of safe levels of absorption and exposure. The result of this process fixed on the idea that maintaining a population's blood lead level at about 40 would provide sufficient protection over a working lifetime.

A series of studies, principally from Scandinavia,[13,14] have since demonstrated adverse effects on health among patients with blood lead levels well within those permitted by the standard. While many of these reports discuss the concept of abnormalities of physiology among patients with "asymptomatic" or "subclinical" lead poisoning, it is clear from the reports that many of the patients in question were, in fact, symptomatic. This literature, besides documenting the presence of objective signs of neurological dysfunction, has sharpened the debate on the question of what constitutes

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symptomatic lead poisoning. Concern is growing about the potential long term effects of "low level" lead absorption on blood pressure and neurological function. It is clear that if there is a "threshold" for lead's deleterious effects on the human organism, it is not yet defined, and may even be below the level to which we are all exposed in the general urban environment.

In controlling the exposure of workers to lead, one's goal ought to be to reduce blood levels and body burdens to those seen in the community in general. No extra absorption of lead at the workplace is desirable, and absolute protection ought to be the goal. Achieving this goal may not be possible in all workplaces at all times because employer and employees may not be willing or able to take the steps necessary. While these sorts of compromises with the ideal may be necessary, the physician should not compromise the clarity of his advice and should make clear that mere compliance with the OSHA standard is the minimum required by law, not the maximum than can be aspired to.

Keeping this perspective is important to the practical day to day approach to surveillance. In the worst of situations employer and employees may begin to believe that any blood level below those mandated for removal is without risk or consequence. The standard may then be used as a "speed limit" and workers be allowed to remain exposed until their lead rises above the 60 mcg/dl limits (or the alternative limit of three tests whose average is above 50) before removal to a lower exposure job. The removed worker is replaced by another to whom the same thing occurs. As long as there are sufficient non-exposed jobs available this process may continue indefinitely allowing more and more workers to develop larger and larger body burdens. (The process of being pulled at 60 and returned at 40 mcg/dl will gradually allow a larger and larger body burden, even if blood levels never greatly exceed 60). Thinking of medical surveillance as merely enforcing a "speed limit" of 60 can result in most of the "traffic" moving between 50 and 70. In such a setting the medical task is rapidly complicated by "crashes" of acute symptomatic poisoning.

The physician running a medical surveillance program should look forward to seeing the blood levels of those under his care remain normal (for those recently hired) or return toward normal (for those with prior body burdens). By watchful use of biological monitoring, by careful listening to patients, by feedback to those responsible for work conditions, and above all by effective health education, those goals can be achieved.

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Appendix 2.3 - OSHA-COC LIST OF LABORATORIES APPROVED FOR BLOOD LEAD ANALYSIS, MARCH-AUGUST 1987

ALABAMA

ALABAMA REFERENCE LABORATORIES, INC.
ATTN: QC COORDINATOR
P.O. BOX 4600
MONTGOMERY, ALABAMA 36103

ARIZONA

DAMON CLINICAL LABORATORY
ATTN: DAVID ALTHAUS, M.D.
210 NORTH 24TH STREET
PHOENIX, ARIZONA 86034

CALIFORNIA

CENTRAL DIAGNOSITIC LABORATORY
ATTN: JAMES T. DAWSON
18408 OXNARD STREET
TARZANA, CALIFORNIA 91356

CENTRAL PATHOLOGY LABORATORY
ATTN: MR. JERRY W. CURRY
1110 NORTH DUTTON AVE.
P.O. BOX 1709
SANTA ROSA, CALIFORNIA 95401

INDUSTRIAL HYGIENE LABORATORY
MEDICAL DEPT.
BLDG. 201, MARE ISLAND NAVAL SHIPYARD
VALLEJO, CALIFORNIA 94592

INTL CLINICAL LABS-WESTERN
ATTN: JAMES E. FITZWATER, M.D.
6511 GOLDEN GATE DRIVE
DUBLIN, CALIFORNIA 94568

KAISER FOUNDATION
ATTN: ALLAN ZIMMERMAN
10407 MAGNOLIA
NORTH HOLLYWOOD, CALIFORNIA 91601

LABORATORY SERVICES
ATTN: SPENCER HIRAKI, PH.D.
967 MABURY ROAD
SAN JOSE, CALIFORNIA 95133

LETTERMAN ARMY MEDICAL CENTER
DEPT. OF PATHOLOGY, ROOM 202
BLDG. 1100, PRESIDIO OF SAN FRANCISCO,
CALIFORNIA 94109

LOMA LINDA FACULTY MEDICAL LAB
ATTN: RONALD HILLOCK
LOMA LINDA, CALIFORNIA 92354

MEDICAL SCIENCE LABORATORY
ATTN: JACK D. GARNER
2029 DIVISADERO STREET
FRESNO, CALIFORNIA 93701

MEMORIAL MED. CENTER OF LONG BEACH
ATTN: CHEMISTRY DEPT.
2801 ATLANTIC AVENUE
LONG BEACH, CALIFORNIA 90801

NICHOLS INSTITUTE REFERENCE LABS.
ATTN: ROXANN PETTIS, M.T.
26441 VIA DE ANZA
SAN JUAN CAPISTRANO, CALIF. 92135

PATHOLOGY INSTITUTE
ATTN: R. THOMAS/DEBBIE ARNOLD
2920 TELEGRAPH AVENUE
BERKELEY, CALIFORNIA 94705

PHYSICIAN'S REFERENCE LABORATORY
ATTN: E.B. VEISSMAN, PH.D.
15162 TRITON LANE
HUNTINGTON BEACH, CALIFORNIA 92649

REFERENCE LABORATORY
ATTN:GEOFFREY N. MOYER, M.D.,PH.D.
1011 RANCHO CONEJO BLVD.
NEWBURY PARK, CALIFORNIA 91320

ROCHE BIOMEDICAL LABS., INC.
ATTN: C. ROMME. & E.G. SIMON, M.D.
3714 NORTHGATE BLVD.
SACRAMENTO, CALIFORNIA 95834

SMITH KLINE BIO-SCIENCE LABS.
ATTN: PETER S. NOCE, M.D., PH.D.
7600 TYRONE AVENUE
VAN NUYS, CALIFORNIA 91405

SAN FRANCISCO DEPT OF PUBLIC HEALTH
ATTN: MICROBIOLOGY DEPARTMENT
101 GROVE STREET, ROOM 419
SAN FRANCISCO, CALIFORNIA 94102

UNIVERSITY HOSPITAL
CLINICAL PATHOLOGY
ATTN: DAVID N. BAILEY, M.D.
225 DICKENSON STREET, H-720
SAN DIEGO, CALIFORNIA 92103

COLORADO

C3MR1 - ANALYTICA, INC.
ATTN: PETER MIHALIK
5920 MCINTYRE STREET
GOLDEN, COLORADO 80403

GATES ENVIRONMENTAL LAB
* ATTN: THOMAS M. VINCENT, M.D. 303-744-5684
65 EAST MISSISSIPPI
DENVER, COLORADO 80217

SAINT FRANCIS HOSPITAL
ATTN: D.L. BOWERMAN, M.D.
800 EAST PIKES PEAK AVENUE
COLORADO SPRINGS, COLORADO 80903

CONNECTICUT

CONN. DEPT. OF HEALTH SERVICES
LABORATORY DIVISION
ATTN: M.R. MICHINI, PH.D.
P.O. BOX 1689
HARTFORD, CONNECTICUT 06144

UNIV. OF CONN. HLTH. CENTER
J. DEMPSEY HOSPITAL
ATTN: MICHAEL LADZINSKI
263 FARMINGTON AVENUE
FARMINGTON, CONNECTICUT 06032

OLIN ENVIRONMENTAL HYGIENE LAB
ATTN: JAMES P. DAWSON
91 SHELTON AVENUE
NEW HAVEN, CONNECTICUT 06511

YALE-NEW HAVEN HOSPITAL
DEPT. OF LABORATORY MEDICINE
ATTN. PETER JATLOW, M.D.
20 YORK STREET
NEW HAVEN, CONNECTICUT 06504

DELAWARE

MEDLAB, INC.
ONE PIKE CREEK CENTER
WILMINGTON, DELAWARE 19805

D.C.

* WALTER REED MEDICAL CENTER
DEPARTMENT OF PATHOLOGY
ATTN: SPECIAL CHEMISTRY
WASHINGTON, D.C. 20307

FLORIDA

DIAGNOSTIC SERVICES, INC.
349 TAMIAMI TRAIL #9
P.O. BOX 2987
NAPLES, FLORIDA 33940

IDAHO

TREASURE VALLEY LABORATORY, INC.
ATTN: W.C. PIERCE
5475 BETHEL STREET
BOISE, IDAHO 83707

GEORGIA

CENTERS FOR DISEASE CONTROL
METABOLIC BIOCHEM BR-HANES LAB
ATTN: MS. ELAINE GUNTER
BLDG 17, ROOM 2814
ATLANTA, GEORGIA 30333

DWIGHT D. EISENHOWER ARMY MED CTR
ATTN: CHIEF, CLIN. PATH. LAB
BLDG 300
FORT GORDON, GEORGIA 30905

ICL - ATLANTA
ATTN: ROBERT JERNIGAN
3500 MCCALL PLACE
DORAVILLE, GEORGIA 30340

ILLINOIS

ARGONNE NATIONAL LABORATORY
BLDG 202
ATTN: D. PETERSON
9700 SOUTH CASS AVENUE

AUGUSTANA HOSP. & HEALTH CAR CTR.
ATTN: H.H. ROTHENBERG, M.D.
2035 NORTH LINCOLN AVENUE
CHICAGO, ILLINOIS 60614

CHICACO DEPARTMENT OF HEALTH
ATTN: H.G. ORACH, PH.D.
RICHARD J. DALEY CENTER
CHICAGO, ILLINOIS 60602

DEERE & COMPANY
INDUSTRIAL HYGIENE LAB
ATTN: THOMAS M. SNYDER
1231 - 13TH STREET
EAST MOLINE, ILLINOIS 61244

ILLINOIS DEPT. OF PUBLIC HEATH
ATTN:
535 WEST JEFFERSON STREET
SPRINGFIELD, ILLINOIS 62761

MEMORIAL MEDICAL CENTER
ATTN: GRANT O. JOHNSON, M.D.
800 NORTH RUTLEDGE
SPRINGFIELD, ILLINOIS 62781

METPATH, INC.
ATTN: LYNN BONSE
1355 MITTEL BLVD.
1355 MITTEL BLVD.
WOOD DALE, ILLINOIS 60191

MICHAEL REESE HOSPITAL & MED. CTR
PATHOLOGY DEPT.
ATTN: M.A. SWERDLOW, M.D.
KING DRIVE AT 26TH STREET
CHICAGO, ILLINOIS 60616

PARKE DEWATT LABORATORIES
ATTN: J. ALAWATTAR
5445 WEST DIVERSEY
CHICAGO, ILLINOIS 60639

SMITH KLINE CLINICAL LABORATORIES
ATTN: SURVEY COORDINATOR
506 EAST STATE PARKWAY
SCHAUMBURG, ILLINOIS 60195

INDIANA

INLAND STEEL COMPANY
DEPT. 8-210
ATTN: EILEEN COMMINGS
3210 WATLING STREET
EAST CHICAGO, INDIANA 46312

MEDICAL LABORATORY
HAYMOND, COSTIN, BOLIGNER & WARNER
* ATTN: ROBERT L. COSTIN, M.D.
5940 WEST RAYMOND STREET
INDIANAPOLIS, INDIANA 46241
317-925-6467
317-248-2448

SOUTH BEND MEDICAL FOUNDATION
ATTN: LUIS N. GALUP, M.D.
530 N. LAFAYETTE BLVD.
SOUTH BEND, INDIANA 46601

ST. CATHERINE HOSPITAL OF EACH CHICAGO, INDIANA, INC.
ATTN: P.B. CABRERA, M.D.
EACH CHICAGO, INDIANA 46312

INDIANA

UNIVERSITY HOSPITAL
DEPT. OF PATHOLOGY N-440
ATTN: JOHN C. BAENZIGER
926 WEST MICHIGAN STREET
INDIANAPOLIS, INDIANA 46223

WITHAM MEMORIAL HOSPITAL
ATTN: DAN CONEN
1124 NORTH LEBANON STREET
LEBANON, INDIANA 46052

IOWA

JOHN DEERE DUBUQUE WORKS
ATTN: R.E. DEBORD
P.O. BOX 538, DEPT. 975
DUBUQUE, IOWA 52001

UNIVERSITY HYGIENIC LABORATORY
ATTN: DES MOINES BRANCH
EAST 9TH AND GRAND HA WALLACE BLDG.
DES MOINES, IOWA 50319

UNIV. OF IOWA HOSPITALS & CLINICS
DEPT. OF PATHOLOGY
ATTN: MARIE WITTHOFT
145 MRC
IOWA CITY, IOWA 52242

KANSAS

BIO CENTER LABORATORY
ATTN: RICK FRIESEN
3100 N. HILLSIDE
WICHITA, KANSAS 67219

ST. FRANCIS REGIONAL MEDICAL CTR
ATTN: JOE J. LIN, M.D.
929 N. ST. FRANCIS
WICHITA, KANSAS 67214

KENTUCKY

ST. ANTHONY HOSPITAL
ATTN: LASZLO MARK, M.D.
1313 ST. ANTHONY PLACE
LOUISVILLE, KENTUCKY 40204

UNIV. OF KENTUCKY MEDICAL CENTER
CLINICAL LABORATORIES
ATTN: EDSEL R. BAKER
8080 ROSE STREET HL-400
LEXINGTON, KENTUCKY 40536

LOUISIANA

ETHYL TECHNICAL CENTER
ATTN: E.M. SCHAEFFER
8000 GSRI AVENUE
BATON ROUGE, LOUISIANA 70820

OCHSNER FOUNDATION HOSPITAL
ATTN: CHEMISTRY
1516 JEFFERSON HIGHWAY
NEW ORLEANS, LOUISIANA 70121

MARYLAND

KENNEDY INSTITUTE
★ TRACE METALS LABORATORY
ATTN: DR. J. JULIAN CHISHOLM, JR.
707 NORTH BROADWAY 301-550-0348
BALTIMORE, MD 21205

MARYLAND MEDICAL LABORATORY, INC.
★ PATH. BLDG.
ATTN: SELVIN PASSEN, M.D. 301-247-9100 EXT. 376
1901 SULPHUR SPRING ROAD
BALTIMORE, MD. 21227

METPATH, INC.
ATTN: E. QUINTOS, M.D.
5516 NICHOLSON LANE
KENSINGTON, MD 20895

UNION HOSPITAL OF CECIL COUNTY
ATTN: PAT REED, MT. ASCP
106 SINGERLY AVENUE
ELKTON, MD 21921

MASSACHUSETTS

BIO-MEDICAL LABORATORIES

10 WINTHROP STREET
WORCESTER, MASSACHUSETTS 06104

BIORAN MEDICAL LABORATORY
ATTN: ROBERT MEEHAN
877 MAIN STREET
CAMBRIDGE, MASSACHUSETTS 02139

CLINICAL SCIENCE LABORATORY, INC.
ATTN: STANLEY G. ELFBAUM, PH.D.
51 FRANCIS AVENUE
MANSFIELD, MASSACHUSETTS 02048

DAMON CLINICAL LABORATORY, INC.
ATTN: RICHARD W. KOCON, PH.D.
82 WILSON WAY
WESTWOOD, MASS. 02194

ESA LABORATORIES, INC.
ATTN: RICHARD R. KEENAN, PH.D.
43 WIGGINS AVENUE
BEDFORD, MASSACHUSETTS 01730

MICHIGAN

CHRYSLER CORP. IND. HYGIENE LAB.
ATTN: LOUIS P. GENDERMALIK, PH.D.
12220 OAKLAND AVENUE
HIGHLAND PARK, MICHIGAN 48288

CLAYTON ENVMNTL. CONSULTANTS, INC.
ATTN: JOHN SPURR
22345 ROETHEL DRIVE
NOVI, MICHIGAN 48050

CONTNL. BIO-CLIN LAB SVC., INC.
ATTN: W.G. VANDER PLOSS
2740 - 28TH STREET
GRAND RAPIDS, MICHIGAN 49509

DETROIT HEALTH DEPARTMENT
HERMAN DIEFER HEALTH COMPLEX
ATTN: JESSE F. GOODWIN, PH.D.
1151 TAYLOR
DETROIT, MICHIGAN 48282

GENERAL MOTORS INDUST. HYGIENE LAB
RESEARCH ADMIN. BLDG., ROOM 3-229
ATTN: DONALD J. HART, PH.D.
30500 MOUND ROAD
WARREN, MICHIGAN 48090

IHI-KEMRON LABORATORY
ATTN: CHARLES O.'BRAYAN
32740 NORTHWESTERN HIGHWAY
FARMINGTON HILLS, MICHIGAN 48018

MICHIGAN DEPARTMENT OF PUBLIC HLTH
BUR. OF ENVIRONMENT & OCCUPTL. HLTH
ATTN: MARGO L. SCHAFER
3500 N. LOGAN ST., P.O. BOX 30035
LANSING, MICHIGAN 48909

TOXICOLOGY LABORATORY CENTER
ATTN: GERRIT E. SCHUT
5836 EXECUTIVE DRIVE
LANSING, MICHIGAN 48911

ADVANCE MEDICAL & RES. CTR., INC.
ATTN: MR. ROBERT L. MOLONEY
1270 DORIS ROAD
PONTIAC, MICHIGAN 48057

MINNESOTA

HENNEPIN COUNTY MEDICAL CENTER
CLINICAL LABORATORIES
ATTN: DON CHANDLER
701 PARK AVENUE SOUTH
MINNEAPOLIS, MINNESOTA 55415

MAYO CLINIC
DEPT. OF LAB MEDICINE
ATTN: RODNEY W. FORSMAN
200 1ST STREET, S.W.
ROCHESTER, MINNESOTA 55905

MINNESOTA

MAYO LABORATORIES
ATTN: DR. R.D. ELLEFSON
210 HILTON BLDG.
ROCHESTER, MINNESOTA 55905

NORTH CENTRAL LABORATORIES, INC.
CLINICAL LABORATORY DIVISION
6975 SAURVIEW DR., P.O. BOX 1417
ST. CLOUD, MINNESOTA 56302

MISSISSIPPI

THOMAS F. PUCKETT LABORATORY
ATTN: MS. JACKIE BLAKENEY
NO. 1 MEDICAL BOULEVARD
HATTIESBURG, MISSISSIPPI

NEBRASKA

PHYSICIANS LABORATORY SERVICES
ATTN: DR. B.Y. ROFFMAN
105 NORTH 37TH STREET
OMAHA, NEBRASKA 68131

MISSOURI

CITY OF ST. LOUIS
ATTN: PUBLIC HEALTH LABORATORY
634 NORTH GRAND BLVD.
ST. LOUIS, MISSOURI 63103

ENVIRONMENTAL TRACE SUBSTANCES
RESEARCH CTR., UNIV. OF MISSOURI
ATTN: LYNN HARTMAN
ROUTE 3, SINCLAIR ROAD
COLUMBIA, MISSOURI 65203

MISSOURI DEPT. OF SOCIAL SERVICES
ATTN: R.H. GNAFSINGER, PH.D.
P.O. BOX 570
JEFFERSON CITY, MISSOURI 65102

SMITH KLINE BIO-SCIENCE LABS.
ATTN: R.L. PATRICK, M.D.
11636 ADMINISTRATION DRIVE
CREVE COEUR, MISSOURI 63141

ST. LOUIS COUNTY HEALTH DEPT.
ATTN: W.E. BLACK, PH.D.
8012 S. BRENTWOOD BLVD.
CLAYTON, MISSOURI 63105

THE DOE RUN CO.
ATTN: QUENTIN SCHMIDT, JR.
BOX 500
VIBURNUM, MISSOURI 65566

THE DOE RUN COMPANY
ATTN: B. ALBANO, M.D.
881 MAIN STREET, P.O. BOX 158
HERCULANEUM, MISSOURI 63048

UPSHER LABORATORIES
ATTN: GEORGIANNA DORRELL
20 EAST FOURTEENTH STREET
KANSAS CITY, MISSOURI 64106

NEVADA

REYNOLD'S ELEC. & ENGINEERING CO.
INDUSTRIAL HYGIENE LABORATORY
ATTN: A.R. FRAZIER
P.O. BOX 14400
LAS VEGAS, NEVADA 89114

SIERRA NEVADA LABORATORIES
ATTN: ANTOINETTE CAVIN
888 WILLOW STREET
RENO, NEVADA 89502

NEW HAMPSHIRE

NEW HAMPSHIRE PUBLIC HEALTH LAB.
DIVISION OF PUBLIC HEALTH
ATTN: VERONICA MALMBERG
HAZEN DRIVE - STATE LAB BLDG.
CONCORD, NEW HAMPSHIRE 03301

NEW JERSEY

ACCUMED DIAGNOSTIC LAB
ATTN: STANLEY LEVY
187 LIVINGSTON AVENUE
NEW BRUNSWICK, NJ 08901

ACCUTEST LABORATORIES
ATTN: RALPH J. PUGLIESE, SR.
578 LIVINGSTON AVENUE
NORTH BRUNSWICK, NJ 08902

KAULSON LABORATORIES, INC.
ATTN: PRASHA S. KAUL, M.D.
691 BLOOMFIELD AVENUE
WEST CALDWELL, NJ 07006

METPATH, INC.
ATTN: JOSEPH E. O'BRIEN, M.D.
ONE MALCOLM AVENUE
TETERBORO, NJ 07608

NEWARK BETH ISRAEL MED CENTER
ATTN: KAMIL GAL, M.D.
201 LYONS AVENUE
NEWARK, NJ 07112

ROCHE BIOMEDICAL LABORATORIES, INC.
ATTN: M. HAIDER, PH.D.
5 JOHNSON DRIVE
RARITAN, NJ 08869

NEW MEXICO

THE REFERENCE LABORATORY, INC.
ATTN: DAN FRANKLIN
1224 CENTRAL, S.E.
ALBURQUERQUE, NEW MEXICO 87106

S.E.D. MEDICAL LABORATORY, INC.
ATTN: KEN PAULK
500 WALTER, N.E., SUITE 500
ALBURQUERQUE,NEW MEXICO 87102

NEW YORK

BENDER HYGIENIC LABORATORY
ATTN: JEFFREY D. HUBBARD, M.D.
9 SAMARITAN DRIVE
ALBANY, NEW YORK 12208

CMX LABORATORIES
ATTN: DR. PETER VASILION, DIR.
50 HIGH STREET
BUFFALO, NEW YORK 14203

MONROE CO. ENVIR. HEALTH LAB
ATTN: RICHARD E. BURTON
435 EAST HENRIETTA ROAD
ROCHESTER, NY 14620
NEW YORK

ROCKLAND MEDILABS, INC.
POMONA PROFESSIONAL PLAZA
ATTN: DR. ALEX N. HELPER
BLDG. 2, ROUTE 45
POMONA, NY 10970

CHARLES M. SHAPIRO AND SONS, P.C.
ATTN: ELLIOT J. SHAPIRO, P.E.
6315 MILL LANE
BROOKLYN, NEW YORK 11234

ERIE COUNTY LABORATORY
PUBLIC HEALTH DIVISION
ATTN: RICHARD E. BETTIGOLE, M.D.
1021 MAIN STREET
BUFFALO, NEW YORK 14203

OMONDAGA COUNTY DEPT OF HEALTH
PUBLIC HEALTH LABORATORIES
ATTN: ERIK K. MITCHELL, M.D.
SYRACUSE, NY 13202

UNITED HEALTH SERVICES, INC.
ATTN: GARABED A. FATTAL, DIR.
WILSON DIVISION
33-57 HARRISON STREET
JOHNSON CITY, NY 13790

NORTH CAROLINA

DUKE UNIVERSITY MEDICAL CENTER
TOX LAB/CHEMISTRY LABORATORY
ATTN: BARBARA BENTON
132 CARL BLDG., BOX 3015
DURHAM, NORTH CAROLINA 27710

NORTH CAROLINA ST. BOARD OF HEALTH
LABORATORY DIVISION
ATTN: MRS. MILDRED A. KERBAUGH
RALEIGH, NORTH CAROLINA 27602

ROCHE IOMEDICAL LABORATORIES, INC.
ATTN: DR. BEN FLORA
1447 Y RK COURT
BURLINGTON, NORTH CAROLINA 27215

RUSSELL & AXON, INC.
ATTN: SIDNEY L. CHAMPION
P.O. BOX 473, 106 SHORT STREET
KERNERSVILLE, NORTH CAROLINA 27284

OHIO

B.F. GOODRICH COMPANY
CORPORATE ENVIRONMENTAL SERVICE
ATTN: SUE KURTZ
9921 BRECKSVILLE ROAD
BRECKSVILLE, OHIO 44141

CLEVELAND CLINIC FOUNDATION
CHMN. .AB. MED. L21
ATTN: T.L. GAVIN, M.D.
9500 EUCLID AVENUE
CLEVELAND, OHIO 44106

CLINICAL HEALTH LABS, INC.
ATTN: ALAN FIRESTONE
26300 EUCLID AVENUE, #910
CLEVELAND, OHIO 44132

MEDICAL COLLEGE OF OHIO
PATHOLOGY
ATTN: AL GEHA
3000 ARLINGTON AVENUE
TOLEDO, OHIO 43614

OHIO DEPT. OF HEALTH
ATTN: GARY D. DAVIDSON, DR. PH.
1571 PERRY ST., P.O. BOX 2568
COLUMBUS, OHIO 43266

SOUTHGATE MEDICAL LAB. SERVICE
ATTN: E.E. SIEGLER, M.D.
21100 SOUTHGATE PARK BLVD.
CLEVELAND, OHIO 44317

TRACE ELEMENTS ANALYSIS
ATTN: RANDAL H. MILLER
P.O. BOX 33022
NORTH ROYALTON, OHIO 44133

DEYOR LABORATORIES, INC.
ATTN: DENNIS GRELL
7655 MARKET STREET, SUITE 2500
YOUNGSTOWN, OHIO 44512

PROVIDENCE HOSPITAL
ATTN: VICTOR CABANA, M.D.
2446 KIPLING AVENUE
CINCINNATI, OHIO 45239

ROCHE BIOMEDICAL LABORATORIES, INC.
ATTN: G.E. BARNETT, M.D.
6370 WOLCOX ROAD
DUBLIN, OHIO 43017

TOLEDO HOSPITAL
ATTN: JUSTO M. DOMINGUEZ,M.D.
2142 N COVE BLVD.
TOLEDO, OHIO 43606

UNIVERSITY OF CINCINNATI HOSPITAL
ENVIR. HEALTH LAB-KETTERLING LAB.
3223 EDEN AVE., ROOM 201
CINCINNATI, OHIO 45267

OKLAHOMA

EAGLE-PICHER INDUSTRIES, INC.
ATTN: IVAN RILEY
P.O. BOX 1090, 200-9TH AVE., N.E.
MIAMI, OKLAHOMA 74354

OREGON

METROPOLITAN HOSPITALS
LABORATORY
235 N. GRAHAM STREET
PORTLAND, OREGON 97227

ST. VINCENT HOSPITAL & MED. CENTER
ATTN: ALBERT OYAMA, M.D.
9205 S.W. BARNES ROAD
PORTLAND, OREGON 97225

PENNSYLVANIA

A. KIRBY MEMORIAL HEALTH CENTER
ATTN: J.O. TURNER, PH.D.
71 N. FRANKLIN STREET
WILKES-BARRE, PENNSYLVANIA 18701

CLINICAL PATHOLOGY FACILITY, INC.
ATTN: WILLIAM B. ZEILER, M.D.
BIGNHAM AT S. EIGHTH STREET
PITTSBURGH, PENNSYLVANIA 15203

EAST PENN MANUFACTURING CO., INC.
ATTN: ROBERT P. FLICKER, M.S.
DEKA ROAD
LYON STATION, PENNSYLVANIA 19536

LANCASTER HOSPITAL
ATTN: GERALD R. FAHS, M.D.
555 N. DUKE ST., P.O. BOX 3555
LANCASTER, PENNSYLVANIA 17603

SMITHKLINE BIO-SCIENCE LABS.
ATTN: WILLIAM C. KASHATUS, M.D.
400 EGYPT ROAD
NORRISTOWN, PENNSYLVANIA 19403

IHF ANALYTICAL LABORATORY
ATTN: MARIANNE C. KASCHAK
34 PENN CIRCLE WEST
PITTSBURGH, PENNSYLVANIA 15206

MDS LABORATORIES
ATTN: GARY SHUGAR, M.D.
4418 POTTSVILLE PIKE
READING, PENNSYLVANIA 19605

ST. JOE MINERALS CORPORATION
HEALTH CHEMISTRY LABORATORY
300 FRANKFORT ROAD, ROUTE 18
MONACA, PENNSYLVANIA 15061

RHODE ISLAND

RHODE ISLAND DEPT. OF HEALTH
ATTN: R.G. LUNDGREN, PH.D.
HEALTH LABS. BLDG.
50 ORMS STREET
PROVIDENCE, RHODE ISLAND 02904

TENNESSEE

BAPTIST REGIONAL LABORATORIES
ATTN: MICHAEL V. STEVENS, PH.D.
22 NORTH PAULINE
MEMPHIS, TENNESSEE 38105

ENVIRONMENTAL SCIENCE & ENGR. CORP.
ATTN: ARTHUR SCHULBERT, PH.D.
1776 MAY'S CHAPEL ROAD
MT. JULIET, TENNESSEE 37122

TENNESSEE

INTERNATIONAL CLINICAL LABS., INC.
ATTN: HUGO C. PRIBOR, M.D., PH.D.
56 PARK PLAZA, P.O. BOX 4027
NASHVILLE, TENNESSEE 37202

SPECIALIZED ASSAYS, INC.
ATTN: KAY WILLIAMS-SMITH
206 12TH AVENUE SOUTH, BOX 2511
NASHVILLE, TENNESSEE 73202

TENNESSEE EASTMAN COMPANY
ATTN: JAMES C. GILLAND, JR.
P.O. BOX 1975
KINGSPORT, TENNESSEE 37662

TEXAS

ALLIED CLINICAL LABORATORIES
ATTN: STEPHEN W. ALRED, M.D.
201 PLAZA BLVD., P.O. BOX 93013
HURST, TEXAS 76053

AM LABORATORIES
ATTN: ANN REYNOLDS, M.T. (ASCP)
3434 SWISS AVE., SUITE 10
DALLAS, TEXAS 75204

ALLIED CLINICAL LABORATORIES
5303 CAROLINE
HOUSTON, TEXAS 77004

AMARILLO CLINICAL LABORATORY, INC.
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1500 COULTER SUITE 1/P.O. BOX 3010
SAN ANTONIO, TEXAS 78284

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ATTN: ROGER E. HALLSTEIN
9742 SKILLMAN
DALLAS TEXAS 75243

DAMON CLINICAL LABORATORIES
ATTN: JANICE AIRHART, M.T.
8300 ESTERS BLVD., SUITE 900
IRVING, TEXAS 75063

DEPARTMENT OF PATHOLOGY
& AREA LABORATORY SERVICES
ATTN: QUALITY CONTROL ANALYST
BROOKE ARMY MED. CTR - BLDG. 2630

HARRIS HOSPITAL
ATTN: HORACE HAMILTON
1300 WEST CANNON STREET
FORT WORTH, TEXAS 76104

INTERNATIONAL CLIN. LABS., INC.
SOUTHWEST DIVISION
ATTN: DENNEY FRANK
8000 SOVEREIGN ROW
DALLAS, TEXAS 75247

NATIONAL HEALTH LABORATORIES, INC.
SUITE A-200
ATTN: LARRY FERRERI, PH.D.
7777 FOREST LANE
DALLAS TEXAS 75230

PATHLAB, P.A.
ATTN: RICHARD D. JUEL, M.D.
1600 MEDICAL CENTER STREET
EL PASO, TEXAS 79902

QUEMETCO LABORATORIES
ATTN: C.T. KENNER, M.D.
2804 SFA HARBOR
DALLAS, TEXAS 75212

SOUTHWEST BIOCLINICAL LABORATORY
ROSA VERDE TOWERS, SUITE 206
ATTN: J. KYLE FARQUHAR
343 E. HOUSTON STREET
SAN ANTONIO, TEXAS 78205

TEXAS COLLEGE OF OSTEOMEDICINE
ATTN: GARY H. WIMBISH, PH.D.
CAMP BOWIE AT MONTGOMERY
FORT WORTH, TEXAS 76107

UTAH

BIOTRACE/ASARCO, INC.
ATTN: SANDRA MACKOWSKI
3422 SOUTH 700 WEST
SALT LAKE CITY, UTAH 84119

DATACHEM, INC.
ATTN: LANCE EGGENBERGER
520 WAKARA WAY
SALT LAKE CITY, UTAH 84108

KENNECOTT
ATTN: LYNN A HUTCHINSON
1515 MINERAL SQUARE
SALT LAKE CITY, UTAH 84112

U.S. DEPT.LABOR, OSHA
ANALYTICAL LABORATORY
ATTN: W.E. BABCOCK
1781 S. 300 W., P.O. BOX 15200
SALT LAKE CITY, UTAH 84115

VERMONT

MEDICAL CENTER HOSPITAL OF VERMONT
CLIN LABS, M FLETCHER UNIT
ATTN: FLORENCE CZERNIAWSKI
BURLINGTON, VERMONT 05401

VIRGINIA

AMERICAN MEDICAL LABS., INC.
ATTN: JAN TURNER
11091 MAIN STREET
FAIRFAX, VA 22030

MEDICAL COLLEGE OF VIRGINIA
ATTN: GEORGE P. VENNART, M.D.
PO BOX 662, SANGER HALL, RM. 4-011
RICHMOND, VA 32398

NATIONAL HEALTH LABORATORIES, INC.
ATTN: N. SHERMAN, M.D.
1007 ELECTRIC AVENUE
VIENNA, VA 22180

NEWPORT NEWS SHIPBUILDING
028 MELICAL BLDG. 15
ATTN: S.A. MONDAY
4101 WASHINGTON AVENUE
NEWPORT NEWS, VA 23607

OLD DOMINION UNIVERSITY
DEPT. OF CHEMICAL SCIENCES
ATTN: PATRICIA PLEBAN, M.D.
NORFOLK, VA 23508

OMEGA-TECH, INC.
ATTN: ZHENG-XIAN LIUS
RIPSHIN ROAD, P.O. BOX 1
TROUTDALE, VA 24378

UNIVERSITY OF VIRGINIA HOSPITAL
CLINICAL LABORATORY
ATTN: ROBERT BROWNING
P.O. BOX 168
CHARLOTTESVILLE, VA 22908

WASHINGTON

BOEING COMPANY
ATTN: MASON CAMPBELL
P.O. BOX 3707, MS8H-08
SEATTLE, WASHINGTON 98124

INTERNATIONAL CLINICAL LABORATORY
NORTHWEST
ATTN: TEH Y. WANG, PH.D.
1100 EAST UNION
SEATTLE, WASHINGTON 98122

WASHINGTON

LAB OF PATHOLOGY OF SEATTLE
ATTN: WILLIAM B. HAMLIN, M.D.
1229 MADISON, 5THFLOOR
SEATTLE, WASHINGTON 98104
206-386-2672

PUGET SOUND NAVAL BASE
BRANCH CLINIC
ATTN: H. LINDLEY
BLDG. 340, LAB DEPT.
BREMERTON, WASHINGTON 98314

UNIVERSITY OF WASHINGTON
ATTN: RENEE C. LANG
LAB MEDICINE, SB10
SEATTLE, WASHINGTON 98195
206-548-6235

WISCONSIN

WEST ALLIS MEMORIAL HOSPITAL
ATTN: JAY F. SCHAMBERG, M.D.
8901 WEST LINCOLN AVE., P.O. BOX 17167A
WEST ALLIS, WISCONSIN 53227

CANADA

HEALTH & WELFARE CANADA
OCCU. HEALTH UNIT
ATTN: J. KIRKBRIDGE, M.D.
DU CHARDON AT SORREL STREET
OTTAWA, ONTARIO, CANADA KIA OL3

MDS LABORATORIES
ATTN: T. ENGLAND, M.D.
100 INTERNATIONAL ROAD
ETOBICOKE, ONTARIO, CANADA M9W 6J6

ONTARIO MINISTRY OF HEALTH
BIOCHEMISTRY LABORATORY
81 RESOURCES ROAD
WESTON, ONTARIO, CANADA M9P 3T1

Program Directory

Information regarding program changes affecting laboratories certified for blood lead analysis may be obtained by contacting OSHA (see paragraph C.3 of this Notice) or the following organizations.

CENTER FOR DISEASE CONTROL

Office of Training and
Laboratory Programs
Executive Park Bldg. 24
1600 Clifton Road
Atlanta, Georgia 30333

Dr. D. Joe Boone
Div. of Lab Assessment &
Management Consultation
Jewell Mitchell,
Laboratory Programs
FTS 23?-1967/(404)329-1967

Center for Environmental Health
Blood Lead Proficiency Testing
Childhood Lead Program
Koger Center F-37
1600 Clifton Road
Atlanta, GA 30338

James ?. Simpson,
Public Health Advisor
Louise Yert, Chemist
FTS 236-4780/(404)454-4780

ACCREDITED LABS
CAT.# B376
LINDA SCOTT

COLLEGE OF AMERICAN PATHOLOGISTS

William E. Williamson, Director
Laboratory Improvement Programs
5202 Old Orchard Road
Skokie, IL 60077-1034
(312)966-5700

Diane Gilbo, Surveys Manager
CAP Computer Center
P.O. Box 1234
Traverse City, MI 49685-1234
(616)947-4500/(800)253-1790

NEW YORK STATE DEPT. OF HEALTH

Proficiency Testing Programs
Empire State Plaza
Albany, NY 12201

Dr. P.J. Parsons
Lead Poisoning Unit
Laboratory of Inorganic Analytical Chemistry
Barbara Robertson, Laboratory Services
(518)474-4924

****

LIST OF OSHA REGIONAL OFFICES

Region 1

16-18 N Street
1 Dock Square Building 4th Floor
Boston, Massachusetts 02109

Region 2

201 Varick Street
Room 670
New York, New York 10014

Region 3

Gateway Building
Suite 2100
3535 Market Street
Philadelphia, Pennsylvania 19104

Region 4

1375 Peachtree Street, N.E.
Suite 587
Atlanta, Georgia 30367

Region 5

32 Floor/Room 3244
230 South Dearbourne Street
Chicago, Illinois 60604

Region 6

525 Griffin Square
Room 602
Dallas, Texas 75202

Region 7

911 Walnut Street
Room 406
Kansas City, Missouri 64106

Region 8

Federal Building
Room 1576
1961 Stout Street
Denver, Colorado 80294

Region 9

71 Stevenson Street
Room 415
San Francisco, Calif.94105

Region 10

Federal Office Building
909 First Avenue/Room 6003
Seattle, Washington 98174

Items to Support Chapter 3

3-1 Instructions for Completing the Survey Form

3-2 Diagrams

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Appendix 3-1 -- INSTRUCTIONS FOR COMPLETING THE LEAD-BASED PAINT SURVEY FORMS

The inspector should complete a survey sheet for each room (or exterior) surveyed. At the top of the sampling sheet, a number of items must be completed as follows:

PRELIMINARY DATA

Address:	Fill in the number, street, city, state, and zip code. Also, an apt. number, if appropriate.
Room #:	Fill in room number. If none is provided, assign room numbers on the sketch you draw below and use these numbers.
Date:	Date survey is conducted.
Time:	Fill in the time you started the survey.
Client's name and address:	Fill in the client's name and address.
Company name and address:	Fill in your employer's name and address.
Operator:	Fill in your name.
# Windows:	Fill in the number of windows in the room you are inspecting.
# Doors:	Fill in the number of doors in the room you are inspecting.
Sampling Temp:	Record the temperature in the room you are inspecting.
EBL Case:	If the case involves a child (or adult) with elevated blood lead, indicate the name of that person here and, immediately following, under "ID", the case ID number.
XRF:	Fill in the manufacturer's name, the model number, and the serial number.
Log:	Fill in the page number reference for the XRF log.
Diagram:	If floor plans are not available, draw a plan view of the apartment unit or house. On either your diagram or a floor plan, assign a number to each room. For your future reference it will be helpful to note the function of each room as well, i.e., "kitchen." If the entire house or unit will not fit in the space provided, draw as much as you can fit comfortably and draw additional diagrams as necessary.

Label N from Entry: Label where North is relative to the entry into the unit. Make sure you also label the location of the entry on your diagram or blueprint.

SAMPLE DATA

For each individual testing location (sample), the following information must be recorded:

Sample Number: The number, however it is derived, should be unique and should contain some information that helps to identify the origin of the sample, such as the project number.

Sample Site: The exact location being sampled should be indicated as specifically as possible. A list of sample sites is included in Section 3.3.2 of this manual.

Location: The approximate location of each sample should be shown on the diagram or floor plan. The location should be indicated in a specific, unique way--the last digit or two of the sample number, for example--not just with an "X." Also indicate height of sample site from the floor.

ALC: Apparent Lead Concentration. Record the XRF reading in each of the 7 boxes in the row.

SEL: Substrate Equivalent Lead Response. In these boxes, record the XRF readings obtained on the scraped substrate (the same substrate type as that on which the corresponding ALC samples were taken.)

CLC: Corrected Lead Concentration. Calculate the CLC by subtracting the average SEL from the average ALC.

Check Zeros: Remember to record the results each time you check the "zero."

Surf/Subs: Also record the type and condition of the substrate surface. Suggested substrate surface type and condition codes are as follows:

Type:		Condition:	
Brick	B	Good	G
Concrete	C	Poor	P
Gypsum Board	G	(cracked, chipping, peeling, blistering, or generally loose)	
Plaster	P		
Wood	W		
Metal	M		
Other	O		

Lab Analysis: If samples were collected for laboratory analysis, the sample numbers should be entered with the name of the lab to which they are sent. The results should be posted when received.

Finally, the inspector should complete the following items:

Approximate Sampling Time: The time it took to conduct the survey

Initials: Your initials

CALCULATIONS

AVERAGE (ave): - The mean or arithmetic average (symbolized by $\bar{x}$) is the sum of a group of numbers (both negative and positive) divided by the number of readings in that group. In symbols:

$$\bar{x} = \frac{x_1 + x_2 + x_3 + \ldots x_n}{n}$$

In the case of averaging the ALC responses, each ALC area response is represented as an "x" and n is the total number of responses.

The standard deviation (dev) and error (err) need not be calculated for every sample site. If this information is desired for evaluating the performance of the instrument, it can be calculated as follows:

STANDARD DEVIATION (dev):

The standard deviation is a way of measuring the spread within a group of numbers. It is the square root of the sum of squared deviations of each observation x_i from the mean x divided by (n-1). In symbols:

$$s = \sqrt{\frac{\sum_{i=1}^{n} (x_i - \bar{x})^2}{n-1}}$$

The significance of the standard deviation lies in the fact that if a distribution is approximately normal and there is no bias or systematic error, then 68.3% of the readings will lie within one standard deviation of the maean, 95.4% will lie within two standard deviations of the mean, and 99.7% will lie within three standard deviations of the mean.

An automatic standard deviation function is available on many hand calculators.

Lead-Based Paint Survey Form

Survey Site: Address________________ Room No.________ Date________ Time________ am___ pm___

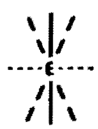
Client: Name________________ Address________________

Testing Company: Name________________ Address________________ Operator________________

No. Windows: __________ No. Doors: __________ Sampling Temp: __________ EBL Case: __________ ID: __________

XRF: Mfr.__________ Model__________ Serial No.__________ Calibration Log________

Label N from Entry :



Notes (Key for Codes) :

X Coord

1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26 27 28 29 30 31 32 33 34 35 36 37 38 39 40 41 42 43 44 45

Y Coord

a b c d e f g h i j k l m n o p q r s t u v w x y z aa bb cc dd ee ff gg hh ii

Back of Page One

Sample Codes		area response mg/cm²							sample		CLC	check zeros			zeros		surf/subs		Lab Analysis
		1	2	3	4	5	6	7	ave	dev		1	2	3	ave	dev	Type	Cond	
1 No. ______	ALC																		
Site ______	SEL																		
2 No. ______	ALC																		
Site ______	SEL																		
3 No. ______	ALC																		
Site ______	SEL																		
4 No. ______	ALC																		
Site ______	SEL																		
5 No. ______	ALC																		
Site ______	SEL																		
6 No. ______	ALC																		
Site ______	SEL																		
7 No. ______	ALC																		
Site ______	SEL																		
8 No. ______	ALC																		
Site ______	SEL																		

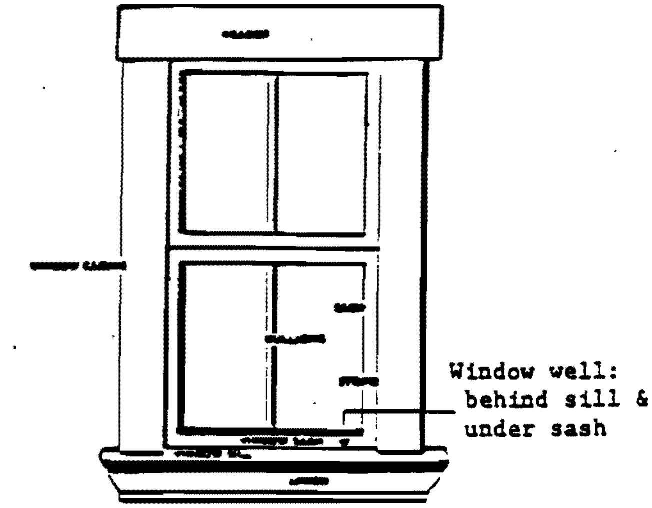
Comments: ______________________________

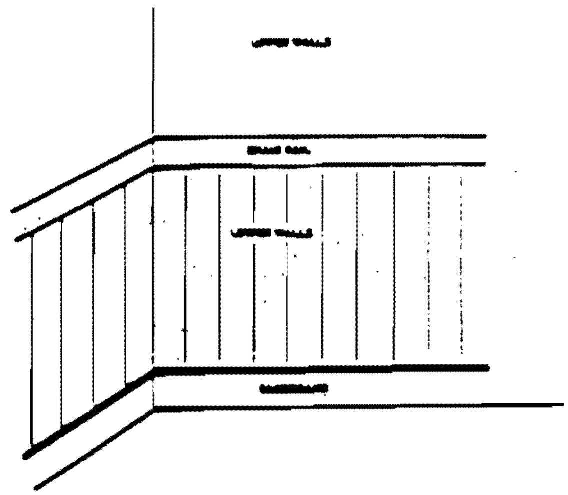
Approx. Sampling Time ________

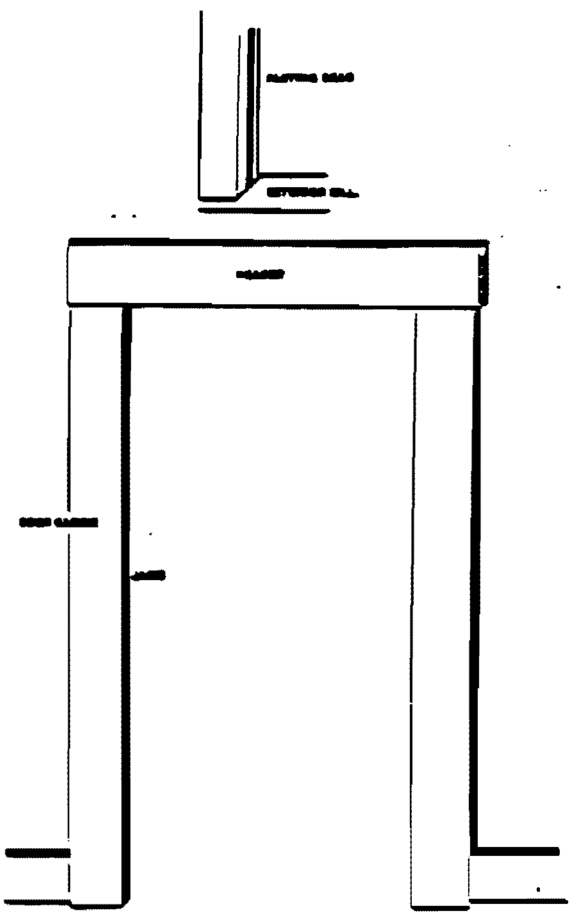
Initials ________

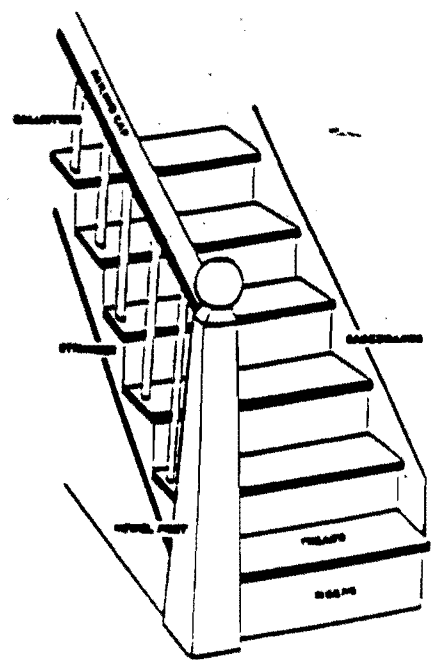
* Adapted from a form by Georgia Institute of Technology, Environmental Health, Safety Division.

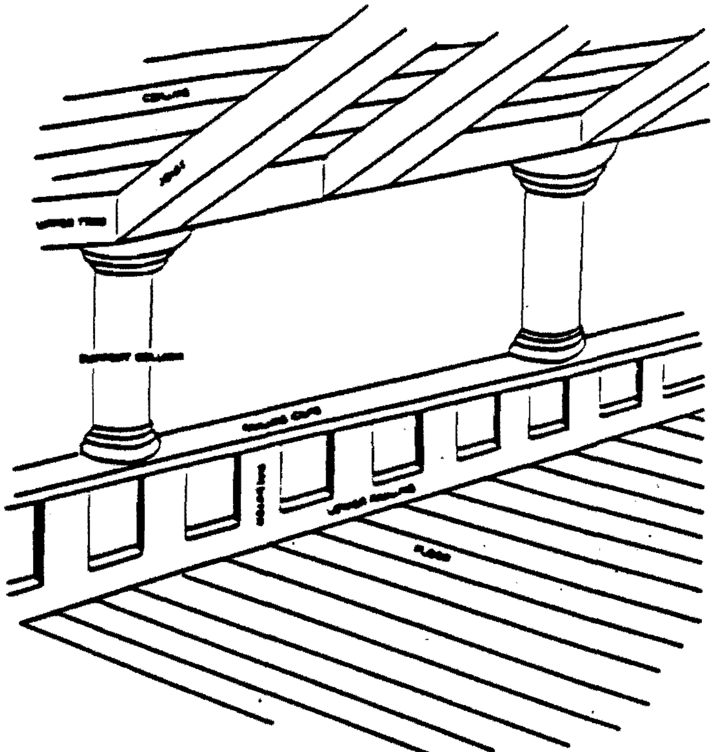
Appendix 3-2 -- DIAGRAMS OF BUILDING COMPONENTS

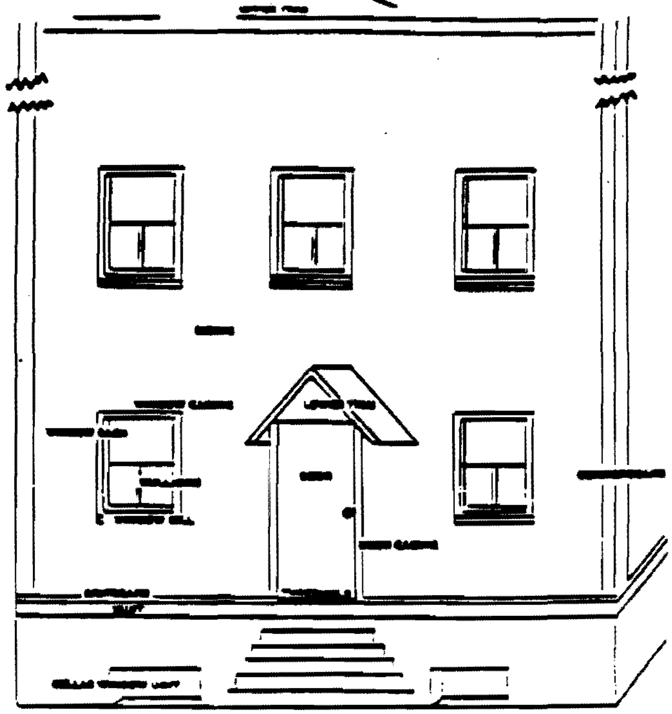












Appendix 3-3 -- USING THE XRF ANALYZER

General Guidelines for Using the XRF Analyzer

The guidance presented in this appendix is not intended to be a substitute for comprehensive classroom and on-the-job training in the use of the XRF analyzer. Surveys using the XRF analyzer should never be conducted by an untrained operator. Section 3.7 discusses necessary qualifications for testing personnel, including minimum requirements for developing proficiency in operation of the portable XRF analyzer.

How does the XRF analyzer work? Portable XRF analyzers measure the concentration of lead in paint using the principle of x-ray fluorescence. Radiation from a cobalt source within the instrument will excite lead atoms in the paint. As the atoms return to a stable state, they emit x-rays that are characteristic of lead. The instrument detects these x-rays, converts them to electrical signals, counts them, and produces a reading for lead concentration in mg/cm2.

Beginning the survey. Make sure the batteries are charged. (The batteries that power the instrument should be charged continually when not in use and for 12 hours before use in the field.) Warm up and check the zero and calibration of the instrument. (See specific instructions for each instrument.)

How many readings should be taken at each sample site? One XRF reading at a sample site is not enough to make a decision about the presence of lead-based paint. The XRF response is subject to statistical fluctuations, so that multiple readings should be taken to obtain a more precise analysis.

It is recommended that a minimum of 3 XRF readings be taken at every sample site. Five to eight readings are recommended for levels under 3.0 mg/cm2. If the average of readings at a sample site falls within 0.7 to 1.3 mg/cm2, it is recommended that before proceeding with abatement, backup laboratory analysis of paint from representative surfaces should be obtained. It is recommended that 0.5% or higher be considered an action level when laboratory analysis is used. (See Table 3.2)

Size of the sample site. It is desirable for the sampling area to equal or exceed an area as large as the face of the instrument. In no instance should the sample size be smaller than the size of the active area of the instrument (see figures 3.1 and 3.2), since a reading over an air space will be inaccurate. (Laboratory analysis is recommended for very small or very narrow surfaces.)

Positioning the instrument. The face of the instrument should lie flush with the sample surface. (Some surface features result in the face not being flush with the surface, such as sculptured surfaces, surfaces with grooves, and tubular surfaces. If XRF readings on these surfaces read 4.0 mg/cm^2 or higher, it may be assumed that there is at least 1.0 mg/cm^2 of lead present. If XRF readings on these surfaces are less than 4.0 mg/cm^2, laboratory analysis is recommended.) The instrument must also remain stationary during the reading.

Correcting for the substrate. The substrate (the material to which the paint adheres, such as wood, concrete, metal, brick, masonry, and plaster) returns or "backscatters" radiation to the XRF analyzer. This backscatter may be counted as lead x-rays. The inspector therefore must be aware of this and compensate for the substrate effect, if necessary. XRF readings should be obtained on a representative area in the dwelling that has been scraped to the bare substrate. The substrate correction factor obtained in this way is then substracted from or added to (as appropriate) the readings obtained on the painted substrate. The inspector should record this information on the survey form.

Rechecking the zero. Because the zero may "drift" over time, it is recommended that the zero be rechecked on known materials frequently during the survey (at least once per room, or more frequently if zero drift is suspected). This information is also to be recorded on the survey form to document that the instrument is working properly.

Other potential interferences.

o Temperature extremes and drastic temperature change may affect XRF readings. Allow the instrument additional time to reach equilibrium after it is turned on if it is brought in from a different temperature environment (e.g., wait 5 minutes plus 5 minutes for every 10 degree temperature differential).

o The inspector should be aware of building features that may affect XRF readings. Studs, nails, pipes, and wire within walls can produce high readings. (A "stud finder" device may be useful during the survey.) Hollow core doors and other objects that contain air spaces can give false readings. (The substrate correction procedure outlined above can be used for such surfaces, as long as the scraped surface zero reading and the readings for lead are taken at the same relative location on each door or other item.)

o The Microlead I can be affected by radio waves and magnetic flux. The manufacturer recommends taking readings about 12 inches away from electrical outlets, switches, and wiring.

Keeping a logbook. XRF analyzers have or develop their own peculiarities. A notebook should be kept for each machine (by serial number). Information about operation and maintenance, including daily performance, reading time, maintenance problems, and any damage to the instrument, should be recorded chronologically. An inspector will be able to learn the instrument's history and its individual responses through this notebook. It will also assist in diagnosing any problems with the instrument that may develop.

Source decay. The Cobalt 57 source decreases by one-half every 276 days (its "half-life"), regardless of how much the instrument is actually used. This is why an instrument with a source several months old takes longer to obtain a reading than an instrument with a fresh source. The source should be replaced every 10 to 14 months. The radioactive source used in XRF analyzers is not a user serviceable component. Consult the manufacturer for information on repair or source replacement for your analyzer.

Licensing and registration. Licensing and registration requirements for XRF analyzers vary from state to state. The state Department of Labor, Department of

Health, or Radiation Control Program should be contacted for applicable requirements. The XRF manufacturers are also familiar with procedures in each state.

Travel and shipping There are restrictions on interstate travel with XRF analyzers; these can be determined by contacting the appropriate state authorities. Intrastate travel and interstate shipping of XRF analyzers are governed by Department of Transportation regulations (49 CFR 173.422). Details of shipping regulations can be obtained from the XRF manufacturers.

Health and safety for XRF operators. XRF analyzers use a low-level radioactive isotope (Cobalt 57) to activate lead atoms in paint. The radioactive source is shielded to minimize the operator's exposure to radiation. When XRF analyzers are properly used, the amount of radiation exposure is negligible. However, the following practices are recommended to ensure safe and responsible use of portable XRF analyzers:

o No one should operate an XRF analyzer unless he/she has received thorough training, including training in radiological safety principles, emergency procedures, and regulation of XRF devices.

o Although the amount of radiation exposure from the instrument is very low, it should always be kept as low as possible. Operator exposure to radiation can be reduced by minimizing the time personnel are near the instrument and by maximizing the distance from it when it is not in use. For example:

- Store the instrument in a room not occupied by personnel when not in use
- Transport the instrument in the trunk of a car, not on the seat next to personnel
- Place the instrument as far away from personnel as possible when not actually operating it; do not put it on a desk or table while preparing paperwork
- Be aware of the direction that the radiation travels when the shutter is open and avoid having any part of the body in its path
- Don't lean into the instrument while operating it.

o It is a good practice to wear radiation dosimetry badges when using XRF analyzers. (In some localities this is required.) These badges indicate cumulative exposure to radiation. The badges are worn for 1-3 months and then returned to the supplier for analysis. Radiation dosimetry badges can be obtained from radiological services companies throughout the country.

o The radioactive source should be tested every 6 months for leakage. (Most states require this.) These tests are performed using cotton swabs or wipes which are analyzed for radiation leakage. Leak test kits can be obtained by contacting radiological services companies, state radiation control programs, or the XRF manufacturers.

o The analyzer should not be placed in precarious areas (on the roof of a car, window ledge, coffee table, child's playroom, etc.)

o In the unlikely event that the analyzer is smashed, it should not be picked up. An environmental agency that can respond to the release of hazardous materials should be called to determine the extent of the hazard and to contain the source.

o Each XRF analyzer should be labeled with an emergency phone number for the appropriate environmental agency in the state in which the survey is being conducted.

o Each XRF analyzer that is no longer in use should be returned to the manufacturer for storage or permanent radioactive source disposal.

o Pregnant women or women of childbearing age who use the XRF analyzer should be aware that improper handling of the instrument can result in radiation exposure which can harm a developing fetus.

Quality control for XRF surveys. To check overall inspection thoroughness and accuracy, spot checks should be conducted. That is, an inspector's work should be independently verified by another "blind" inspector, who conducts the inspection as he/she normally would without knowing it is a quality control inspection. Once an inspector is fully trained, his or her inspections should be checked 10 percent of the time.

How many units per day can be tested for lead-paint hazards using the XRF? If residential units are on scattered sites and of varying construction an inspector will be able to conduct approximately two to four surveys per day.

This number may be somewhat higher if the units are of similar construction and/or within one building. However, the time needed to conduct a thorough survey will depend upon a number of factors, including:

o The number of painted and varnished surfaces in a unit

o The size of the unit

o The amount of lead in the paint. (More readings may be needed if it is near the regulatory level.)

o The reading time of the particular XRF analyzer being used.

IMPORTANT: The information presented below on the Princeton Gamma-Tech and Warrington XRF analyzers are not intended to be operator manuals for these instruments. They are presented here to give the reader a basic idea of how trained operators use the XRF analyzer. Inspections for lead-based paint using the XRF analyzer should only be conducted by properly trained personnel (see section 3.7 of these guidelines).

The Princeton Gamma-Tech XK-3 (NOTE: These guidelines do not cover the much older XK-2. Details for operation of the XK-2 can be obtained from the manufacturer.)

Warmup and Calibration Check

1. Set up and unlock the XK-3 system as outlined in step (1) through (4) under Operating Procedure.

2. Place the check block (supplied by the manufacturer) on a lead-free table or desk. Take 10 warm up readings on the zero end of the check block. (If the readings stabilize with a zero offset and this offset is also obtained on the lead check block, this offset should be subtracted from or added to (as appropriate) the readings obtained at each sample site.)

3. Place the XK-3 unit over the lead end of the check block. (NOTE: Make certain that the wooden board and the XK-3 unit are facing in the same direction. Align the arrows on the side of XK-3 with those of the board, otherwise, the sensitive area in the face-plate of the unit (Figure 3.1) may not be directly over the lead sample on the board and the reading may be inaccurate. If you receive a reading of zero or a minus reading, the unit has probably been positioned incorrectly over the board. Check to see that you are reading the correct end of the board.

4. Depress the RED RESET button on the back plate of the unit, just above the coiled cable connection, and hold for 3-4 seconds.

5. Depress the handle until a new read-out replaces the existing display.

6. Check the new reading against the reading given on the check board label.

7. Take a total of 10 readings in the same way. The unit is properly calibrated if the three readings average within 0.3 mg/cm^2 of the standard.

8. If the average reading falls outside the 0.3 mg/cm^2 range, depress the red reset button on the back plate of the XK-3 (above) the coiled cable connection). This reset activates an internal circuit that instantaneously resets the electronic circuit. This process should enable the instrument to recover its calibration. Now take another reading and check it against the standard.

9. Recheck the zero after a reading of 10.0 mg/cm^2 is obtained, or after a series of readings of 5.0 mg/cm^2 or higher.

Operating Procedure

1. Remove the battery pack, coiled cable, and XK-3 unit from the carrying case.

2. Connect the battery pack to the XK-3 unit, using the coiled cable. (Do not operate the XK-3 unless the battery pack is connected to the unit, or a rapid power drain on the handle batteries may cause erroneous readings and/or damage to

these batteries.)

3. Locate the LOCK SWITCH underneath the handle toward the rear of the unit and push it forward. A red light over the display window will now glow to indicate that the instrument is ready to perform its analysis as soon as the shutter is opened.

4. Depress the RED RESET button on the back plate of the unit, just above the coiled cable connection, and hold for 3-4 seconds. (This is done only when the instrument is turned on or to enable the instrument to recover its calibration.)

5. Grasping the wooden handle, position the face-plate of the instrument against the surface to be measured and push down firmly and evenly on the handle to open the shutter. The red light over the window will now blink to indicate that the shutter is not fully closed. When the handle is fully depressed, and the shutter is fully open, the previous readout vanishes (except for the decimal point), indicating that a measurement is being taken.

6. Keep the handle firmly depressed until the new read-out appears, indicating that a measurement is complete.

7. When the new read-out appears, the handle may be released. The reading will remain on display until the handle is depressed again to start a new measurement.

The Warrington Microlead I, Revision 4

Power-up

To turn on the Microlead I, depress the switch on the back of the analyzer. The analyzer will go through a series of diagnostic checks. The analyzer displays FAULT ## if diagnostics discovers an internal problem. Refer to the Diagnostic FAULT Numbers section for definitions of each fault number. If the analyzer does not click during diagnostics consult the Troubleshooting Section. If the problem persists consult the factory.

Upon power-up the analyzer checks the current date against the Source Date and compensates for the source decay. Check Today's Date for the correct date. If an adjustment is necessary, make the change, turn the analyzer off, and turn it back on.

Warm-up

Take 8-10 warm-up readings. Take several reading on the center of the gypsum zero standard block to establish a zero reference. (NOTE: The "standards" referred to in this section are not true standards, but reference blocks supplied by the manufacturer.) Zero Standardize on that block if the average readings are more than 0.2 mg/cm^2 high or low. To Zero Standardize, place a zero standard block on top of the foam inside the carrying case lid (or styrofoam block) to negate background fluorescence from whatever you Zero Standardize on. Center the probe on that standard block, Clear Display, and press Zero Standard. A small "1" appears at the left of the display indicating the corresponding keypad function. The time appears on the display and then disappears as the trigger is pulled and the analyzer begins to adjust the background reference. "PROBE" indicates that the Zero Standard function is "teaching" the analyzer a new zero reference for this particular background material.

Depress the trigger completely throughout this procedure. The display will remain blank and after about one reading cycle the analyzer will beep. Continue to depress the trigger through three more beeps. On the fourth beep the analyzer will display the zero reference at that moment. Continue to hold the trigger until the display reads 0.0 mg/cm^2 plus or minus 0.1. Release the trigger and the analyzer automatically clears the display.

After Zero Standardizing, recheck your zero standard blocks, even the block you just standardized on. Take several readings on each block to establish a zero reference. Never Zero Standardize on anything containing lead.

Write down the zero reference offset (if there is one) for each substrate (scraping representative areas to the bare substrate) and its particular density. Use these offsets to correct your reading during the survey.

Next, test the lead standards placed on top of the zero standards. The analyzer will not normally require lead adjustments. However, if the average of the readings exceeds the factory tolerances, the following adjustments should be made. Calculate the direction and percentage that the average of the readings must change to have the average reading agree with the value of the lead standards within the lead standard's tolerance. If the average remains out of tolerance (based on the zero reference reading) press Lead Standard (a small "2" appears at the left of the display indicating the corresponding keypad function and the time appears at the right) followed by one of the arrow keys. After each adjustment the analyzer clears the display.

Use the Up/Down Arrow keys to bring the average of the lead readings within the tolerance of the lead standards. The Up/Down Arrow keys adjust the analyzer's internal lead calculations in 6 percent increments.

Test the lead standards after each adjustment. If necessary, repeat. If more than two adjustments are necessary, consult Warrington.

Operating Procedures

To take a lead reading, place the Microlead I probe against a test surface and depress the trigger completely. Depressing the trigger activates the shutter, thereby exposing the source and initiating the first reading cycle. (NOTE: Releasing the trigger by as little as 1/16 inch closes the shutter slightly and affects the results.

As the numerals on the display disappear COUNT appears, signalling the ongoing process of counting incoming x-rays. Midway into the reading the probe clicks as it switches its sensing mechanism. Upon completion of the first reading cycle the probe clicks again and the analyzer beeps and displays 1) the lead reading; 2) the background substrate's radiation density; and 3) one bar on the Reading Cycle Bargraph, which indicates one complete reading cycle. Releasing the trigger at this point terminates further reading cycles and the results from one reading cycle remain displayed. Releasing the trigger before completing one reading cycle produces an IEEE error message. If this occurs, press Clear Display and begin again. If the problem persists consult the factory.

If you continue to depress the trigger after completing the first reading cycle the analyzer automatically initiates the next reading. Midway through the second reading cycle the probe will click. Upon completion of the second reading cycle the probe clicks again and the analyzer beeps and displays 1) the average of the first and second lead readings; 2) the density indicator; and 3) two bars, to indicate two complete reading cycles. Releasing the trigger terminates further reading cycles.

The Microlead I can complete nine (9) successive reading cycles before it requires you to release the trigger. Continuing to depress the trigger initiates additional reading cycles. Upon completion of each reading cycle the Microlead I displays the average of all previous readings obtained since the first reading cycle.

Cover as much of the test surface as possible with the window on the probe face. Note the position of the sensor and source in the probe face. The probe detects lead most accurately between the sensor and source. The more surface you can cover the more accurate and representative the readings will be.

The Microlead I, Revision 3

Some of the differences between the Microlead I, Revision 3 and Revision 4 that an operator should be aware of are:

Display - Readings are displayed after the trigger is released. Hold trigger until the display indicates the "Accuracy Level" you desire, then release trigger to see lead reading.

Bar display indicates apparent radiation density, on Revision 4 it is used to indicate number of read cycles.

Zero Standard Function - Similar except for slight differences. Warm-up time is greatly reduced or eliminated on Revision 4 and "zeroing" is held accurately through periods of inactivity or power off.

Lead Standard Function - Similar, however, rarely if ever necessary to use on either Revision.

Source Date - Done automatically upon power-up of analyzer on Revision 4. See Revision 3 Owner's Manual for procedure for this function. Source Data should be done by operator at least once per week.

Operation - See Inspection "How To's" in Owner's Manual for helpful techniques on taking readings on various surfaces and substrates. In general, better results are obtained with the probe handl eperpendicular to the wood grain. The Revision 4 is independent of orientation with respect to wood grain.

FIGURE 3.1

XK3: LOCATION OF LEAD ANALYSIS AREA (SOLE PLATE TOP VIEW)

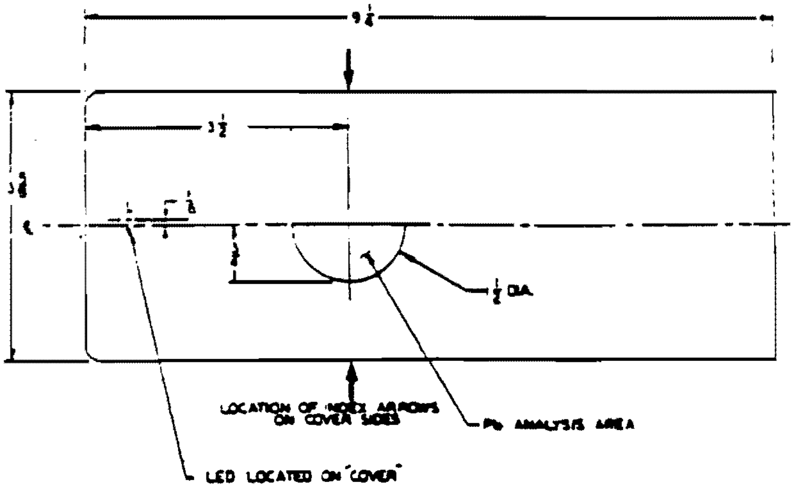
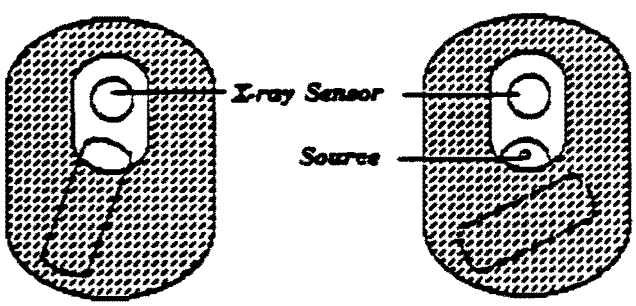


FIGURE 3.2

MICROLEAD I: SENSOR AND SOURCE POSITIONING AT PROBE FACE



Probe Face Shutter Closed *Probe Face Shutter Open*

Appendix 3-4 -- RECOMMENDED PROCEDURES for COLLECTING PAINT SAMPLES

Materials Needed

- Clean, see-through plastic baggies with a zip-lock mechanism.
- Tape or labels.
- Marker.
- Cutting knife with a fine edge or thin scalpel blade (a paint scraper may be necessary to scrape down to the bare wood).
- Small boxes for mailing.

Sample size and condition

- Samples of paint should be at least 1" by 1 1/4"; the larger, the better.
- Do not submit samples mixed with dirt or soil.
- Samples should contain all layers of paint down to the wood or plaster surface.

Sample collection

- On a strip of tape or label, identify the exact location where the sample was taken (for example, ceiling, room #2, first floor, 1700 Main Street, Washington, D.C.).
- Affix the label to the outside of the baggy near the top.
- Using the knife or scalpel, score the area of paint in question to an appropriate size, lift the paint off by sliding the thin blade along the score and underneath the paint, and remove a section down to the wood or plaster, making sure all layers of paint are intact. Care should be taken to avoid including wood, paper, or plaster in the sample.
- Place the sample into the corresponding prelabeled baggy and secure with the zip-lock mechanism.
- Using a separate baggy, collect the next sample following the above procedures. Do not put more than one sample in a bag.

If samples are mailed:

- Use boxes.
- Seal the boxes securely so that samples don't leak out.
- Enclose the samples and mail.

Appendix 3-5 -- LABORATORY METHODS: XRF, ATOMIC ABSORPTION, AND ICP-AES

X-ray Fluorescence

Computer-enhanced x-ray fluorescence (XRF) analyzers are used to analyze the lead content of samples. These laboratory models use the same principle of operation as the portable models: a radiation source strikes the sample, exciting the atoms. As the atoms return to the ground state, they emit x-rays which are used to determine the elements and their concentrations in the sample. (The laboratory XRF looks at a different energy region than the portable XRF.) The x-rays are detected by the XRF, which converts them to electrical signals that are displayed as spectra on the computer screen. These spectra are compared to standards that are stored in a computer and can be visually laid over the sample spectra. This allows the technician to determine the sample concentration.

Laboratory XRFs are generally expensive, but they provide a very rapid (less than 5 minutes/sample) and accurate method of analysis, if properly used.

Atomic Absorption

Flame atomic absorption spectrophotometry (AAS) is the most widely used method for analyzing air, dust, and paint samples for lead. The sample is digested in acid, then atomized in the flame of a burner. The atoms that become "excited" are measured by a detector; a hollow cathode lamp provides the light source in the wavelength of interest. The results are displayed as a peak or as a digital readout (where a computer calculates the quantity o the element in question). This method is highly specific for lead.

The sensitivity of this method is adequate for lead provided an adequate quantity is submitted in the sample. This is generally not a problem in the analysis of paint chips, which typically contain high quantities of lead, but it may be a problem with air or dust sample analysis. The recommended air sampling volume in an industrial environment is 200 liters, so even larger samples would be required in a nonindustrial environment.

To overcome this limitation, atomic absorption with a graphite furnace is used. Here, the ashed sample is delivered to a graphite furnace and the absorbance is read as peak height on a recorder or on an electronic readout. The major advantage of the graphite furnace method is that it is more sensitive by one or two orders of magnitude than flame atomic absorption. Also, the sample solution prepared for the AAS can be used in the graphite furnace method. The main disadvantage is that the analysis is more time-consuming and the equipment is more expensive. This method, as used to analyze air samples, can be found in NIOSH Analytical Method 214. The NIOSH Atomic Absorption Spectrophotometry method (non-graphite furnace) for measuring lead in air is Analytical Method 7082.

Two methods measuring total lead have been reported by the EPA in conjunction with the Superfund Soil Lead Abatement Demonstration Project: nitric acid extraction and a cold nitric acid digestion. The EPA has determined that the results of these methods are comparable to one another and to those achieved when using an XRF (laboratory model) if the sample contains less than 5,000 parts per million lead. Above 5,000 ppm, both the cold nitric acid digestion and the XRF method were found to underestimate the lead concentrations.

The amount of lead in the paint is recorded as a percent of the total weight of the sample. If the paint chip is attached to a chip of wood, the results will be diluted accordingly. Samples must be collected carefully so as to minimize contamination with non-paint materials, and laboratory analysts must minimize the amount of non-paint materials that constitute the sample being analyzed.

Inductively Coupled Argon Plasma-Atomic Emission Spectroscopy (ICP-AES)

In ICP-AES, the sample is treated with acids to dissolve the elements. It is then reduced to a fine spray and introduced into an inductively coupled argon plasma where the emission spectra is monitored. The methods used are such that each particular wavelength monitored corresponds to an individual element.

For lead, the size of the peak at a wavelength of 220.4 nm is measured. This method, as it is used to determine the amount of lead in air samples, is described in detail in the NIOSH Analytical Method 7300. This method has a very large analytical range, making the use of sample preconcentration, scale expansion, and sample dilutions unnecessary in most cases.

Laboratory Quality Assurance/Quality Control

By blind insertion into the sample stream, the inspector will provide the following blanks at the indicated frequency:

Field blank	1/field sampling day
Sample blank	1/field sampling day

Field blanks and sample blanks are collected in the same manner. To collect a blank "air" sample, the inspector should open and close the sample container during the collection of one of the "real" samples, then close it and return it to the lab for analysis. To collect a blank "wipe" sample, the inspector should open the sample container, place a towel in it (folded as if it had been used to collect a sample), close the container, and return it to the lab for analysis. (The inspector should throw out the first wipe from the package, since it is likely to be contaminated.) The field blank should be analyzed directly with no further treatment. The sample blank should be analyzed after it has passed through the sample stream, including storage and sample preparation. The field blank represents contamination added in the field, during storage and sample preparation, while the sample blank represents contamination added in the field and during storage and sample preparation..

The following laboratory QA/QC work is included for completeness and should be used when contracting with a laboratory for sample analysis.

The laboratory is responsible for analyzing the field blank, the sample blank, and a reagent blank. Reagent blanks are required for all methods using reagents; one blank is required for 3 reagent batches. The field blank can be analyzed directly with no further treatment. The sample blank can be analyzed after it has passed through the sample stream.

Additionally, split samples (duplicate) analyses and spiked samples should be determined, as follows:

Split samples	1/20 samples
Spiked samples	1/20 samples

The spiked air and wipe samples will be prepared by mixing dried lead dust of known concentration with the sample. Spiked samples may be used at the discretion of the project director. Additional split samples will be sent to a designated QA/QC laboratory for analysis.

Appendix 3-7 -- RECOMMENDED PROCEDURES for WIPE SAMPLING

Materials needed

- o Wipes consisting of commercial wipes moistened with a non-alcohol wetting agent.
- o Plastic template (1 foot by 1 foot).
- o Measuring tape.
- o Marking pen.
- o 50 ml. polypropylene tube.
- o Pack to carry tubes.
- o Sample sheet (see Appendix 3-8).
- o Disposable gloves.

Sample size

A 1 square foot plastic template should be used when samples are taken from the floor. When window sills and wells are sampled, the length and width of the area is measured in inches. One square foot is sampled according to the formula:

$$\frac{\text{Length X Width}}{144} = \text{Square foot}$$

Sample collection

- Identify and document all areas to be sampled, beginning in one room. Documentation should include:
  - o Location of sample. (See Table 3.5 of this manual for recommended locations of samples. Samples from the floor should be taken near the edge of the room, not the center of the room.)
  - o Surface type (floor, sill, well).
  - o Surface material (wood, metal).
  - o Surface area measurements.
  - o Abatement status (abated, not abated).
  - o Abatement method if known.

- Put on disposable gloves (to prevent sample contamination by lead on the hands).
- Throw the first wipe away, since it is likely to be contaminated. Place the second wipe in a tube to submit to the laboratory as a blank.
- Sample areas from low to high lead, to the extent that this is known.
- Place a wipe flat on the surface to be sampled. Rub the wipe in an "S" pattern once over the entire measured area. (Do not scrub.) Fold the wipe in half, folding the dust into the wipe, and rub once over the surface again, at a 90 degree angle to the first "S". Fold the wipe and place it in a tube.
- Mark the tube with the sample number, location, and surface (sill, well, floor).
- Change gloves after each sample is taken.
- Use the same sampling technique for every sample. For example, use the same amount of pressure when wiping the surface at each sample location. Changing the technique may change the results.
- Submit the samples to the laboratory for analysis. Levels greater than 200

ug/sq. ft. (floors), 500 ug/sq. ft. (sills) and 800 ug/sq. ft. (wells) indicate that dust levels are too high and the dwelling should be recleaned. (A level of 200 ug/sq. ft. should be achievable on windows or other components that have been replaced.) These levels represent the amount of lead in a given area, not the percent of lead in dust. These levels, which are standards in Maryland and Massachusetts, were developed based on determining the amount of absorbed ("bioavailable") lead in the sample area.

Appendix 3-8 -- Documentation Form for Wipe Sampling

SAMPLE SHEET - ANALYSIS FOR LEAD IN DUST

Date: ______________________ Lab: ______________________

Samples Collected by: ______________________

Occupant's Name: ______________________

Address: ______________________

Contractor's Name: ______________________

Address: ______________________

Date and Time Work Completed: ______________________

HEPA Filtration Unit Use: No. ____________ Capacity ____________

Sample Type: Initial test ____________ Retest ____________

Housing Condition: Good ______ Substandard ______ Grossly Substandard ______

For the Following Codes, See Back of This Form

SAMPLE NO.	LOCATION	SURFACE CODE 1 2	MATERIAL CODE 3	METHOD CODE 4	AREA IN INCHES (lxw)	LABORATORY RESULTS (mcg. Pb per sq. ft.)	ANALY-TICAL METHOD CODE 5

Date Received: ____________ Reported ______ ______ Analyst: ___ ______

Remarks: ______________________

Interpretation of Results

Threshold Limit: Floor: 200 $\mu g/ft^2$ Window sill: 500 $\mu g/ft^2$
Window well: 800 $\mu g/ft^2$ (200 $\mu g/ft^2$ should be achievable on components that have been replaced.)

CODE

1 SURFACE
- F Floor
- S Sill
- W Wall
- O Other

2 SURFACE CONDITION
- S Smooth
- R Rough
- O Other

3 MATERIAL
- W Wood
- V Vinyl
- C Concrete
- P Plaster,
- A Aluminum
- B Brick
- O Other

4 REMOVAL METHOD
- 1 Heatgun
- 2 Replace
- 3 Dipped
- 4 Encapsulated
- 5 Sander - HEPA attached
- 6 Sander - No HEPA attached
- 7 Sand-blasting - dry
- 8 Sand blasting - mist or wet
- 9 Peel away
- 10 Solvent

5 ANALYTICAL METHOD
- A Atomic Absorption Spectrophotometry
- X X-ray Fluorescence

APPENDIX 4

Items to Support Chapter 1

4.1 Work Design for Force Account

4.2 A suggested notification to occupants regarding the possible existence of lead paint

Appendix 4.1

WORK DESIGN FOR FORCE ACCOUNT

The key to success in using Force Account is careful selection of the work that Force Account will perform. HUD wage scales, for the most part, preclude competing in the open market for the best craftsmen that can be found. Therefore, the work must be selected and designed to be accomplished by workers who either have moderate skills or can be trained by one of several workers who can be trained by one of several highly skilled crew members. Also, there are specialized types of work in which there is enough competition among available contractors that Force Account may not be cost effective.

The Force Account crew must be adequate for the work to be performed. Each crew is headed by a supervisor and an assistant. The crews are divided into teams of specialized craftsmen. The interior renovations in process in multiple communities can be done in a unit-sequence manner, .e., a team does its work in an apartment unit and moves on to the next sequential unit. The following specialized team moves into the unit the previous team just finished.

Suggested sequence for work-flow planning:

a. Divide the work into logical steps by craft.

b. Expand or contract the steps by sequentia: portions of the work that can or cannot be performed concurrently. Allow for drying time when using liquid materials of any kind.

c. Determine the desired number of units to be completed per period based on budget constraints and HUD required time for completion. This number should reflect a whole number of days that each crew will spend in a unit, i.e., 1,3 days. Experience has shown that scheduling a crew into a unit for a fraction of a day is unmanageable and is difficult for crew members to visualize as a deadline.

d. Determine the number of days between unit completions per 3c. above. This will be the maximum number of days that a single crew of craftsmen can work in a unit.

e. Determine crew size necessary to accomplish the work within this number of available days. If the scope of work in a unit is too great for a manageable crew to accomplish within this number of days, then that crew may have to be split into either phase 1 and phase 2 crews (each doing their portion of the work in the al owable days) or two separate crews working in alternate units for twice the maximum number of days, giving a net crew time-in-unit equal to the maximum allowable. If the scope of work in a unit is too small for a crew to use the number of days available, consider using some or all of the crew to augment or replace other crews during the unutilized portion of the allowable time-in-unit.

f. Determine the minimum number of days for completion of a unit by multiplying separate blocks of work by the allowable time-in-unit. Insert one or more blocks of "dead" time into the sequence to allow for absences, foul-ups, or unit-specific unplanned-for repairs. It is, however, vital that the crew in the block preceding "dead" time understands that the following block does not constitute a "soft" deadline for its work. The placement within the sequence of this time will depend on the owner's past experience with the project's problems.

g. Determine the actual number of units that must be available for renovation by adding the number of work and "dead" time blocks together. If the owner is moving residents out of their units ahead of the renovation and moving back in after renovation, extra blocks reflecting relocation preparation and moving time must be added to the total. This final total will be the number of temporary relocation units that must be available if the plan is to work.

h. Publish a schedule and post it at the work site so that every crew member can tell at a glance what he/she is supposed to accomplish.

Appendix 4.2 - A Suggested Occupant Notification Regarding Lead Based Paint

WATCH OUT FOR LEAD-BASED PAINT POISON!!

NOTIFICATION

TO: Renters of Housing Constructed Before 1978

If your residence was constructed before 1978, there is a possibility that it may contain lead-based paint.

PLEASE READ THE FOLLOWING INFORMATION CONCERNING LEAD-PAINT POISONING

The interiors of older homes and apartments often have layers of lead-based paint on the walls, ceilings, window sills, and door frames. Lead-based paint and primers may also have been used on outside porches, railings, garages, fire escapes, and lamp posts. When the paint chips, flakes, or peels off, there may be a real danger for babies and young children.

Children may eat paint chips or chew on painted railings, window sills, or other items when parents are not around. Children can also ingest lead even if they do not specifically eat paint chips. For example, when children play in an area where there are loose paint or dust particles containing lead, they may get these particles on their hands, put their hands into their mouths, and ingest a dangerous amount of lead.

Has your child been especially cranky or irritable? Is he or she eating normally? Does your child have stomach aches and vomiting? Does he or she complain about headaches? Is your child unwilling to play? These may be signs of lead poisoning, although many times there are no symptoms at all. Lead poisoning can eventually cause mental retardation, blindness, and even death.

If your child is seven [7] years old, or younger, you should have him/her tested for lead poisoning. If the test shows that your child has an elevated blood lead level, treatment is available. Contact the local Health Department for help or more information.

Inform other family members and baby sitters of the dangers of lead poisoning. You can safeguard your child from lead poisoning by preventing him or her from eating paint that may contain lead.

Look at your walls, ceilings, door frames, window sills. Are there places where the paint is peeling, flaking, or chipping? If so, there are some things you can do immediately to protect your child:

1. Write the owner of your housing unit and inform him/her of the problem.

2. Write the Housing Authority and describe the problem.

3. Gather up all pieces of paint and plaster and put them in a paper bag or wrap them in newspaper. Put these packages in the trash can. DO NOT BURN THEM.

4. Do not leave paint chips on the floor. Damp mop floors to remove all dust and paint particles. Keeping the floor clear of paint chips, dust, and dirt is easy and very important.

5. Do not allow loose paint to remain within your children's reach since children may pick loose paint off the lower part of the walls.

AS A RENTER

You should notify the Housing Authority and the Landlord immediately if the unit in which you live has flaking, chipping, or peeling paint; water leaks from faulty plumbing; or defective roofs. You should cooperate with the landlord's efforts to repair any deficiencies and keep ;your unit in good shape. When lead-based paint is removed by scraping or sanding, a hazardous dust is created which can enter the body either by breathing or swallowing the dust. The use of heat or paint removers could create a vapor or fume which may cause poisoning if inhaled over a long period of time. Whenever possible, the removal of lead-based paint should take place when there are no children and pregnant women on the premises.

Remember that you as a parent play a major role in the prevention of lead poisoning. Your actions and awareness about the lead problem can make a big difference.

I have received a copy of the Notice entitled, "Watch Out for Lead Paint Poisoning" and a copy of "The Danger of Lead Poisoning to Renters."

____
Signature

____
Date

APPENDIX 5

ITEMS TO SUPPORT CHAPTER 5

5.1 Excerpts from Regulations

5.2 Forms/Notices

EXCERPTS FROM REGULATIONS

Lead Dust Standards

Maryland (26.02.07 Procedures for Abating Lead Containing Substances from Buildings)

.12-K A lead abatement project shall be deemed to be in compliance with these regulations if:

(1) Floor lead dust levels are below 200 micrograms per square foot;

(2) Windowsill lead dust levels are below 500 micrograms per square foot;

(3) Window well lead dust levels are below 800 micrograms per square foot; and

(4) All abated surfaces and all floors have been treated to provide smooth and easily cleanable surfaces.

Massachusetts - Draft (105 CMR 460.000: Prevention and Control of Lead Poisoning)

460.170 B The dealing contractor shall be deemed to have satisfied the lead dust monitoring protocol if:

(1) Floor lead dust levels are below 200 micrograms per square foot;

(2) Windowsill lead dust levels are below [illegible]00 micrograms per square foot;

(3) Window trough lead dust levels are below 800 micrograms per square foot.

Training and Certification Requirements

Connecticut - Draft (Regulations for Lead Poisoning Prevention and Control)

13.1 Certification of Lead Abatement Contractors and Lead Inspectors
On and after one year following the effective date of these regulations, no person shall provide services as an lead abatement contractor or as a lead inspector in this state without being certified by the Commissioner. Applications for such certificate shall be made to the department on forms provided by it, and shall contain such information regarding the applicant's qualifications as the department may require in of these regulations. Lead abatement, except for a small project as defined by these regulations, must be performed by a certified lead abatement contractor.

13.2 Lead Abatement Workers

Any person employed as an lead abatement worker shall have completed at least a 15 hours approved training course as outlined below or the course required under 13.2(c)(2). The worker training course shall include lectures, demonstrations, at least (3) hours of hands-on training, individual respirator fit testing, course review, and a written examination. Successful completion of the course shall be demonstrated by achieving a score of at least 70% on the examination. The course shall adequately address the following topics:

Maryland (26.02.07 Procedures for Abating Lead Containing Substances from Buildings)

.11 Health and Safety Training

A. Within the 5 years immediately before beginning work on a lead abatement project, all inspectors involved in the enforcement of these regulations, and all workers involved in a lead abatement project shall have taken a qualifying training course which meet the requirements set out in B, and have received a certificate of completion.

Massachusetts - Draft (105 CMR 460.000: Prevention and Control of Lead Poisoning)

460.420 Training and Licensure of Deleaders

A. Upon the date indicated in 454 CMR 22.00, only those persons, firms, corporations or other entities duly licensed as deleaders may conduct lead paint removal or covering.

B. Unlicensed deleaders may conduct deleading under such conditions specified in 454 CMR 22.00.

C. Upon the effective date of applicable regulations promulgated by the Department of Labor and Industries, all persons employed in performing building rehabilitation or renovation in a manner that disturbs paint, plaster or other materials containing dangerous levels of lead, shall meet any licensing requirements and/or follow specified safety procedures.

FORM/NOTICES

CLEARANCE NOTICE TO OCCUPANTS

DRAFT

NOTICE TO OCCUPANTS OF
CLEARANCE
AFTER A LEAD PAINT ABATEMENT PROJECT

Date:

Dear Occupant:

This is to notify you that the dwelling located at ________________________ ____________________________________ has been cleared for reoccupancy as a result of Lead Paint Abatement. This abatement work was necessary in order to address potentially hazardous conditions in your dwelling, such as lead paint and lead dust. Although this abatement was performed in a very careful and comprehensive way, it is possible that additional lead hazards may occur, especially if the dwelling is not properly mainta ned and cleaned regularly. Consequently, it is important to keep your dwelling well maintained and clean at all times. Do not let painted surfaces deteriorate. At the first sign of peeling paint repaint these surfaces. Pay special attention to surfaces where lead dust may reaccumulate, such as floors, window sills and window well. These surfaces should be regularly washed with a high phosphate detergent because this type of detergent seems to work best in helping remove lead dust. Remember, you can help to keep your dwelling safe by keeping it clean and in good condition.

Be Healthy,

(Signature)

APPENDIX 6

Appendices to Support Chapter 6

THE RESOURCE CONSERVATION AND RECOVERY ACT (RCRA)

Defining Solid and Hazardous Wastes

Solid wastes include such diverse wastes as household trash, sewage sludge, and discarded industrial materials. Solid wastes are not, however, necessarily solid. They may be liquid, semisolid, or gaseous. The term "solid waste" is further defined in Section 1004(27) of RCRA as follows:

> The term 'solid waste' means any garbage, refuse, sludge, from a waste treatment plant, water supply treatment plant, or air pollution control facility and other discarded material, including solid, liquid, semisolid, or contained gaseous material resulting from industrial, commercial, mining, and agricultural operations, and from community activities, but does not include solid or dissolved material in domestic sewage, or solid or dissolved materials in irrigation return flows or industrial discharges which are point sources subject to permits under Section 402 of the Federal Water Pollution Control Act, as amended (86 Stat. 880), or source, special nuclear, or byproduct material as defined by the Atomic Energy Act of 1954, as amended (68 Stat. 923).

Hazardous wastes are a sub-category of solid wastes. They can be solid, liquids, or gases. They may appear in a variety of forms:

- In barrels or drums.
- In pits, ponds, or lagoons.
- In sludges.
- As part of contaminated soil.
- In bottles or other fragile or nondurable containers.
- In aboveground or underground storage tanks.
- As part of building materials (e.g., asbestos).

In general, a waste is considered hazardous if it can endanger human health or damage the environment. Congress defined the term "hazardous waste" in Section 1004(5) of the Resource Conservation and Recovery Act (RCRA) of 1976 (42 U.S.C. S6901 et seq.) as follows:

The term 'hazardous waste' means a solid waste, or combination of solid wastes, which because of its quantity, concentration, or physical, chemical or infectious characteristics may:

> (A) cause, or significantly contribute to an increase in mortality or an increase in serious irreversible, or incapacitating reversible, illness; or,
>
> (B) pose a substantial present or potential hazard to human health or the environment when improperly treated, stored, transported, or disposed of, or otherwise managed.

EPA has expanded RCRA's definition of a hazardous waste to mean a solid waste that meets one of four conditions:

- o It shows by observation or testing to have any of the four characteristics of hazardous waste (ignitable, reactive, corrosive, or toxic).
- o It has been named and listed (see below) as a hazardous waste.
- o It is a mixture containing a listed hazardous waste and a non-hazardous waste solid (unless the mixture is explicitly excluded or no longer exhibits any other four characteristics of hazardous waste).
- o It is not excluded from regulation as a hazardous waste.

Listing of Hazardous Wastes

The U.S. Environmental Protection Agency (EPA) has determined that certain wastes are hazardous. These wastes are incorporated into lists published by EPA. Wastes on these lists must always be handled as hazardous wastes regardless of their concentrations. The lists expand and change as new research and testing are performed; therefore, it is important to consult the lists periodically.

The lists are organized into three categories: 1) source-specific wastes (wastes from specific industries); 2) generic wastes (wastes from common manufacturing and industrial process, such as solvents); and 3) commercial chemical products (such as creosote and some pest cides). The hazardous wastes associated with lead-based paint are generic wastes and commercial chemical products.

Any waste mixture containing one or more hazardous wastes that appear on the EPA lists is also considered a hazardous waste. This applies regardless of the percentage of the mixture that is listed as hazardous waste. There are several exemptions to this mixture rule.

If the solid waste is not included in the EPA list of hazardous wastes, or is not a mixture that contains one of these wastes, it may still be a hazardous waste if testing shows it to be ignitable, corrosive, reactive, or toxic. EPA's definition of these characteristics is contained in 40 CFR, Sections 261.20 to 261.24. The standard measures specified by EPA to test for these properties are summarized in Table 6-1.

The Resource Conservation and Recovery Act (RCRA) was passed in 1976 to address the problems posed by the improper disposal of municipal and industrial wastes. RCRA was amended in 1980 and again in 1984. The goals of RCRA are to protect human health and the environment; reduce waste and conserve energy and natural resources; and reduce or eliminate the generation of hazardous waste as expeditiously as possible. Two programs developed under RCRA affect disposal of wastes generated during lead-based paint abatement:

- o Subtitle D governs the management of solid wastes, primarily nonhazardous wastes.

- Subtitle C controls hazardous waste from the time it is generated until its ultimate disposal.

Subtitle D

Subtitle D ensures the proper management of solid wastes. EPA has established standards (commonly called Subtitle D Criteria) covering the operation of municipal solid waste landfills. These standards are designed to eliminate the hazards associated with:

- Flooding of solid waste landfills.
- Reducing the habitat of endangered species.
- Contamination of surface water.
- Contamination of ground water.
- Contamination of food supplies.
- Air pollution.
- Public safety risks at landfills.

Facilities that don't comply with these Criteria are classified as "open dumps" and must either close or upgrade their operations.

Some municipal solid waste landfills receive smal quantities of hazardous waste from households and industrial facilities that generate wastes in quantities too small to be covered under EPA's hazardous waste program. To guard against the hazards of these wastes and to further ensure that municipal solid waste landfills operate safely, EPA is currently revising its regulations. The revised regulations will:

- Place restrictions on new and existing municipal solid waste landfills from being constructed in floodplains, wetlands, seismic zones, and areas near airports.
- Require municipal solid waste landfills to provide operating controls, such as cover material, explosive gas controls, and run-on/run-off controls. States will have the authority to require other controls, such as liners and leachate collection systems where necessary.
- Require these landfills to test ground water periodically to ensure the drinking water supplies will not be contaminated.
- Require municipal solid waste landfills to take steps to protect the health of citizens living near the facility and to clean up contaminants escaping from the landfills.

EPA encourages states to develop and implement their own solid waste management plans. A state's plan outlines the steps it will take to ensure that the solid waste within its borders is managed safely. The plan also details ways to conserve and recover resources wherever possible. Approximately one-half of the states have EPA-approved plans in place.

Subtitle C

Subtitle C ensures proper management of hazardous waste from the moment the waste is generated until its ultimate disposal. Subtitle C regulations contain administrative requirements for permits and procedures for three categories of hazardous waste handlers: 1) generators; 2) transporters; and 3) owners or operators of treatment, storage, and disposal facilities.

Generators are any individuals or facilities that produce a substantial quantity of hazardous waste. Generators must oversee the ultimate fate of the waste, and may choose to dispose of the waste either on-site or off-site. Lead-based paint abatement contractors will transport their wastes offsite. In order to transport their wastes, contractors must obtain an EPA identification number for each site at which hazardous waste is generated and, if necessary, a state identification number. Transporters pick up waste from generators and ship it to facilities that treat, store, or dispose of hazardous wastes.

Treatment facilities use various processes to destroy hazardous waste or render it harmless. Storage facilities temporarily hold hazardous waste until it is treated or disposed of. Disposal facilities are the permanent locations for hazardous wastes. All three types of facilities must have an EPA identification number and a permit from EPA or a state authority in order to operate. In addition, all of these facilities may store up to 132,000 pounds (6,000 kilograms) of hazardous waste on-site for 180 days without a permit, providing an employee is on-site or on-call to handle an emergency. If the waste is shipped over 200 miles to a facility, the same amount of waste can accumulate onsite for 270 days without a permit.

States are encouraged to run their own hazardous waste programs. For a state to have jurisdiction over its hazardous waste program, it must receive approval from EPA by showing that its program is at least as stringent as the EPA program.

TABLE 6-1

CHARACTERISTICS OF HAZARDOUS WASTES DEFINED BY EPA

Ignitability

EPA considers wastes with the following characteristics of ignitability to be hazardous:

- Liquids with a flash point (the temperature at which the vapor easily ignites in air) less than 140° F. (The only exceptions are aqueous alcohol solutions containing 24 percent by volume or less of alcohol.)
- Materials that are not liquids and are capable, under standard temperature and pressure, or causing a fire by means of friction, absorption of the moisture, spontaneous chemical changes.
- Materials that burn so vigorously and persistently when ignited that they create a hazard.
- Ignitable compressed gases.
- Oxidizers.

Corrosivity

EPA considers wastes with the following characteristics of corrosivity to be hazardous:

- Aqueous wastes with a pH less than or equal to 2 or greater than or equal to 12.5.
- Liquid wastes that corrode steel at a rate equal to or greater than 0.25 inches per year at a test temperature of 130° F.

Reactivity

EPA considers wastes with the following characteristics of reactivity to be hazardous:

- Materials that are normally unstable and readily undergo violent change without detonating.
- Materials that react violently with water.
- Materials that form potentially explosive mixtures with water.
- Materials that, when mixed with water, will generate toxic gases, vapors, or fumes in quantities sufficient to endanger human health or the environment.

TABLE 6-1 (continued)

Reactivity (continued)

- o Cyanide- or sulfide-bearing materials that, when exposed to a pH between 2 and 12.5, can generate sufficient quantities of toxic gases, vapors, or fumes to present a danger.
- o Materials capable of detonation or explosive reaction if subject to a strong initiating source or if heated under confinement.
- o Materials that are readily capable of detonation or explosive decomposition or reaction at standard temperature and pressure.
- o Forbidden explosive of Class A (primers, dynamite, and other high-energy explosives) and Class B (propellants, and other low-energy explosives).

Toxicity

EPA defines as toxic those wastes that qualify under the terms of EPA's Extraction Procedure, a test that identifies hazardous concentrations of a constituent in ground water, and the National Interim Primary Drinking Water Standards (NIPDWS). The following steps summarize the determination procedures:

- o Constituents are extracted from the wastes in a manner designed to simulate the leaching action that occurs in landfills.
- o This extract is analyzed to determine whether it posssesses any toxic contaminants identified in NIPDWS.
- o If the extract contains any of the contaminants in concentrations 100 times greater than that specified in NIPDWS, the waste is considered hazardous.
- o If the original solid waste stream contains less than 0.5% solid matter, then technicians analyze the original solid waste stream rather than the leachate.

Source: Code of Federal Regulations, Title 40, Part 261, Subpart C, Section 261.24

Note: EPA issued a "supplemental notice of proposed rulemaking" on May 18, 1987, stating its plan to define some industrial wastes as hazardous based on the type of unit in which they are managed. If adopted, the plan would represent a change in EPA's usual method of identifying wastes as hazardous through their chemica and physical properties.

Appendix 6-2 -- EPA Regional Offices

EPA Region I
State Waste Programs Branch
JFK Federal Building
Boston, Massachusetts 02203
(617) 223-3468

Connecticut, Massachusetts, Maine, New Hampshire, Rhode Island, Vermont

EPA Region II
Air and Waste Management Division
26 Federal Plaza
New York, New York 10278
(212) 264-5175

New Jersey, New York, Puerto Rico, Virgin Islands

EPA Region III
Waste Management Branch
841 Chestnut Street
Philadelphia, Pennsylvania 19107
(215) 597-9336

Delaware, Maryland, Pennsylvania, Virginia, West Virginia, District of Columbia

EPA Region IV
Hazardous Waste Management Division
345 Courtland Street, N.E.
Atlanta, Georgia 30365
(404) 347-3016

Alabama, Florida, Georgia, Kentucky, Mississippi, North Carolina, South Carolina, Tennessee

EPA Region V
RCRA Activities
230 South Dearborn Street
Chicago, Illinois 60604
(312) 353-2000

Illinois, Indiana, Michigan, Minnesota, Ohio, Wisconsin

EPA Region VI
Air and Hazardous Materials Division
1201 Elm Street
Dallas, Texas 75270
(214) 767-2600

Arkansas, Louisiana, New Mexico, Oklahoma, Texas

EPA Region VII
RCRA Branch
726 Minnesota Avenue
Kansas City, Kansas 66101
(913) 236-2800

Iowa, Kansas, Missouri, Nebraska

EPA Region VIII
Waste Management Division (8HWM-ON)
One Denver Place
999 18th Street, Suite 1300
Denver, Colorado 80202-2413
(303) 293-1502

Colorado, Montana, North Dakota, South Dakota, Utah, Wyoming

EPA Region IX
Toxics and Waste Management Division
215 Fremont Street
San Francisco, California 94105
(415) 974-7472

Arizona, California, Hawaii, Nevada, American Samoa, Guam, Trust Territories of the Pacific

EPA Region X
Waste Management Branch (MS-530)
1200 Sixth Avenue
Seattle, Washington 98101
(206) 442-2777

Alaska, Idaho, Oregon, Washington

State Hazardous Waste Agencies

ALABAMA
Alabama Department of Environmental Management
Land Division
1751 Federal Drive
Montgomery, AL 36130

ALASKA
Department of Environmental Conservation
Air and Solid Waste Management
Pouch O
Juneau, AK 99811

AMERICAN SAMOA
Environmental Quality Commission
Government of American Samoa
Pago Pago, American Samoa 96799

ARIZONA
Arizona Department of Health Services
Office of Waste and Water Quality Management
2005 North Central Avenue
Phoenix, AZ 85004

ARKANSAS
Department of Pollution Control and Ecology
Solid and Hazardous Waste Division
P.O. Box 9583
8001 National Drive
Little Rock, AR 72219

CALIFORNIA
Department of Health Services
Toxic Substances Control Programs
714 P Street
Sacramento, CA 95814

State Water Resources Control Board
P.O. Box 100
Sacramento, CA 95801

California Waste Management Board
1020 Ninth Street, Suite 300
Sacramento, CA 95814

COLORADO
Colorado Department of Health
Waste Management Division
4210 E. 11th Avenue
Denver, CO 80220

COMMONWEALTH OF NORTHERN MARIANA ISLANDS
Division of Environmental Quality
Commonwealth of the Northern Mariana Islands
Office of the Governor
Saipan, Mariana Islands 96950

CONNECTICUT
Department of Environmental Protection
Hazardous Material Management Unit
State Office Building
165 Capitol Avenue
Hartford, CT 06106

Connecticut Resource Recovery Authority
179 Allyn Street, Suite 603
Professional Building
Hartford, CT 06103

DELAWARE
Department of Natural Resources and Environmental Control
Solid Waste Management Branch
P.O. Box 1401
Dover, DE 19903

DISTRICT OF COLUMBIA
Department of Consumer and Regulatory Affairs
Pesticides and Hazardous Waste Materials Division
5010 Overlook Avenue, S.W.
Washington, DC 20032

FLORIDA
Department of Environmental Regulation
Solid and Hazardous Waste Section
Twin Towers Office Building
2600 Blair Stone Road
Tallahassee, FL 32301

GEORGIA
Land Protection Branch
Industrial and Hazardous Waste Management Program
Floyd Towers East
205 Butler Street, S.E.
Atlanta, GA 30334

GUAM
Guam Environmental Protection Agency
P.O. Box 2999
Agana, Guam 96910

HAWAII
Department of Health
Environmental Health Division
P.O. Box 3378
Honolulu, HI 96801

IDAHO
Department of Health and Welfare
Bureau of Hazardous Materials
450 West State Street
Boise, ID 83720

ILLINOIS
Environmental Protection Agency
Division of Land Pollution Control
2200 Churchill Road
Springfield, IL 62706

INDIANA
State Board of Health
Division of Land Pollution Control
1330 West Michigan Street
Indianapolis, IN 46206

IOWA
U.S. EPA Region VII
Hazardous Materials Branch
726 Minnesota Avenue
Kansas City, KS 66101

KANSAS
Department of Health and Environment
Bureau of Waste Management
Forbes Field, Building 321
Topeka, KS 66620

KENTUCKY
Cabinet for Natural Resources and Environmental Protection
Department of Environmental Protection
Division of Waste Management
Ft. Boone Plaza, Building #2
18 Reilly Road
Frankfort, KY 40601

LOUISIANA
Office of Solid and Hazardous Waste
Hazardous Waste Division
Department of Environmental Quality
P.O. Box 44307
Baton Rouge, LA 70804

MAINE
Department of Environmental Protection
Bureau of Oil and Hazardous Materials Control
State House Station #17
Augusta, ME 04333

MARYLAND
Maryland Waste Management Administration
Office of Environmental Programs
Department of Health and Mental Hygiene
201 W. Preston Street
Baltimore, MD 21201

MASSACHUSETTS
Department of Environmental Quality Engineering
Division of Solid and Hazardous Waste
One Winter Street
Boston, MA 02108

MICHIGAN
Environmental Protection Bureau
Hazardous Waste Division
Box 30028
Lansing, MI 48909

MINNESOTA
Pollution Control Agency
520 Lafayette Road North
St. Paul, MN 55155

MISSISSIPPI
Department of Natural Resources
Bureau of Pollution Control
Division of Solid and Hazardous Waste Management
P.O. Box 10385
Jackson, MS 39209

MISSOURI
Department of Natural Resources
Waste Management Program
117 East Dunklin Street
P.O. Box 1368
Jefferson City, MO 65102

MONTANA
Department of Health and Environmental Sciences
Solid and Hazardous Waste Bureau
Cogswell Building
Helena, MT 59620

NEBRASKA
Department of Environmental Control
Hazardous Waste Management Section
State House Station
P.O. Box 94877
Lincoln, NE 68509

NEVADA
Department of Conservation and Natural Resources
Division of Environmental Protection
Waste Management Program
Capitol Complex
201 South Fall Street
Carson City, NV 89710

NEW HAMPSHIRE
Department of Health and Welfare
Division of Public Health Services
Office of Waste Management
Health and Welfare Building
Hazen Drive
Concord, NH 03301

NEW JERSEY
Department of Environmental Protection
Division of Waste Management
32 E. Hanover Street, CN-027
Trenton, NJ 08625

NEW MEXICO
Health and Environment Department
Environmental Improvement Division
Groundwater and Hazardous Waste Bureau
P.O. Box 968
Santa Fe, NM 87504-0968

NEW YORK
Department of Environmental Conservation
Division of Solid and Hazardous Waste
50 Wolf Road
Albany, NY 12233

NORTH CAROLINA
Department of Human Resources
Division of Health Services
Solid and Hazardous Waste Management Branch
P.O. Box 2091
Raleigh, NC 27602

NORTH DAKOTA
Department of Health
Division of Hazardous Waste Management and Special Studies
1200 Missouri Avenue
Box 5520
Bismarck, ND 58502-5520

OHIO
Ohio EPA
Division of Solid and Hazardous Waste Management
361 East Broad Street
Columbus, OH 43215

OKLAHOMA
Oklahoma State Department of Health
Waste Management Service
P.O. Box 53551
1000 N.E. 10th Street
Oklahoma City, OK 73152

OREGON
Department of Environmental Quality
Hazardous and Solid Waste Division
P.O. Box 1760
Portland, OR 97207

PENNSYLVANIA
Pennsylvania Department of Environmental Resources
Bureau of Solid Waste Management
P.O. Box 2063
Harrisburg, PA 17120

PUERTO RICO
Environmental Quality Board
P.O. Box 11488
Santurce, Puerto Rico 00910-1488

RHODE ISLAND
Department of Environmental Management
Solid Waste Management Program
204 Cannon Building
75 Davis Street
Providence, RI 02908

SOUTH CAROLINA
Department of Health and Environmental Control
Bureau of Solid and Hazardous Waste Management
2600 Bull Street
Columbia, SC 29201

SOUTH DAKOTA
Department of Water and Natural Resources
Office of Air Quality and Solid Waste
Foss Building
Pierre, SD 57501

TENNESSEE
Tennessee Department of Public Health
Division of Solid Waste Management
701 Broadway
Customs House
Nashville, TN 37219-5403

TEXAS
Texas Department of Health
Bureau of Solid Waste Management
1100 West 49th Street, T-601A
Austin, TX 78756-3199

Texas Water Commission
Hazardous and Solid Waste Division
1700 North Congress
P.O. Box 13087, Capitol Station
Austin, TX 78711

UTAH
Department of Health
Bureau of Solid and Hazardous Waste Management
P.O. Box 45500
State Office Building
Salt Lake City, UT 84140

VERMONT
Agency of Environmental Conservation
Waste Management Division
State Office Building
Montpelier, VT 05602

VIRGIN ISLANDS
Department of Conservation and Cultural Affairs
P.O. Box 4399, Charlotte Amalie
St. Thomas, Virgin Islands 00801

VIRGINIA
Virginia Department of Health
Division of Solid and Hazardous Waste Management
Monroe Building
101 North 14th Street
Richmond, VA 23219

WASHINGTON
Department of Ecology
Solid and Hazardous Waste Management Division
Mail Stop PV-11
Olympia, WA 98504

WEST VIRGINIA
Division of Water Resources
Solid and Hazardous Waste/Ground Water Branch
1201 Greenbrier Street
Charleston, WV 25311

West Virginia Department of Natural Resources
1800 Washington Street, East
Charleston, WV 25305

WISCONSIN
Department of Natural Resources
Bureau of Solid Waste Management
P.O. Box 7921
Madison, WI 53707

WYOMING
Department of Environmental Quality
Solid Waste Management Program
122 West 25th Street
Herschler Building
Cheyenne, WY 82002

<u>Alabama</u>

Alabama Department of
Environmental Management
Land Division
1751 Congressman W.L. Dickinson
Drive
Montgomery, Alabama 36130
205-271-7730

<u>Alaska</u>

Alaska Department of
Environmental Conservation
Division of Environmental
Quality
P.O. Box 0
Juneau, Alaska 99811-1800
907-465-2666

<u>America Samoa</u>

Environmental Quality
Commission
American Samoan Government
Pago Pago, American Samoa
633-2304 (overseas operator)

<u>Arizona</u>

Arizona Department of
Environmental Quality
Office of Waste Programs
2005 North Central
Phoenix, Arizona 85004
602-257-2318

<u>Arkansas</u>

Arkansas Department of Control
and Ecology
Solid Waste Division
8001 National Drive
P.O. Box 9583
Little Rock, Arkansas 72209
501-562-7444

<u>California</u>

Department of Health Services
Toxic Substances Control
Division
P.O. Box 942732
400 P Street
Sacramento, California 94234-
7230
916-323-2913

California Waste Management
Board
1020 Ninth Street, Suite 300
Sacramento, California 94814
916-322-3330

<u>Colorado</u>

Colorado Department of Health
Hazardous Materials and Waste
Management Division
4210 East 11th Avenue
Denver, Coloado 80220
303-331-4830

<u>Connecticut</u>

Connecticut Department of
Environmental Protection
Solid Waste Management Unit
165 Capitol Avenue
Hartford, Connecticut 06106
203-566-3672

<u>Delaware</u>

Delaware Department of Natural
Resources and Environmental
Control
Division of Air and Waste
Management
89 Kings Highway
P.O. Box 1401
Dover, Delaware 19903
302-736-4764

District of Columbia

Department of Consumer and
Regulatory Affairs
Pesticides and Hazardous Waste
Management Branch
5010 Overlook Avenue, SW
Room 114
Washington, DC 20032
202-783-3194

Florida

Florida Department of
Environmental Regulation
Bureau of Waste Management
2600 Blair Stone Road
Tallahassee, Florida 32399-2400
904-488-0190

Georgia

Georgia Department of Natural
Resources
Land Protection Branch
Industrial and Hazardous Waste
Management Program
205 Butler Street, S.E.
Room 1154
Atlanta, Georgia 30334
404-656-2833

Guam

Guam Environmental Protection
Agency
P.O. Box 2999
Agana, Guam 96910
671-646-8863

Hawaii

Hawaii Department of Health
Environmental Protection and
Health Services Division
1250 Punchbowl Street
Room 325
P.O. Box 3378
Honolu, Hawaii 96813
808-548-4139

Idaho

Department of Health and
Welfare
Division of Environment
Hazardous Materials Bureau
450 West State Street
Boise, Idaho 83720
208-334-5845

Illinois

Illinois Environmental
Protection Agency
Division of Land Pollution
Control
2200 Churchill Road
P.O. Box 19276
Springfield, Illinois 62794-9276
217-782-6760

Indiana

Department of Environmental
Management
Solid and Hazardous Waste
Management
105 S. Meridian Street
Indianapolis, Indiana 46225
317-232-3210

Department of Environmental
Management
Office of Environmental
Response
5500 West Bradbury
Indianpolis, Indiana 46241
317-243-5057

Iowa

Iowa Department of Water, Air,
and Waste Management
900 East Grand Avenue
Henry A. Wallace Building
Des Moines, Iowa 50319-0034
515-281-8852

Kansas

Kansas Department of Health and Environment
Bureau of Waste Management
Forbes Field
Topeka, Kansas 66620
913-296-1607

Kansas

Department of Health and Environment
Bureau of Environmental Remediation
Forbes Field
Topeka, Kansas 66620
913-296-1662

Kentucky

Department of Environmental Protection
Division of Waste Management
18 Reilly Road
Frankfort, Kentucky 40601
502-564-6716

Louisiana

Louisiana Department of Environmental Quality
Office of Solid and Hazardous Waste
P.O. Box 44066
Baton Rouge, Louisiana 70804
504-342-9099

Maine

Maine Department of Environmental Protection
Bureau of Oil and Hazardous Materials COntrol
State House - Station 17
Augusta, Maine 04333
207-289-2651

Maine Department of Environmental Protection
Bureau of Land Quality
State House - Station 17
Augusta, Maine 04333
207-289-2111

Nevada

Division of Environmental Protection
Waste Management Section
201 S. Fall Street, Room 221
Carson City, Nevada 89710
702-885-4670

New Hampshire

Department of Environmental Services
Waste Management Division
6 Hazen Drive
Concord, New Hampshire 03301-6509
603-271-4611

New Jersey

Department of Environmental Protection
Division of Solid Waste Management
401 East State Street
Cn 414
Trenton, New Jersey 08625
609-292-8879

New Mexico

Health and Environment Department
Environmental Improvement Division
Solid and Hazardous Waste Management Program
P.O. Box 968
Santa Fe, New Mexico 87504
505-827-2835

New York

Division of Solid Waste
Department of Environmental Conservation
50 Wolf Road
Albany, New York 12233
518-457-6603

North Carolina

Department of Human Resources
Solid and Hazardous Waste Management Branch
P.O. Box 2091
Raleigh, North Carolina 27602
919-733-2178

North Dakota

State Department of Health
Division of Waste Management and Special Studies
1200 Missouri Avenue, Room 302
Box 5520
Bismarck, North Dakota 58502-5520
701-224-2366

Northern Mariana Islands

Department of Public Health and Environmental Services
Commonwealth of Northern Mariana Islands
Saipan, Mariana Islands 96950
633-6984 (commercial overseas operator)

Ohio

Ohio Environmental Protection Agency
Division of Solid and Hazardous Waste Management
1800 WaterMark Drive
P.O. Box 1049
Columbus, Ohio 43266-0149
614-644-2956

Oklahoma

Oklahoma State Department of Health
Waste Management Service
P.O.Box 53551
1000 N.E. 10th Street
Oklahoma City, Oklahoma 73152
405-271-5338

Oregon

Department of Environmental Quality
Hazardous and Solid Waste Division
811 S.W. Sixth
Portland, Oregon 97204
503-229-5356

Department of Environmental Quality
Environmental Cleanup Division
811 S.W. Sixth Avenue
Portland, Oregon 97204
503-229-5774

Pennsylvania

Department of En ironmental Resources
Bureau of Waste Management
P.O. Box 2063
Fulton Building
Harrisburg, Pennsylvania 17120
717-787-9870

Puerto Rico

Puerto Rico Environmental Emergency Commission
Environmental Quality Board
Del-Parque Avenue, #204
Pumarada Street
Santurce, Puerto Rico 00907
809-722-1175

Rhode Island

Department of Environmental Management
Solid Waste Management Program
204 Cannon Building
75 Davis Street
Providence, Rhode Island 02908
401-277-2808

South Carolina

Department of Health and Environmental Control
Bureau of Solid and Hazardous Waste Management
2600 Bull Street
Columbia, South Carolina 29201
803-734-5200

South Dakota

Department of Water and Natural Resources
Office of Air Quality and Solid Waste
Room 217, Foss Building
523 E. Capitol
Pierre, South Dakota 57501
605-773-3153

Tennessee

Department of Health and Environment
Division of Solid Waste Management
Customs House, 4th Floor
701 Broadway
Nashville, Tennessee 37219-5403
615-741-3424

Texas

Texas Water Commission
Hazardous and Solid Waste Division
P.O. Box 13087
Capitol Station
Austin, Texas 78711
512-463-7760

Department of Health
Division of Solid Waste Management
1100 West 49th Street
Austin, Texas 78756
512-458-7271

Utah

Bureau of Solid and Hazardous Waste
Division of Environmental Health
288 North 1460 West
P.O. Box 16690
Salt Lake City, Utah 84116-0690
801-538-6170

Vermont

Agency of Natural Resources
Department of Environmental Conservation
Waste Management Division
103 S. Main Street
West Building
Waterbury, Vermont 05676
802-244-8755

Virgin Islands

Department of Planning and
Natural Resources
Government of the Virgin
Islands
Division of Environmental
Protection
Building 111, Apartment 114
Christiansted, St. Croix,
Virgin Islands 00820
809-773-0565

Virginia

Department of Waste Management
101 North 14th Street
James Monroe Building, 11th
Floor
Richmond, Virginia 23219
804-225-2667

Washington

Department of Ecology
Solid and Hazardous Waste
Management Program
Mail Stop PV-11
Olympia, Washington 89504-8711
206-459-6030

West Virginia

Department of Natural Resources
Division of Waste Management
1260 Greenbrier Street
Charleston, West Virginia
25311
304-348-5935

Wisconsin

Department of Natural Resources
Bureau of Solid and Hazardous
Waste Management
101 S. Webster Street
Madison, Wisconsin 53703
608-266-1327

Wyoming

Department of Environmental
Quality
Solid Waste Management Program
122 West 25th Street
Herschler Building
CHeyenne, Wyoming 82002
307-777-7752

Appendix 6-5 -- Toxic Contaminants Analyzed by EP Toxicity Test

TOXIC CONTAMINANTS ANALYZED BY EP TOXICITY TEST

Hazardous Waste #	Contaminant	Concentration (mg/l)(ppm)
D004	Arsenic	5.0
D005	Barium	100.0
D006	Cadmium	1.0
D007	Chromium	5.0
D008	Lead	5.0
D009	Mercury	0.2
D010	Selenium	1.0
D011	Silver	5.0
D012	Endrin	0.02
D013	Lindane	0.4
D014	Methoxychlor	10.0
D015	Toxaphene	0.5
D016	2,4-D	10.0
D017	2,4,5-TP Silvex	1.0

Recordkeeping Requirements

Who?	What?	How Long Retained?
Generator	Copy of each manifest	3 years
	Test results	3 years
	Waste analysis	3 years
	Biennial report	3 years
	Exception (manifest) report	Active life
	Training records	Until closure/3 years after employee last worked at facility
	Contingency plan	Active life
	EPA identification number	Active life
Transporter	Identification number	Active life
	Copy of each manifest or shipping document (ship/rail)	3 years
Treatment, Storage, or Disposal Facility*	Notice to foreign generator	Active life
	Waste Analysis Plan & Analysis	Active life
	Site Inspection Program	Active life
	Inspection log & records	3 years
	Personnel training records	Until closure/3 years after employee last worked at facility
	Ignitable, reactive incompatibl waste documentation	Active life
	Agreements/nonagreements with local authority	Active life
	Contingency plans and details of manifests/shipping papers	3 years
	Operating record (8 requirements, such as description, location, quantity, etc., of each waste)	Active life
	Ground-water monitoring data	Active life
	Closure plan cost estimates	Annual update

*All records should become part of the operating ecord.

Appendix 6-7 -- Hazardous Waste Manifest

Please print or type. Form designed for use on elite (12-pitch) typewriter.

UNIFORM HAZARDOUS WASTE MANIFEST

1. Generator's US EPA ID No. | Manifest Document No. | 2. Page 1 of | Information in the shaded areas is not required by Federal law.

3. Generator's Name and Mailing Address

4. Generator's Phone ( )

A. State Manifest Document Number

B. State Gen. ID

5. Transporter 1 Company Name | 6. US EPA ID Number

C. State Trans. ID

D. Transporter's Phone ( )

7. Transporter 2 Company Name | 8. US EPA ID Number

E. State Trans. ID

F. Transporter's Phone ( )

9. Designated Facility Name and Site Address | 10. US EPA ID Number

G. State Facility's ID — Not Required

H. Facility's Phone ( )

11. US DOT Description (including Proper Shipping Name, Hazard Class, and ID Number)	12. Containers No.	Type	13. Total Quantity	14. Unit Wt/Vol	I. Waste No.
a.					
b.					
c.					
d.					

GENERATOR

J. Additional Descriptions for Materials Listed Above (include physical state and hazard code.)

a. | c.

b. | d.

K. Handling Codes for Wastes Listed Above

a. | c.

b. | d.

15. Special Handling Instructions and Additional Information

16. GENERATOR'S CERTIFICATION: [illegible]

[illegible]

Printed/Typed Name | Signature | Date: Month Day Year

TRANSPORTER

17. Transporter 1 Acknowledgement of Receipt of Materials

Printed/Typed Name | Signature | Date: Month Day Year

18. Transporter 2 Acknowledgement of Receipt of Materials

Printed/Typed Name | Signature | Date: Month Day Year

FACILITY

19. Discrepancy Indication Space

20. Facility Owner or Operator Certification of receipt of hazardous materials covered by this manifest except as noted in Item 19.

Printed/Typed Name | Signature | Date: Month Day Year

Appendix 7 -- MEMBERS OF THE NIBS PROJECT COMMITTEE

James Keck - Chairman, Lead Poisoning Prevention Program, Baltimore City Health Dept. Baltimore, Maryland
Richard A. Baker, Springfield/Greene County Public Health Center, Springfield, Missouri
Nancy Bernstine, Council of Large Public Housing Authorities, Washington, D.C.
James Boyle, Operative Plasterers' and Cement Masons' Int'l Association of the United States and Canada, Washington, DC 20036
Harlan R. Bratvold, Underwriters Laboratories, Northbrook, Illinois
Cheryl C. Burke, Esquire, Washington, D.C.
Kenneth W. Byk, Warrington, Inc. Austin, Texas
Ken Campbell, National Association of Lead in Paint Analyzers, Mason, Georgia
Jim Chandlee, National Lead Detection Services, Inc., Roswell, Georgia
Bill Vocke -OS311, Office of Solid Waste, (WH-562B), Washington, D.C.
Brenda Cole, Tufts University, Medford, Massachusetts
C. Edwin Craft, Environmental Protection Systems (EPS-Mid-Atlantic), Chantilly, Virginia
Helen English, Steven Winter Associates, Inc., Washington, D.C.
John Ervin, National Corporation for Housing Partnerships, Washington, D.C.
Dr. Henry Falk, CEHIC/EHHE, Koger Center, F28, Atlanta Georgia
Katherine Farrell, Maryland Dept. of the Environment, Center for Environmental Health, Baltimore, Maryland
Alex Fischberg, Princeton Gamma-Tech, Inc., Princeton, New Jersey
Eugene Z. Fisher, Association of the Wall & Ceiling Industries - International (AWCI), Alexandria, Virginia
Ellis G. Goldman, U.S. Dept. of Housing and Urban Development, Washington, D.C.
Dr. Lester D. Grant, Research Triangle Park, North Carolina
David B. Hattis, Building Technology Inc., Silver Spring, Maryland
Alexander M. Houtzager, Corps of Engineers, Engr & Hsg Support Center, Washington, D.C.
Steve M. Hays, P.E., Gobbell Hays Partners, Inc., Nashville, Tennessee
Richard L. Heimer, Richard L. Heimer PE PC, Huntington Station, New York
William H. Hoffman, QUESTCO Inc., Bethesda, Maryland
Lee C. Jensen, AIA, City of Milwaukee, Dept. of Building Inspection, Milwaukee, Wisconsin
Donald F. Luebs, Upper Marlboro, MD 20772-8731
William J. Lau, Housing Authority of the City of New Jersey, Jersey City, New Jersey
Dr. Jane S. Lin-Fu, Bureau of Maternal & Child Health and Resources Development, Rockville, Maryland
John A. McCauley, Housing Authority of Baltimore City, Baltimore, Maryland
Mary McKnight, Gaithersburg, Maryland
Philip P. Carpenter, Nilfisk of America, Inc., Malvern, Pennsylvania
Miles Mahoney, Brookline, Massachusetts
Khaled Masri, BOMA, Washington, D.C.
Chris T. Matthews, Naval Facilities Engineering Command-HQ, Alexandria, Virginia
Mark L. Matulef, Ph.D., PHM, National Association of Housing and Redevelopment Officials, Washington, D.C.
Carol B. Meeks, College of Home Economics, University of Georgia, Athens, Georgia
James W. Miller, Thomas P. Harkins, Inc., Baltimore, Maryland
Richard A. Morris, National Association of Home Builders, Washington, D.C.
Roger G. Morse, AIA, ENTEK Environmental and Technical Services, Inc., Troy, New York
H. V. Nagendra, S. Stewart Farnet AIA, Arch. & Assoc., Inc., New Orleans, Louisiana

Herbert Needleman, University of Pittsburgh, Pittsburgh, Pennsylvania
Carolyn Newton, U.S. Dept. of Housing and Urban Development, Washington, D.C.
Edward W. Novak, US Army, Construction Engineering Research Laboratory, (CERL), Champaign, Illinois
Angus T. Olson, Alexandria Redevelopment & Housing Authority, Alexandria, Virginia
Stephanie Pollack, Boston, Massachusetts
Brad Prenney, Childhood Lead Poisoning Prevention Program/Mass. DPH, Jamaica Plain, Massachusetts
Tom Ramsey, P.E., (American Council of Independent Labs), SW Labs, Houston, Texas
Anthony Brown, Office of Construction and Maritime Compliance Asst, OSHA, Washington, D.C.
Dr. John Rhodes, Columbia Scientific Industries, Austin, Texas
Michael R. Rowder (Ms.), Chicago Housing Authority, Chicago, Illinois
Maryann M. Russ, Wilmington Housing Authority, Wilmington, Delaware
Don Ryan, House Appropriation Subcommittee on HUD-Independent Agencies, Washington, D.C.
Vince Sandusky, National Painting and Decorating Contractors of America, Fairfax, Virginia
R. M. Santucci, Enterprise Foundation, Columbia, Maryland
Malcolm "Mac" Scott, Lead Testing & Abatement Inc., Sarasota, Florida
James M. Simpson, and Dr. Henry Falk
CEHIC/EHHE, Koger Center, F28, Atlanta, Georgia
Joseph I. Smith, Housing Authority of Savannah, Savannah, Georgia
Ralph Lee Smith, Upper Marlboro, Maryland
Wesley Straub, Kaselaan & D'Angelo Associates, N. Quincy, Massachusetts
Dale Trippler, MN Pollution Control Agency, St. Paul, Minnesota
Carl R. Vander Linden, Vander Linden and Associates, Littleton, Colorado
Richard Wallace, National Lead Detection Services, Inc., Roswell, Georgia
David Weiss, National Association of Realtors, Washington, D.C.
Jim Werner, The Brand Companies, Inc., Park Ridge, Illinois
John Yoder, Lead Industries Association, New York, NY
Amy Zimmerman, New England Consortium of Childhood Lead Poisoning Programs, Rhode Island Dept of Health, Providence, Rhode Island

NIBS PROJECT STAFF

Rudolph W. Kohler

SUBCONTRACTORS

The Eastern Research Group
Susan Guyaux
The Kennedy Institute
Jim McCabe

Appendix 8 - Minority Opinions

Issue #1 - Purpose, Use and Goals of the Guidelines

It is important to clearly identify and state the objective before choosing the method by which it is to be achieved.

It is impossible to judge these Guidelines in isolation. It is not clear how the Guidelines can or will be incorporated into a national program for abating lead paint. To be effective the Guidelines need to be part of a logical process to obtain better data and to delineate a program of action that will succeed. The final goals of the program need to be defined.

Is our goal for the guidelines to achieve the minimum possible dust level? Is it to use the best available technology at the present time, to meet the current standard in selected states, to prevent blood lead levels of greater than 10, 15, 25, or 40 ug/dl in children under 6 years of age, or some other goal? Maybe it should be some combination of the above? The scientific justification for future recommended procedures and target dust lead clean-up levels needs to be adequately presented and referenced.

Lead in the home environment, principally paint lead, is increasingly the dominant source of childhood lead poisoning. Further, lead paint abatement will have to be done in a more rigorous and controlled fashion than in the past, especially as research findings and the public health concern further reduce allowable blood lead levels, both for children and for lead abatement workers. The goal, however, is not a method for lead paint abatement (no matter now good), but rather the elimination of lead poisoning. To achieve final consensus, a Guidelines document will have to be consistent with a detailed, realistic, and credible strategy for eliminating childhood lead poisoning.

The guidelines describe a method (or techniques) to abate paint lead hazards. The selection of a particular method, however, depends on the purpose and goals for which it is to be used. Are we selecting a method to be used in 100 homes or in 2 million homes? Do we want to describe a theoretically best method or propose one that is realistically achievable by most state and local public health, housing, and environmental programs? This document has the caveat that if the total abatement package cannot be adhered to (because of time, cost, or other practical considerations) then other approaches which meet minimum performance standards are acceptable. The report provides minimal guidance on how to make these judgments or decisions. It needs a more balanced presentation of optimal and acceptable approaches.

Issue #2 - Resources to Support a National Lead-Based Paint Abatement Program

Will resources be made available to permit housing authorities and other appropriate groups to follow the guidelines? Where will the resources for such a program come from? I do not feel that the Committee should take this maximal, highly conservative, and very rigorous approach unless the will and resources are present to assure that HUD will follow through fully in what will be an extraordinarily expensive undertaking. There is a real risk that we could end up worse off than before.

The Committee has also heard very little, if anything, about details of the HUD Demonstration Program, and it is not at all clear that the Demonstration Program will provide the necessary answers to the evident data gaps.

Dr. Henry Falk
U.S. Department of Health and Human Services

ISSUE #3: Lack of Guidance for Public Housing Agencies

After reviewing the final draft document and consulting among ourselves, we members of the project committee for NIBS "Guidelines for Testing, Abatement, Clean-up and Disposal of Lead Based Paint" have concluded that the guidelines are not ready to be released for implementation. The Housing and Community Development Act of 1987 addressed the need to test for and abate lead-based paint hazards in public housing. Congress's intent was that the NIBS guidelines help Public Housing Authorities (PHAs) implement the HUD lead-based paint regulations immediately. The guidelines were intended also as authoritative state-of-the-art information on various testing, abatement, clean-up, and disposal techniques based on the extent of current experience. The guidelines do contain some valuable information which has not been published before. Yet the document does not adequately satisfy the general objectives of the project.

The guidelines must be substantially rewritten and expanded to fulfill these objectives. The document appears more as a set of guidelines for lead-based paint testing and abatement contractors, than as a set of guidelines to aid in decision-making by PHAs. The document is not an authoritative, comprehensive guide to lead-based paint hazard planning. It does not relate the detection and elimination of lead-based paint hazards directly to public housing management or the Comprehensive Improvement Assistance Program.

The shortcomings in the report are substantive and they must be dealt with by persons who approach the issue as a problem in health and science and with the single-minded purpose of providing a guide for housing authorities to conduct their maintenance and modernization programs. What is required is that HUD employ a consultant with demonstrated skills in the areas of health and industrial hygiene who has the capability to integrate abatement guidelines with construction and contracting procedures. In addition, HUD must address the issue of liability insurance for PHAs and their consultants and contractors, providing indemnification if necessary for all.

We realize that the scope of the project and time available were limited. We appreciate the efforts of the document's authors and of all the members of the project committee to develop a worthwhile product. We recommend, nevertheless, that HUD address the shortcomings of the NIBS guidelines (listed below) before releasing them to public housing authorities.

We look now to HUD, in consultation with public housing and health professionals, to address the deficiencies within the NIBS guidelines. HUD needs to initiate a process which results in a guide for PHAs to integrate lead-based paint hazard assessment and reduction with the modernization and maintenance process. In addition, HUD must address the issue of liability insurance for PHAs, their consultants, and their contractors.

I. Providing Sufficient Guidance - The NIBS document should be expanded to address the following subjects, to the extent that information is available.

A. Planning and Organization

1. Guidance on the testing and treatment of movable objects within apartments.

2. Guidance on PHA liability insurance.
3. Guidance on interim containment protocols -- for example, guidance on containing work spaces when lead-based paint abatement is integrated with maintenance or comprehensive modernization work. Maintenance or modernization jobs may be performed after initial abatement, but before repainting and inspection to certify that a living space may be reoccupied.
4. Guidance on treating soil contaminated by lead after abatement.
5. Specifics on PHA reporting requirements to HUD -- for example, format and frequency.
6. Guidance on phasing (ordering) the various testing, abatement, worker protection, etc., tasks outlined in the document, particularly where other maintenance or modernization tasks are being undertaken.
7. Guidance to help PHAs select industrial hygienists and qualified inspectors.
8. Guidance to help PHAs decide whether to hire contractors, use in-house personnel resources, or bring on force account labor. (The document assumes PHAs will hire outside contractors for virtually all activities.)
9. Recommendations for PHA employee and resident education and training.

B. Worker and Resident Protection

1. Description of different types of respiratory protection equipment and instruction on appropriate use.
2. Description of different types of suitable protective clothing.
3. Discussion of protective gear for PHA maintenance personal and supervisors.

C. Testing

1. More Guidelines for XRF testing:

    a. Guidance on confounding variables which may result in inaccurate readings.
    b. Guidance on the effects of various substrate materials on XRF readings, and methods of eliminating the confounding effects of substrate materials.
    c. Guidance on factoring out the confounding effects of lead from non-paint sources (for example, lead from gasoline or tap water).
    d. Recommendations with respect to XRF testing under certain weather conditions (temperature, barometric pressure, humidity).
    e. Recommendations on follow-up procedures to initial and random sample surveys.
    f. Guidance on testing strategies for paint of different conditions (powering, buckled, intact, etc.).

2. Guidance on selecting laboratories.

D. Abatement

1. References to new encapsulation materials and techniques --even to say that they are new and have yet to be tested.

2. Guidance to help a PHA relate abatement strategies to findings from testing, and to conditions of lead-based paint.

E. Clean-up

Guidance on the proper or applicable use of HEPA filtration under various abatement techniques.

F. Testing

Eliminate the endorsement of XRF testing. Laboratory testing is recommended only as a follow-up to XRF tests which yield certain findings, and as the preferred technique for a new surfaces where XRF cannot be done accurately.

G. Disposal

Elimination of confusion of the terms "solid and hazardous" waste.

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ISSUE #4: Guidelines Ignore the Issue of Cost

As strong advocates of lead poisoning prevention, we cannot support the adoption of these guidelines by the National Institute of Building Sciences or the Department of Housing and Urban Development. The complicated and costly recommendations made throughout the guidelines document add up to an abatement strategy that is unquestionably costly -- but not necessarily cost-effective.

In order to understand their deficiencies, the guidelines must be considered in context, as an early step in a much larger effort in which Congress has ordered HUD to develop "a comprehensive and workable plan for the cost-effective inspection and abatement of public housing." From a public health perspective, the goal of such an abatement program is to reduce lead hazards in public housing -- to lower the population blood lead levels of children living in public housing. This must be the most critical criterion for any guidelines.

Given limited money and resources, this goal will not be accomplished by maximizing the removal of lead from individual housing units. These guidelines lay out a professedly ideal approach to removing every microgram of lead possible, regardless of the scope of the benefits and the costs and practicality of such an effort. Unfortunately, we do not live in an ideal world. From a practical point of view, a less intensive abatement method is needed if we are to benefit the health of millions of children at risk for lead poisoning.

Devoid of context and lacking in medical justification, the strategy embodied in the guidelines will drive up the per-unit cost of deleading to the point where far fewer units are deleaded and far fewer children benefit. HUD may produce a few thousand pristine housing units -- but it will leave millions in unacceptable condition. The perfect will have become the enemy of the good.

The guidelines do not tackle these troubling issues because they ignore entirely the issue of cost. The document provides no information whatsoever on the combined costs of these myriad recommendations, even though that information is critical to any property owner, public or private. It avoids any mention of the costs of the proposed techniques -- or the implications these costs would have.

Cost is, of course one-half of the cost-effectiveness equation. As persons concerned with the health of America's children, we acknowledge the need to expend significant amounts of resources to prevent the devastating consequences of lead-induced learning and developmental impairments. But it makes no sense to incur the exorbitant costs anticipated by these guidelines if they are not necessary to protect health.

Clearly there is a shortage of definitive information on the positive and adverse effects of alternative abatement techniques. But there is more information available than was considered in assembling these guidelines, including information generated by experienced lead poisoning prevention programs, housing authorities and property owners that have been struggling to provide effective deleading for close to two decades.

Even after all of the available date has been collected and analyzed, the guidelines may have to make judgement calls based on what little is known. That is perfectly appropriate. But these guidelines do not present themselves as making judgement calls or providing useful advice based on limited data. Instead, the guidelines are presented to public housing authorities as an authoritative source of technical information. They are filled with categorical statements about the inadequacy of certain methods and the efficacy of others. These are not supported by any documentation. Users are admonished that every step of every recommendation must be followed to the letter.

We do not endorse traditional lead paint abatement methods. The old way -- deleading in occupied units, generating large amounts of dust with no containment, failing to clean up or even to repaint deleaded surfaces -- can endanger workers and increase children's lead burden. But these guidelines assume that every element of traditional abatement must be rejected and replaced by more costly and complicated procedures in order to produce any benefit whatsoever. The truth is that it may be possible to alter only some of the old practices -- to relocate occupants, provide some measure of containment and worker protection, require repainting and vigorous cleanup, and produce a substantially safer living environment for young children. Because each chapter was considered in isolation, however, issue involving the cumulative need for and cost of all of the guidelines' recommendations have not been adequately considered.

These guidelines fail to establish the medical justification for any of their recommendations. Some citations have apparently been added to the final document -- but so late that they were not available for review at the time this minority report was drafted! The mere addition of references cannot establish justification for a recommendation if those references have not been reviewed by the members of the project committee, let alone outside experts.

The failure to provide for external review of these guidelines is itself extraordinary, given the importance of this document. This deficiency is exacerbated because the short time frame for preparing the guidelines precluded effective review even by members of the project committee. More importantly, the committee lacked experts capable of evaluating the two most important unanswered issues: the relationship between recommended actions and public health outcomes and the cost of the guidelines.

This document may well reflect the consensus of the building, design and operation sectors, but Congress asked for guidelines representing a broader consensus among "experts in public health, housing and public housing, environmental science, and the abatement industry." These guidelines represent no such consensus, in part because so few experts from the fields of public health and environmental science have examined them. This problem can be rectified only by subjecting the guidelines to examination by a distinguished panel of experts in pediatrics, public and occupational health, environmental science and economics.

Unless HUD undertakes such a review process and makes substantial changes in response the Department will not be able to use this document as the basis for the congressionally mandated consensus guidelines. The Department must ensure that this external review process addresses the questions ignored by this project committee: Does reasonable lead abatement reduce lead stores in children? How much lead abatement is required? What degree of assiduousness is required to lower blood lead levels? The answers must be based on sound scientific data.

Circulating the document and making necessary changes will, of course, take time. There is unquestionably an urgent need for HUD to produce these guidelines as quickly as possible, since it cannot enforce its lead paint regulations until guidelines are adopted. There is, however, no statutory deadline for the preparation of these guidelines. And it does public housing officials no good to have guidelines which, while made available promptly, do not provide them with comprehensive and scientifically and economically justified advice on how best to reduce lead paint hazards.

Both NIBS and HUD know that impact of these guidelines will extend well past the conduct of lead paint abatement in public housing projects and determine to a significant degree the kind, cost and number of both public and private residences that will be abated. Having presented itself as an authoritative source of information, this document could quickly come to define the legally required standard of care for lead paint removal in all public and private housing. And, if viewed as an authoritative demonstration that lead paint abatement is prohibitively expensive, the guidelines could serve as justification for Congress, HUD and private property owners to do nothing.

If public and private property owners, particularly of low-cost housing, are unwilling or unable to pay the exorbitant price tag for lead paint abatement under these guidelines, poor people will once again be shut of a program initially designed for their benefit. In deciding whether to adopt these guidelines, HUD must decide whether all children in public housing will be protected from the ravages of lead poisoning -- or whether the benefits will accrue only to a lucky few.

Because we, on the basis of our considerable collective experience in lead paint poisoning prevention, believe that the net impact of this document will be adversely affect the health of children, we emphatically register our opposition to its acceptance and promulgation by HUD.

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February 16, 1990

Mr. Ellis Goldman
Program Manager
Division of Innovative Technology
and Special Projects
U.S. Department of Housing and Urban Development
Room 8232
451 Seventh Street, S.W.
Washington, D.C. 20410-6000

Dear Mr. Goldman:

This letter outlines the role NIOSH proposed to play as observer/evaluator during HUD's Lead-based Paint Demonstration Project, lists our accomplishments, summarizes our observations and the results of the evaluation to date, and provides interim recommendations. Our recommendations are consistent with NIOSH's previously stated policies regarding the most feasible and effective measures to reduce and control occupational exposures. This policy sets up a hierarchy of control techniques, beginning with product or process substitution, followed by engineering controls (including effective ventilation), and ending with personal protective equipment requirements. These recommendations are offered as a prudent approach toward minimizing the health and safety hazards encountered during this Demonstration Projects' abatement procedures as well as improving the working conditions within the abatement site, while maintaining a reasonable degree of protection against the principal hazard in this project, which is lead. These recommendations are pertinent to the HUD Demonstration Project and are interim in nature; at this time, they should not be used to develop guidelines or requirements for abatements other than those undertaken as part of the HUD Demonstration Project.

We recognize this demonstration abatement project is an experimental design to identify the most economical and safe abatement techniques for removing lead-based paint in housing. HUD and the principal contractors (Dewberry and Davis, and Tracor Inc.) are to be commended for their diligence and dedication, especially considering the time constraints imposed on this project, logistical difficulties, and complexity of this effort. This project is very important since its conclusions will shape the development of a model for public and private lead-based paint abatement. Also, the outcome of this project will influence several health interest areas; namely the public health, the environment, and occupational health. With this in mind, the opportunity and ability to make procedural changes in the conduct of this study during its course is an important attribute of the project. Similar to the way in which decisions were made to abandon a technique (i.e., needlegun usage) or modify procedures (e.g., dust suppression during carpet removal), we feel it is important and advantageous to identify areas for improvement or change which will expand the knowledge gained from this project, improve the working conditions at abatement sites, and protect the workers, the environment and the general public.

<u>The NIOSH Role</u>:

NIOSH agreed to conduct exposure monitoring and medical surveillance at five (as a minimum) of the HUD identified abatement sites selected by NIOSH in each of the two cities of Denver, Colorado and Indianapolis, Indiana. The sites selected were to represent the five principal abatement methodologies (enclosure/encapsulation, abrasive removers, on-site chemical strippers, vacuum blasting removers, and heat gun blower removers). The proposed objectives of the NIOSH effort were to:

1. Characterize the variation in lead (Pb) exposure potential for the five principal abatement methodologies.

2. Characterize the short-term Pb exposure increments during job tasks or processes which contribute to the full-shift exposure potential.

3. Assess Pb exposure experience during single site abatement via medical surveillance of the concentration of lead in workers' blood in comparison with the airborne exposure monitoring data. Based on this information, evaluate the effectiveness of the personal protective and hygiene program requirements.

4. Evaluate and monitor, if appropriate, exposures to other hazards during the abatement procedure (i.e., chemical solvents, noise, heat stress, etc.).

5. From information collected, determine if personal protective measures and hygiene requirements are appropriate and effective for minimizing exposure to Pb. Also, if possible, identify abatement techniques and job tasks which result in the highest and lowest exposure potentials.

<u>ACCOMPLISHMENTS</u>

NIOSH industrial hygienists have observed lead abatement procedures in Baltimore, Denver, and Indianapolis; they have conducted exposure monitoring for lead, volatile organics, carbon monoxide, carbon dioxide, and alkaline dusts. We have not monitored all proposed abatement techniques, but we have observed and monitored chemical (caustics) stripping, heat gun, the removal portion of remove and replace, and encapsulation techniques. NIOSH has, at the request of Dewberry & Davis, reviewed the Material Safety Data Sheets (MSDSs) for the products which may be used in this project and provided suggestions and recommendations concerning these products (letter to Chip Harris dated November 13, 1989). We have reviewed the available environmental/exposure monitoring and medical surveillance (blood lead) data collected by Tracor and Dewberry & Davis.

ENVIRONMENTAL OBSERVATIONS

Observed Problems:

1. Inconsistent respirator requirements. An example is the required wearing of half-mask respirators for workers placing polyethylene outside the structures, while observers without respirators stand by a few feet away.

2. The protocol did not adequately address the need for ventilation of the houses. Use of propane heaters inside the containment was found by NIOSH to be a potential health hazard. In the situations with heaters on and windows covered, a lack of ventilation appeared to compound and present a more serious hazard than potential lead release alone. The contractors protested an outright ban on the heaters, so HUD's principal contractor instructed workers to keep windows open while operating heaters inside.

3. Tracor and Dewberry & Davis personnel did not wear gloves while inside the containment areas (at odds with the protocol and the contractors' practice of wearing gloves). This practice detracts from the efforts to enforce the work practice guidelines for the abatement workers.

4. We observed the presence of suspected asbestos-containing materials (ACM) which were in a deteriorated and friable state in several of the homes in Indianapolis. The presence of ACM in older homes should have been addressed in developing the protocol for this project.

5. The use of propane-fired space heaters, designed for outdoor use only (as stated on the heater), were being used inside the homes. An alternative and less hazardous heating source should be specified for use in the project. Electrical heating would probably present additional problems (see #6).

6. Inadequate or improper grounding of equipment (cheater plugs being used at one location) was observed at several locations. In addition, excessive electrical consumption (primarily by heat guns and negative air pressure units) strained or exceeded the amperage service available from neighboring homes. This was reflected in blown fuses and melted extension cords.

7. Restrictions placed on the operation of the heat guns limit their effectiveness in removing the paint. Based on the Consumer Product Safety Commission study results and worksite observations, we are not convinced that temperature restrictions for heat gun usage reduce lead exposure potential within this demonstration project. The 700° F restriction appears to result in additional time required to remove the paint, and results in workers holding the gun's nozzle closer to the paint surface to compensate for the temperature restriction. The temperature restriction may in fact produce higher exposures because of the extended exposure time required to abate a surface.

8. We are not confident that detailed observations of the variations in work practices which have occurred at the various abatement sites are being recorded.

9. Numerous tripping hazards are produced by extension cords, abatement equipment, and the extensive use of plastic to maintain the "containment" at the abatement site. The extensive use of plastic barriers, in conjunction with wearing Tyvek and (in some cases) poorly constructed scaffolding increases the injury potential from accidental trips and falls.

10. We have observed set-up of industrial hygiene equipment, eating, drinking, and smoking in an area which was scheduled for lead abatement with peeling paint and considerable dust on surfaces These practices should be prohibited in this type of area.

11. The handwashing arrangements/facilities observed at these abatement sites are not adequate to provide an effective means to remove lead contaminated dirt and grime from the skin. Water for handwashing was frozen at some of the sites in Indianapolis; this is surely detrimental toward effective handwashing. At one Indianapolis site, the hand sprayer designated for handwashing was found inside the house being used to mist surfaces. We have not observed consistent washing of the face and neck areas by the abatement workers at these sites.

12. During the removal phase of the "remove and replace" technique, dust suppression technique (misting with water) was not used, yet was warranted by the visible dust generated.

The following is a summary of the available NIOSH air monitoring data collected in Denver and Indianapolis.

Abatement Technique	Sample Type	# of Samples	Range	# ND
Heat Gun	Lead	29	ND - 286 ug/m^3	14
	Carbon Dioxide	10	.500 - 5000 ppm*	
	Carbon Monoxide	6	10 - 30 ppm*	
	Volatile Org's	5	(+ see comment below)	
Caustic Stripper	Lead	12	ND - 4.0 ug/m^3	6
	Alk. Dusts	5	ND (< 0.11) - 0.5 mg/m^3	3
Carpet Removal	Lead	5	ND - 3.9 ug/m^3	4
Encapsulation	Lead	4	ND (< 1.7 ug/m^3)	4
	Bulk Asbestos	3	10 - 25% Chrysotile	0

* results from detector tubes

\+ The results of the volatile organic samples indicated a variety of organic hydrocarbon species including hexanes, toluene, methylcyclopentane, perchloro ethylene, xylenes, pinene, and benzene. Two phthalate compounds [bis(2-ethylhexyl)phthalate and butyl(2-ethylhexyl)phthalate] were identified from heated paint chips; all results were qualitative and merit a quantitative evaluation of some of these compounds.

The following table summarizes our review of the available air monitoring data collected by the contractors in Baltimore, Denver, and Birmingham.

Abatement Tech/Task	Sample Type	# of Samples	Range Pb Exp.* ug/m³	# ND
Heat Gun, int.	PBZ	6	<0.5 - 69	1
Heat Gun, ext.	PBZ	6	<0.5 - 20	1
Heat Gun, int.	Area	12	<0.5 - 83(121)	5
Heat Gun, ext.	Area	15	<0.5 - 89	9
Encap./encl.	PBZ	17	<0.5 - 8	13
Encap./encl.	Area	25	<0.5 - 6(33)	19
Chemical Strip	PBZ	40	<0.5 - 20(88)	15
Chemical Strip	Area	71	<0.5 - 16	42
HEPA Vacuum	PBZ	8	<0.5 - 11	5
HEPA Vacuum	Area	9	<0.5 - 8	6
Abrasive Blast	PBZ	5	<0.5 - 7	3
Abrasive Blast	Area	3	<0.5	3
Needlegun	PBZ	13	<1 - 32(230)	3
Needlegun	Area	16	<0.5 - 61(203, 299)	4
Sanding	PBZ	2	<0.5 - 4	1
Exterior Prep.	PBZ	22	<0.5 - 13	16
Exterior Prep.	Area	27	<0.5 - 18(68)	12
Decon/wash	Area	9	<0.5 - <0.6	9
Interior Prep.	PBZ	42	<0.5 - 36	16
Carpet Removal	PBZ	8	<0.5 - 3(588)	4
Interior Prep.	Area	45	<0.5 - 32	30
Carpet Removal	Area	8	<0.5 - 6	4
Unknown	PBZ	11	<0.5 - 5	3
Unknown	Area	48	<0.5 - 19(68)	34

* These lead (Pb) exposure results are not 8-hour exposure values; they are results for the time of sample duration (generally less than two hours) thus we could not calculate an 8-hour time weighted average. Values in parenthesis represent the next highest values and should be considered outliers due to specific circumstances of the sampling situation.

MEDICAL OBSERVATIONS

We have reviewed the available blood lead data and medical clearance forms. The study protocol essentially follows the National Institute for Building Sciences (NIBS) recommendation of blood lead determinations prior to working in lead abatement, at one month after beginning work, every other month for the next 6 months, and every 6 months thereafter.

Blood lead levels had been performed on 140 workers. Of these, 21 had 2 tests results (one prior to work and one 30 days after beginning work). Of the 140 initial blood lead determinations, 61% were 10 ug/dl or less, 89% were 15 ug/dl or less, and three cases (2%) were greater than 25 ug/dl. Two of these three had prior industrial exposure to lead and blood lead levels in excess of 30 ug/dl. These workers were excluded from lead abatement work on this project. In the 21 workers for whom follow-up blood lead levels were available, there were no increases after approximately 30 days of exposure potential.

Initially, both blood lead and erythrocyte protoporphyrin (EP) levels were obtained. The EP determinations, however, were discontinued by the end of the first month of the study.

To date, and with a limited period and number of observations, increases in blood lead levels have not been seen. This is consistent both with the levels of airborne lead detected by environmental monitoring and the universal use of personal protective equipment. These data do not allow us to predict the effect on blood lead levels, if any, from reducing or discontinuing personal protective equipment usage in these workers.

INTERIM RECOMMENDATIONS

The following recommendations and suggestions are based on our field observations, NIOSH exposure monitoring data, and our review of the contractors' air monitoring and medical surveillance data. Our recommendations are consistent with NIOSH's previously stated policies regarding the most feasible and effective measures to reduce and control exposure (i.e., product or process substitution, engineering controls [including effective ventilation], with personal protective equipment as the last echelon of exposure reduction). These recommendations emphasize the utilization of abatement techniques which appear to minimize the lead exposure potential to abatement workers. Secondary emphasis is placed on the need to examine engineering controls and ventilation approaches for exposure reduction. While personal hygiene and work practices play a very critical role (and should receive equal emphasis as process substitution for exposure control purposes) in preventing lead exposure by ingestion and inhalation, personal protective equipment should be considered the least desirable method of reducing lead exposure in abatement work.

Therefore, the following recommendations are offered toward improving the working conditions within the abatement site, while maintaining a reasonable degree of protection against the principal hazard in this project, which is lead. These recommendations are pertinent to the HUD Demonstration Project and are interim in design; at this time, they are not intended for use in developing strict guidelines or requirements outside the HUD Demonstration Project. At the conclusion of the NIOSH effort on this project, final recommendations and conclusions pertinent to lead-based paint abatement procedures will be provided.

Worksite Procedure:

1. The data collected on abatement techniques (air monitoring data for lead, surface lead-dust clearance sampling, field notes on abatement techniques, blood-lead data, and average cost per technique) should be reviewed to identify which techniques may be abandoned due to exposure potential, effectiveness, and cost. Decisions on this basis could be used to minimize exposure potential and address the first echelon of exposure control (i.e., process substitution).

2. The use of a two-stage decontamination/entry/exit facility to the abatement site should be discontinued; this requirement does not afford any substantial increase in exposure protection to the workers, or the surrounding environment, but does present complicate access to the site by the workers. A designated area, where no abatement or lead hazard exists, should be identified and utilized to prepare to enter/exit the abatement area. This area would contain hand washing facilities, clean clothes storage, dirty clothes storage, and respirator storage space.

3. Proper signage should be utilized to warn all who enter the site that lead abatement is occurring on site and that access is restricted, and that eating, drinking, and smoking within the site is not allowed.

4. Strict attention to proper hygiene practices (hand washing after exiting the house, prior to eating, drinking, smoking, etc.) must be maintained. A designated clean area should be provided for these activities.

5. Adequate ventilation should be provided when using the heat gun, solvent-based strippers and adhesives, or heating the house with propane or kerosene heaters. Appropriate techniques include negative air machines and/or opening the house up to provide natural ventilation (remove polyethylene from and open the windows). Effective ventilation of the abatement areas should be identified and evaluated to address the second echelon of exposure control (i.e., engineering controls to minimize exposures). The use of in-home heating and ventilation systems as an attempt to improve ventilation of abatement sites does not seem feasible and may lead to contamination of other areas (e.g., ductwork and furnace).

Personal Protective Equipment:

1. We recommend a change in the requirements for use of respiratory protection and full Tyvek suits for certaim operations and tasks. During exterior preparation, chemical stripping with caustic-based strippers, encapsulation/enclosure, interior preparation, and heat gun use on the exterior, the use of half-face cartridge respirators and full Tyvek does not appear necessary,

2. Fabric (cotton blend) coveralls may be provided in lieu of Tyvek and laundered appropriately. The laundry must be informed of the potential lead contamination of the garments. Coveralls should not be taken home for laundering by workers.

3. Face shields, impervious aprons or clothing, and appropriate gloves should be used with the caustic strippers.

4. The use of gloves for all operations and tasks are not necessary, except during chemical stripping.

5. Portable eye wash bottles with saline solution, or an eye wash station, should be on-site where chemical strippers are used.

6. We recommend the continued use of proper respiratory protection during heat gun use on interior areas which are small and/or not well ventilated, during the use of solvent-based strippers, when removing carpet (whether moistened or not), and during any technique which has not been shown by air monitoring to have minimal (less than 15 ug/cubic meter) to no lead exposure potential.

Environmental Monitoring:

1. Personal breathing zone and area air monitoring for lead should be continued for each abatement technique and the variety of associated tasks until the demonstration project is completed. A provision for follow-up surface dust sampling for lead should be conducted, after the clearance sampling, to determine if abatement procedures have been fully effective. The Baltimore city study indicates certain techniques may not provide complete lead abatement over an extended period of time after re-occupancy.

2. Care and attention to detail should be stressed to the field industrial hygienists, especially concerning documenting details about sample collection and variations in observed work practices.

   (The tasks or operations associated with many samples cannot easily be determined from the field data sheets. Variations in work practices or techniques may account for some of the higher exposures measured; however, 8-hour TWAs cannot be calculated due to lack of information of other work tasks performed during the rest of the shift.)

3. It should be demonstrated (by the contractor) that an 8-hour TWA exposure level can or cannot be calculated. This will aid HUD and Speedwell in interpreting the data and revising data collection techniques.

4. Thought should be given to the mechanism whereby considerable lead concentrations (in some cases blank values exceed actual sample results) are deposited on field blank samples and whether this affects the validity of the actual sample results.

5. Media blanks should be generated in the field, and spiked quality control samples should be submitted blind to the laboratory.

<u>Protection from Hazards Other than Lead</u>:

Health and safety hazards attendant to lead based-paint abatement should be recognized and dealt with using appropriate measures. NIOSH investigators identified potential exposures to non-lead hazards including asbestos, carbon monoxide, and organic compounds. These hazards should be identified and controlled in accordance with good industrial hygiene practices.

<u>Medical Surveillance</u>:

1. Regardless of any changes in work practices or equipment, biological monitoring should continue to be performed at least as frequently as currently practiced in this project.

2. If there are changes in process or control measures (e.g., the elimination of respiratory protection on some tasks) we recommend reverting to the beginning of the biological monitoring protocol and obtaining follow-up blood lead levels at one month intervals. Similarly, a baseline and monthly level should be obtained if workers return to abatement work after a hiatus of a few to several months. If a worker's blood lead level increase by 10 ug/dL or more, factors contributing to the increase should be identified. Work practices and personal hygiene practices should be reviewed with the worker.

3. Consideration should be given to reinstituting erythrocyte or zinc protoporphyrin testing. Theoretically, this test is an indicator of longer-term effects of lead exposure, though it is not truly specific to lead. Its usefulness in the context of these workers with relatively low levels of exposure has not been tested, so if protoporphyrin testing is restarted, it should be done with a clear plan to evaluate its utility. Zinc protoporphyrin (ZPP) testing is a component of the required testing mandated by the OSHA lead standard for general industry.

Areas for Further Study:

1. NIOSH plans to investigate the proper setting for using heat guns. In particular, the appropriateness of selecting 700° F as the maximum heat output, a level which, from observation in Indianapolis, made it extremely difficult to remove the paint. A thermocouple used to measure the heat output generated at the gun nozzle, and also at the painted surface (which should be considerably lower), in conjunction with determining the amount of lead exposure for the various settings will be performed at worksites.

2. HUD should review the usage of abatement techniques with the intent to minimize exposure potential. We have observed the use of chemical strippers and heat guns to clean woodwork (which was not of historical value), which could be more easily and cheaply replaced. The performance of these abatement techniques when a simpler and less hazardous technique is available increases the exposure potential, public health hazard, and overall cost.

3. NIOSH will continue to conduct exposure monitoring during abrasive sanding, removal techniques, and extensive chemical stripping operations. We will also determine the variety and extent of volatile organics generated from heat gun usage.

4. The use of crystalline-silica containing encapsulants (Encap Systems) in these abatement homes should be evaluated by HUD. The use of such encapsulants may result in future hazards to the occupants or construction worker.

5. Maintaining adequate ventilation in homes when using heat guns and space heaters should be reviewed by HUD and NIOSH. A determination should be made whether the use of general exhaust fans result in a public health hazard versus the use of filtered negative air units.

We extend our appreciation to HUD, Dewberry and Davis, and Tracor Inc. personnel for their assistance, cooperation, and patience. As scheduled, Larry Elliott will meet with you, and the principal contractors on Wednesday, February 21, 1990, to discuss the contents of this letter. Please contact Larry Elliott at 513-841-4374 if you have any immediate questions prior to this meeting.

Sincerely yours,

Aaron Sussell for

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cc:
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D. Chute, Tracor Inc.
Dr. Millar, NIOSH

LEAD-BASED PAINT ABATEMENT DEMONSTRATION FOR THE OFFICE OF POLICY, DEVELOPMENT AND RESEARCH, U.S. DEPARTMENT OF HOUSING AND URBAN DEVELOPMENT

LEAD-BASED PAINT ABATEMENT HEALTH AND SAFETY TRAINING MANUAL

CONTRACTOR:

DEWBERRY AND DAVIS
FAIRFAX, VA

PREPARED BY:

TRACOR TECHNOLOGY RESOURCES, INC.
INDUSTRIAL HYGIENE SERVICES DEPARTMENT
ROCKVILLE, MD

JULY 1989

FOREWORD

This manual has been prepared as part of the Lead-Based Paint Abatement Demonstration Project for the Office of Policy, Development and research for the U.S. Department of Housing and Urban Development to provide health and safety training for workers, supervisors and key personnel. It is to be used as part of a 6-hour training program delivered by experienced, knowledgeable professionals. This represents the best available data on current practices, procedures and standards in the industry.

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THE FAMOUS FRANKLIN LETTER ON LEAD POISONING

(To Benjamin Vaughan)

Phila July 31, 1786

Dear Friend,

I recollect that when I had the great Pleasure of seeing you at Southampton, now a 12 month since, we had some Conversation on the bad Effects of Lead taken inwardly; and that at your Request I promis'd to send you in writing a particular Account of several Facts I then mention'd to you, of which you thought some good Use might be made. I now sit down to fulfil that Promise.--

The first Thing I remember of this kind, was a general discourse in Boston when I was a Boy, of a Complaint from North Carolina against New England Rum, that it poison'd their People, giving them the Dry Bellyach, with a Loss of the Use of their Limbs. The Distilleries being examin'd on the Occasion, it was found that several of them used leaden Still-heads and Worms, and the Physicians were of Opinion that the Mischief was occasion'd by that Use of Lead. The Legislature of the Massachusetts thereupon pass'd an Act prohibiting under severe Penalties the Use of such Still-heads & Worms thereafter. Inclos'd I send you a Copy of the Act, taken from my printed Law book:

In 1724, being in London, I went to work in the Printing-House of Mr Palmer, Bartholomew Close as a Compositor. I there found a Practice I had never seen before, of drying a Case of Types, (which are wet in Distribution) by placing it sloping before the Fire. I found this had the additional Advantage, when the Types were not only dry'd but heated, of being comfortable to the Hands working over them in cold weather. I therefore sometimes heated my Case when the Types did not want drying. But an old Workman observing it, advis'd me not to do so, telling me I might lose the Use of my Hands by it, as two of our Companions had nearly done, one of whom that us'd to earn his Guinea a Week could not then make more than ten Shillings and the other, who had the Dangles, but Seven & sixpense. This, with a kind of obscure Pain that I had sometimes felt as it were in the Bones of my Hand when working over the Types made very hot, induc'd me to omit the Practice. But talking afterwards with Mr James, a Letter-founder in the same Close, and asking him if his People, who work'd over the little Furnaces of melted Metal, were not subject to that Disorder; he made light of any Danger from the Effluvia, but ascrib'd it to Particles of the Metal swallow'd with their Food by slovenly Workmen, who went to their Meals after handling the Metal, without *well-washing their Fingers, so that some of the metalline Particles were taken off by their Bread and eaten with it. This appear'd to have some Reason in it. But the Pain I had experienc'd made me still afraid of those Effluvia.*

Being in Derbishire at some of the Furnaces for Smelting of Lead Ore, I was told that the Smoke of those Furnaces was pernicious to the neighboring Grass and other Vegetables. But I do not recollect to have heard any thing of the Effect of such Vegetables eaten by Animals. It may be well to make the Enquiry.--

In America I have often observ'd that on the Roofs of our shingled Houses where Moss is apt to grow in northern Exposures, if there be any thing on the Roof painted with white lead, such as Balusters, or Frames of dormant Windows, &c. there is constantly a streak on the Shingles from such Paint down to the Eaves, on which no Moss will grow, but the Wood remains constantly clean & free from it.--We seldom drink Rain Water that falls on our Houses; and if we did, perhaps the small Quantity of Lead descending from such Paint, might not be sufficient to produce any sensible ill Effect on our Bodies. But I have been told of a Case in Europe, I forgot the Place, where a whole Family was afflicted with what we call the Dry-Bellyach, or Colica Pictonum, by drinking Rain Water. It was at a Country Seat, which being situated too high to have the Advantage of a Well, was supply'd with Water from a Tank which receiv'd the Water from the leaded Roofs. This had been drank several Years without Mischief; but some young Trees planted near the House, growing up above the Roof, and shedding their Leaves upon it, it was suppos'd that an Acid in those Leaves had corroded the Lead they cover'd, and furnish'd the Water of that Year with its baneful Particles & Qualities.

When I was in Paris with Sir John Pringle in 1767, he visited La Charite, a Hospital particularly famous for the Cure of that Malady, and brought from thence a Pamphlet, containing a List of the Names of Persons, specifying their Professions or Trades, who had been cured there. I had the Curiosity to examine that List, and found that all the Patients were of Trades that some way or other use or work in Lead; such as Plumbers, Glasiers, Painters, &c. excepting only two kinds, Stonecutters and Soldiers. These I could not reconcile to my Notion that Lead was the Cause of that Disorder. But on my mentioning this Difficulty to a Physician of that Hospital, he inform'd me that the Stonecutters are continually using melted Lead to fix the Ends of Iron Balustrades in Stone; and that the Soldiers had been employ'd by Painters as Labourers in Grinding of Colours.

This, my dear Friend, is all I can at present recollect on the Subject. You will see by it, that the Opinion of this mischievous Effect from Lead, is at least above Sixty Years old; and you will observe with Concern how long a useful Truth may be known, and exist, before it is generally receiv'd and practis'd on.

- I am, ever,

Yours most affectionately

B. Franklin

Distributed by:

Philadelphia Department of Public Health
Accident Control Section
CHILDHOOD LEAD POISONING PREVENTION PROJECT

(Benjamin Vaughan was a youthful admirer and close friend of Franklin, who was 80 years old when he wrote to Vaughan. The letter press copy of Franklin's communication is in the Library of Congress, the holograph not having survived. The letter is reproduced here with the original capitalization and spelling.)

OUTLINE OF OSHA LEAD STANDARD 29 CFR 1910.1025

A. <u>SCOPE AND APPLICATION</u>

B. <u>DEFINITIONS</u>

C. <u>PERMISSIBLE EXPOSURE LIMIT (PEL)</u>

1. 50 micrograms per cubic meter of air averaged over an 8-hour period.

2. Maximum permissible limit (ug/m^3) = 400 - hours worked in a day.

3. When respirators are used and all requirements of paragraph F are met, the PEL = the protection factor of the respirator used.

D. <u>EXPOSURE MONITORING</u>

1. General

   a. The employer shall collect personal samples.

   b. Personal samples at least 1 per shift per job classification per work area.

2. Initial Determination

3. Basis of Initial Determination

4. Positive Initial Determination

5. Negative Initial Determination

6. Frequency

   a. If initial monitoring below action level - do not repeat.

   b. If above action level but below permissible level - repeat 6 months.

   c. If above PEL - repeat quarterly.

7. Additional Monitoring

   - If production, process, control of personnel change

8. Employee notification

   - Within 5 working days.

9. Accuracy of Measurement

   - ± 20%

E. METHODS OF COMPLIANCE

1. Engineering and work practice controls

2. Respiratory protection

3. Compliance program

4. Bypass of interim level

5. Mechanical ventilation

6. Administrative controls

F. RESPIRATORY PROTECTION

1. General

a. If respirators required, they will be provided to employee, at no cost, by employer and the employer will assure that the proper respirator is used.

2. Respirator Selection

3. Respirator Usage

a. Proper fit

b. Initial and every 6 months qualitative/quantitative fit test.

4. Respirator Program

G. PROTECTIVE WORK CLOTHING AND EQUIPMENT

1. Provision and use

- Employer shall provide coveralls, gloves, disposable shoe covers, and goggles at no cost to employer if above PEL.

2. Cleaning and Replacement

H. HOUSEKEEPING

1. Surfaces - Maintained as free as practicable of lead.

2. Cleaning Floors - Do not use compressed air.

3. Vacuuming - No shoveling, dry or wet sweeping.

I. HYGIENE FACILITIES AND PRACTICES

1. No eating, drinking, tobacco, or applying cosmetics in work area.

2. Change Rooms

3. Showers - If above PEL

4. Lunch Rooms

5. Lavatories

J. MEDICAL SURVEILLANCE

1. General

- If exposed to action level for more than 30 days/year.

2. Biological Monitoring

a. Blood lead and Zinc Protoporphyrin (ZPP) level

1. Every 6 months

2. Every 2 months if at or above 40ug/100g.

3. Monthly - If elevated blood level.

b. Follow-up blood sampling test.

c. Accuracy of blood level

d. Employee notification - Within 5 days upon receiving results.

3. Medical Examination and consultations

a. Frequency - Annually if 40ug/100g or above.

- Prior to assignment

- If develop signs of lead intoxication

b. Content of medical exam

c. Physician review mechanism

d. Information provided to examining and consulting physician

e. Written medical opinion

f. Alternative physician determination mechanisms

4. Chelation

K. MEDICAL REMOVAL PROTECTION

1. Temporary medical removal and return of employee.

   a. Removal due to elevated blood lead levels.

      - If blood lead level $\geq$ 60ug/100g

   b. Removal due to a final medical determination.

   c. Return of worker to job.

      - 2 consecutive blood tests until blood lead is $\leq$ 40ug/100g

      - No longer is at an increased risk

   d. Removal of other employee special protective measures.

   e. Employer options pending a final medical determination.

      1. Removal

         - May remove from exposure, provide special protective measures, or place limitations on employee.

      2. Return

         a. Based on physician(s) review

         b. Medical removal protection benefits

            - Employer provides up to 18 months of benefits (maintains earnings, seniority, and other).

            - Employer may condition benefits upon employee's participation in follow-up exams.

         c. If blood lead does not adequately decline within 18 months.

            - Employer shall - Final medical determination of employee.

         d. If employer voluntarily removes or restricts employee, the employer must provide 18 months medical protection benefits.

L. EMPLOYEE INFORMATION AND TRAINING

1. Training Program - For all employees exposed to lead $\geq$ action level.

- Repeated annually

- Required information

2. Access to information and training material.

   - The employer shall make available copy of 1910.1025, and training material.

M. SIGNS

1. Warning signs must be posted in each work area while the PEL is exceeded:

WARNING
LEAD WORK AREA
POISON
NO SMOKING OR EATING

N. RECORDKEEPING

1. Employer shall maintain records on exposure monitoring, medical surveillance and medical removals.

2. Employer must keep exposure monitoring and medical surveillance records for 40 years. Medical removal records for duration of employment.

3. These records are available upon request to director and employees.

4. If employer ceases to do business - Records turned over to director.

O. OBSERVATION OF MONITORING

1. Employer shall allow observation of exposure monitoring and provide protective equipment, as required for the observer.

P. EFFECTIVE DATE

1. March 1, 1979

Q APPENDICES

1. Occupational exposure to lead

2. Employee standard

3. Medical surveillance

4. Qualitative fit test protocol

HEALTH AND SAFETY

LEAD PAINT HAZARD

FACT SHEET

THE ABATEMENT OF LEAD PAINT HAZARDS

Abatement means the elimination of exposure to lead-based substances that may result in lead toxicity or poisoning, by the removal or encapsulation of lead-containing substances, by thorough cleanup procedures, and by post-cleanup treatment of surfaces.

> **CAUTION:** The presence of lead paint can be a hazard, especially to young children. Removing lead paint can cause even greater hazards for adults as well as children by spreading lead dust, fumes, and debris. It is critically important that anyone involved in removing lead paint select appropriate methods, follow safe work practices, and take necessary steps to contain and cleanup all lead dust and debris.

HEALTH EFFECTS

There is no established safe level of lead in the human body. No exposure can be regarded as free from potential harm. It has long been known that high levels of lead exposure can cause serious disability or death. More recent research has focused on the toxic effects of low level exposure.

The brain and nerves are particularly susceptible to lead poisoning. Lead poisoning interferes with the formation of blood cells which may cause anemia (low iron). It can also damage the kidneys, digestive system, reproductive system and other organs. Low level exposure can damage hearing, learning ability, and coordination.

Lead has been used in making paint, solder, plumbing, ammunition, gas for cars, and many other products. When lead is burned or heated, anyone who breathes the fumes will take lead into his/her body. People can also swallow lead; for example, lead dust can get onto food. Lead can also be found in drinking water.

Lead accumulates in the body following exposure. Therefore, lead poisoning usually results from many small exposures over a period of weeks or even years. Lead is stored throughout the body. It stays in the blood for several months, and it can be stored in the bone for many decades.

Lead Poisoning in Children - Young children, less than six years of age, are of special concern because their developing brains and other organs can easily be damaged by lead. It is normal for young children to put everything including hands, pacifiers, and toys into their mouths. Anything which contains lead, from small dust particles to large paint chips, can cause harm if swallowed. Lead poisoning commonly causes learning and behavior problems which may be permanent in young children.

Lead poisoning is often not noticed. A child with lead poisoning may seem to be well, and symptoms usually do not develop until the condition becomes quite serious. When symptoms occur, they are easy to confuse with symptoms of other illnesses such as the "flu".

Blood tests are very important to detect lead poisoning early and should be part of the routine health care for all young children.

Lead Poisoning in Pregnancy - Research now shows that lead, even at very low levels, can have toxic effects on the developing fetus. Lead carried in the mother's blood is passed to her unborn child. Lead toxicity may cause miscarriage or premature birth as well as other problems. Infants born with only slightly elevated blood lead levels have been found to have developmental problems.

Lead may be stored in a woman's bones and picked up in increased amounts in her blood stream while she is pregnant. Previous exposure to lead can also affect the unborn baby.

Lead Poisoning in Adults - The most important sources of lead exposure in adults are found in workplace environments. People who breathe lead fumes from activities such as the removal of old paint or the manufacture of lead products are at high risk for lead poisoning. Workers with lead dust on their hands can also contaminate the food that they eat and the cigarettes that they smoke.

An adult who has lead poisoning may notice fatigue, irritability, headache, weight loss, stomachache, or constipation. But lead can cause damage without any symptoms. Blood tests are important for anyone who works with lead at their job, in a hobby, or in any other activity.

SAFETY PRECAUTIONS

1. Read and Follow the Regulations

Regulations have been designed to protect the abatement workers and the environment. The Lead Paint Hazard Fact Sheets in this series provide guidance which is consistent with these regulations. You must be sure that you follow those regulations which apply to your project. Failure to follow regulations may result in the development of hazardous conditions, the assessment of fines or other penalties, and costly delays or revisions to your project. For more information, contact:

Occupational Safety and Health Administration
U.S. Department of Labor
1726 M Street, NW
Washington, DC 20210

2. Restrict Entry to Work Area

Only workers or other people directly involved in the project may enter the work area. For any project involving removal of lead paint, young children and pregnant women must stay out of the work area until cleanup has been completed.

Post warning signs immediately outside all entrances and exits to the work area.

For any project involving the abatement of identified lead hazards in a home or involving removal of more than a very limited amount of lead paint, all residents of that home, including pets, must find other housing. Residents must stay out of the building until cleanup and any required inspections have been completed. Consult local regulations for further information.

3. Pick the Safest Method

Select the most appropriate methods for your project. The methods for the lead based paint demonstration project will be pre-determined.

4. Wear Appropriate Clothing

Disposable coveralls are recommended to minimize contamination of clothing by lead dust.

5. Use Required Safety Equipment

A respirator is needed when using an electric heat gun or other methods which produce high levels of lead fumes or dust. Check with your surpervisor to be sure that you select the right respirator filters. Make sure the respirator fits properly.

6. Do Not Smoke or Eat in the Work Area

Lead dust can easily get on your food or cigarettes. Store any eating or smoking materials away from the work area. Leave the work area and wash your hands and face before eating or smoking.

7. Contain Lead Dust and Debris within the Work Area

Do not permit lead dust and debris to leave the work area. See project specifications for detailed infor-mation. Wear disposable shoe covers to keep from tracking lead dust outside of the work area.

8. Change Clothes and Wash Hands and Face

Change clothes and wash hands and face when leaving the work area. Workers can expose their families to toxic levels of lead dust from work clothes and shoes which are brought home from the work site.

9. Do Not Use Unsafe Methods

Burning and uncontained sanding of lead paint are prohibited by some state regulations and will not be used during the demonstration project.

NEVER burn lead paint with an open flame torch. Burning produces very high levels of lead dust and fumes.

DO NOT sand lead paint. Sanding produces very high levels of lead dust.

10. Work Safely with Chemicals

Follow the manufacturer's instructions and Material Safety Data Sheets carefully when using any chemical stripper. Any product which is strong enough to remove paint will probably be harmful to humans if not used properly. Use strippers which contain methylene chloride only for touchup work in well ventilated areas.

The "Right to Know" law requires that workers receive essential information for working with all hazardous chemicals encountered at their work place.

MEDICAL AND EXPOSURE RECORD ACCESS

FACT SHEET

THE OSHA "RIGHT TO KNOW" STANDARD OPENS THREE TYPES OF VALUABLE DOCUMENTS TO WORKERS:

Medical Records

The worker is assured access to virtually all medical records maintained by their employers or by outside contractors. Medical records include:

- Medical and employment questionnaires or histories (including job description and occupational exposures).
- Results of medical examinations (pre-employment, pre-assignment, periodic or episodic) and laboratory tests (including X-ray examinations and all biological monitoring).
- Medical opinions, diagnoses, progress notes and recommendations.
- Descriptions of treatment and prescriptions.
- Employee medical complaints.

The worker has the option, under this Standard of having his/her medical record sent to them in writing, or having it explained by a company physician or by anyone else.

A limited restriction to the worker's access denies direct access to information "regarding specific diagnosis of a terminal illness or a psychiatric condition which could be detrimental to the worker's health." However, the worker's designated representative can obtain this information, and may then give it to the worker.

Exposure Records

The worker has the right to examine and copy five types of exposure records:

- Industrial hygiene sampling data from personal, area, grab, wipe or other forms of sampling for:
  - chemicals
  - bacteria, virus, fungus, etc.
  - noise
  - heat, cold
  - vibration
  - pressure
  - radiation
- Results of biological monitoring on blood, urine, breath, hair, etc. for toxic chemicals
- Material Safety Data Sheets (MSDS). In the absence of MSDS, any other record which reveals the identity of a toxic substance or harmful physical agent.
- Exposure records of other employees with similar past or present job duties or working conditions.
- Exposure records of workplace conditions to which the worker is to be assigned or transferred.

Company Studies

Any study or analysis using exposure or medical records concerning the employee's working conditions or environment, will be made available to the worker upon request.

Control of Health Hazards in the Workplace

RESPIRATORY PROTECTION

Most industrial chemicals enter the body by inhalation. Inhalation hazards are present in the form of dusts, mists, fumes, gases, and/or vapors. Respirators are used to protect against inhalation hazards. They put a barrier between the contaminated air and the worker's lungs.

TYPES OF RESPIRATORS

There are two major classes of respirators. *Air Purifying Respirators* clean the air that is inhaled while *Air Supplying Respirators* provide workers with their own source of air or oxygen.

Air Purifying Respirators

There are four types of air purifying respirators. They are:

(1) Mechanical Filter Respirators,

(2) Chemical Cartridge Respirators,

(3) Combination Respirators, and

(4) Gas Mask Respirators.

Mechanical filter respirators clean the air of dusts and fumes by not allowing the particles to pass through a fiber bed.

Chemical cartridge respirators are used when there is exposure to solvents or chemicals with a high vapor pressure. They clean the air of vapors by absorbing them onto some media such as charcoal.

Combination respirators provide protection against dusts, vapors, fumes, and/or mists. Combination respirators are available for any set of inhalation hazards.

Gas Mask respirators clean the air of gases such as Sulfur dioxide (SO_2) or Hydrogen cyanide (HCN). Gas mask respirators can trap the gas or use chemicals to change the gas to a non-toxic form.

CAUTION: Air Purifying respirators should *not* be used when there is exposure to:

(1) Cancer Causing Substances,

(2) Unknown Chemicals,

(3) Unknown Chemical Concentrations,

(4) Chemicals that are immediately dangerous to life or health,

(5) Areas where the oxygen concentration is too low to support life (less than 19% by volume),

(6) Chemicals that produce toxic effects below the smell threshold (for example, Toluene Diisocyanate).

Air purifying respirators have a limited lifetime. If you smell something coming through a respirator, it is no longer effective. Gas mask cannisters should have color indicators, visible to the wearers, that indicate when a cannister is no longer providing protection.

Air Supplying Respirators

Air supplying respirators provide workers with clean oxygen or air. There are three basic types of air supplying respirators distinguished by the source of the clean air.

(1) *Hose Mask Respirators*—supply the worker with air by placing the free end of a hose attached to the worker's mask in an area free of contamination. The worker then breathes clean air through the hose.

(2) *Airline Respirators*—supply the worker with air by attaching the free end of a hose to a stationary compressed air source.

(3) *Supplied Air Respirators*—supply the worker with air from tanks carried by the worker.

CAUTION: Only supplied air respirators can be used in areas where the air is immediately dangerous to life and health. Airline and hose devices can be cut, leaving the worker without protection.

FIT TESTING

OSHA requires that all workers who must wear respirators be *fit tested*. Fit testing is a procedure used to determine whether leaks exist in the seal between the respirator and face. There are two types of fit testing:

(1) *Quantitative fit testing* – the worker is placed in a closed booth while wearing a respirator that is probed. A test solution is put into the booth and a machine measures the concentration of the solution in the booth and in the respirator. By comparing the concentration of the solution inside the respirator to that outside the respirator, the degree of leakage (if any) can be found. Caution: There are generally two test solutions used in quantitative fit testing. They are DOP, a phthalate chemical, and salt. DOP is a very dangerous chemical, therefore salt should be the only test solution used in quantitative fit testing.

(2) *Qualitative fit testing* – workers are asked if they smell irritant smoke or banana oil (Isoamyl Acetate) when it is passed three inches from the respirator seal. If the worker can smell the smoke or oil, the respirator does not fit. Qualitative fit testing gives a gross "yes" or "no" answer to the fit test, but does not indicate the degree of fit as quantitative testing does.

RESPIRATOR LIMITATIONS

There are limitations to the use of respirators:

- Respirators are designed to protect only against specific types of substances and in certain concentration ranges. It is important to know with what industrial chemical you are working and to employ the correct respirator. Consult American National Standard Practices Z-88.2-1969 for a step-by-step respirator selection procedure.

- The thin seal on a respirator often breaks when the wearer is talking or moving quickly. This allows the toxic substance to enter through the facepiece.

- Some workers never get a good facepiece seal due to facial hair interference or because the respirator never really fits them.

EMPLOYER'S RESPONSIBILITY

OSHA health standards for Asbestos, Coke Oven Emissions, Acrylonitrile, DBCP, Lead, Arsenic, Vinyl Chloride, and the fourteen regulated carcinogens (See Table 1) require employers to provide workers with respirators if they are exposed above the permissible exposure limit.

In addition to the requirements to provide respirators when there is exposure to the individual chemicals named, employers are required by 1910.132 of the OSHA regulations to, "provide and maintain respirators whenever workers are required to work in an area where process hazards, chemicals, radiological hazards, or irritants can cause injury or impairment by inhalation. OSHA has interpreted this to mean that if a worker is exposed to a chemical in concentrations over the standards listed in tables Z-1, Z-2, and Z-3 of the OSHA regulations (Part 1910.1000), the employer is required to provide and maintain respirators specific for that chemical. Moreover, if the employer is required to supply respirators, the employer must also establish a respiratory protection program which, according to OSHA 1910.134(b)1011, must include:

(1) Written Standard Operating Procedures governing the selection and use of respirators,

(2) Providing the workers with the proper respirator to protect against the specific hazard,

(3) A training program to instruct workers in the proper use and limitations of respirators,

(4) Cleaning of respirators on a daily basis,

(5) Storage in a sanitary location,

(6) Respirator inspection and repair,

(7) Routine Industrial Hygiene inspection of the area in which respirators are required to be worn,

(8) Annual review of each worker's ability to wear respirators by a physician,

(9) Regular inspection and evaluation of the entire program,

(10) Assignment of individual respirators to workers where practicable,

(11) Issuance of NIOSH-MESA approved respirators when available.

TABLE 1

Federally Regulated Carcinogens

4 - Nitrobiphenyl
alpha - Napthylamine
Methylchloromethyl ether
3 - 3' Dichlorobenzidine
beta - Napthylamine
4 - Aminodiphenyl
Benzidine
beta - Propiolactone
Ethyleneimine
4 - Dimethylaminoazobenzene
N - Nitrosodimethylamine
4 - 4' Methylene bis (2 chloroaniline)
bis Chloromethyl ether
2 - Acetylaminofluorene

Other publications with more information:

(1) OSHA Safety and Health Standards (29 Code of Federal Regulations 1910), Sec. 1916.132 - 1910.134.

(2) *American National Standard Practices for Respiratory Protection.* American National Standards Institute Z88.2 - 1969. 1430 Broadway, New York, New York, 10018.

LEAD in CONSTRUCTION

If you are a construction worker, you should be aware of the hazards of lead exposure. You may be exposed to lead in areas where cutting, sanding, burning, melting, abrasive blasting, grinding, soldering, welding, painting or paint removal are occurring. These operations may release lead in the form of dust, fumes or mists into the air or onto surrounding surfaces.

Lead is a toxic substance which may enter the body by breathing or swallowing lead dusts, fumes or mists. If food, cigarettes, or your hands have lead on them, lead may be swallowed while eating, drinking or smoking. Once in the body, lead enters the bloodstream and may be carried to all parts of the body. The body can eliminate some of this lead, but if there is continued lead exposure, the body absorbs and stores more lead than it can eliminate. This stored lead may cause irreversible damage to cells, organs and whole body systems. After exposure stops, it takes months or even years for all lead to be removed from the body.

What are the symptoms?

Exposure to lead may affect each person differently. Even before symptoms appear, lead may cause unseen injury to the body. During early stages of lead poisoning, mild symptoms may be overlooked as everyday medical complaints, including:

Loss of appetite	Joint and muscle aches
Trouble sleeping	Metallic taste
Irritability	Decreased sex drive
Fatigue	Lack of concentration
Headache	Moodiness

Brief intense exposure or prolonged overexposure may result in severe damage to your blood-forming, nervous, urinary and reproductive systems. Some noticeable medical problems include:

Stomach pains	Tremors
Wrist or foot drop	Convulsions or seizures
High blood pressure	Anemia
Nausea	Constipation or diarrhea

Prevention

- RECOGNIZE that lead may be a health hazard.
- BE AWARE OF employer and employee responsibilities under the lead in construction standard.
- CHECK to see that an initial lead determination has been made at your worksite.
- WEAR appropriate personal protective equipment and clothing.
- PRACTICE good personal hygiene.
- DO NOT eat, drink or smoke in a lead-contaminated area.
- DO NOT take lead-contaminated clothing home.

OCCUPATIONAL HEALTH HAZARDS (Cont'd)

The Lead in Construction Standard extends protection to construction workers. The standard requires that before beginning any construction work which may result in lead exposure, an employer must determine if any employee may be exposed to lead at or above the action level (30 ug/m^3). If so, the employer must conduct air sampling at the start of the operation which may involve lead exposure. Depending on the level of exposure to airborne lead, the standard requires various protective measures:

LEVELS ABOVE THE PERMISSIBLE EXPOSURE LEVEL - (50 ug/m^3)

- Conduct periodic air sampling
- Use feasible engineering and work practice controls
- Provide appropriate respirators, protective clothing and personal protective equipment
- Institute a housekeeping and personal hygiene program
- Provide areas for eating and drinking
- Provide washing and lavatory facilities
- Institute a medical surveillance program
- Conduct employee training
- Post warning signs
- Maintain records

LEVELS BELOW THE PERMISSIBLE EXPOSURE LEVEL - (50 ug/m^3) BUT ABOVE THE ACTION LEVEL - (30 ug/m^3)

- Conduct periodic air sampling
- Institute a housekeeping program
- Provide washing and lavatory facilities
- Provide a medical surveillance program
- Conduct employee training
- Maintain records

ANY LEVEL OF LEAD

- Institute a housekeeping program
- Provide washing and lavatory facilities
- Inform employees of the requirements of this standard

This fact sheet is intended to summarize the Lead in Construction Standard and is not to be interpreted as the complete requirements under the standard.

OCCUPATIONAL HEALTH STANDARD

LEAD in CONSTRUCTION

The Lead in Construction Standard requires that before beginning any construction work which may result in lead exposure, an employer must determine if any employee may be exposed to lead at or above the action level (30 ug/m³). This determination must be in writing and be posted. If any employee may be exposed at or above the action level, the employer must conduct air sampling at the start of the operation which may involve lead exposure. The major requirements of the Lead in Construction Standard are detailed below.

Any Airborne Lead	At or Above Action Level (30 ug/m³)	Above PEL (50 ug/m³)	
			CONDUCT EXPOSURE MONITORING
	X	X	- at start of job
	X		- every six months
		X	- every quarter
X	X	X	- when job change may result in new or additional exposure
X	X	X	- if employee complains of symptoms related to lead exposure
			Whenever exposure monitoring is performed, employee must be provided with written notice of results.
		X	USE FEASIBLE ENGINEERING AND WORK PRACTICE CONTROLS
		X	DEVELOP WRITTEN COMPLIANCE PROGRAM AND REVIEW EVERY SIX MONTHS
		X	PROVIDE RESPIRATORY PROTECTION
		X	- as interim measure
		X	- to supplement engineering and work practice controls
		X	- when controls not feasible
		X	- upon employee request
			When respirators are provided, a respiratory protection program in accordance with 29 CFR 1910.134 (b), (d), (e) and (f) must be established and fit testing must be conducted. A medical examination must be provided if an employee exhibits difficulty breathing during respirator fit test or use. An employer must provide a powered air purifying respirator at the employee's request.
		X	PROVIDE APPROPRIATE PROTECTIVE CLOTHING AND EQUIPMENT
		X	- clean clothing weekly (daily if exposure above 200 ug/m³)
		X	- assure protective clothing removed at end of shift
		X	- assure appropriate laundering or disposal
		X	- clean and repair equipment
			Protective clothing and equipment must also be provided when the possibility of skin or eye irritation exists.
X	X	X	MAINTAIN ALL SURFACES AS FREE OF LEAD AS POSSIBLE
X	X	X	- prohibit cleaning by compressed air
X	X	X	- use vacuuming or other equally effective cleaning methods
X	X	X	- use wet methods when vacuuming not feasible
		X	PROHIBIT EATING, DRINKING AND SMOKING IN JOB AREA
		X	- provide eating and drinking area
		X	- assure employees wash prior to eating or drinking
		X	- assure employees do not enter eating area in lead contaminated clothing

OCCUPATIONAL HEALTH STANDARD (Cont'd)

Any Airborne Lead	At or Above Action Level (30 ug/m^3)	Above PEL (50 ug/m^3)	
		X	PROVIDE CHANGE AREAS AND STORAGE
		X	- assure employees do not leave job area in contaminated clothes
			PROVIDE WASH FACILITIES [29 CFR 1926.51 (f)]
X	X	X	- be sure employees wash at end of shift
		X	PROVIDE LAVATORY FACILITIES [29 CFR 1926.51 (c)]
X	X	X	
	X	X	INSTITUTE MEDICAL SURVEILLANCE PROGRAM
			Biological monitoring (Blood Lead + ZPP or FEP Levels)
	X	X	- prior to assignment
	X	X	- every two months for first six months of exposure
	X	X	- written notification of results to employee
			Medical examination must be provided when exposure is above action level and employee has developed signs or symptoms associated with lead intoxication, desires advice on effects of exposure on ability to procreate, or employee's blood lead level is at or above 40 ug/100g. A medical examination must also be provided when an employee exhibits difficulty breathing during respirator fit test or use.
			PROVIDE MEDICAL REMOVAL AND PROTECTION
	X	X	- if blood lead level is at or above 60 ug/100g
	X	X	- if average of last three blood tests is at or above 50 ug/100g
	X	X	- if indicated by a final medical determination
X	X	X	INFORM EMPLOYEES OF STANDARD
X	X	X	- make available a copy of standard
	X	X	PROVIDE TRAINING PROGRAM
			Training must also be made available if the possibility of skin or eye irritation exists.
		X	POST WARNING SIGNS
			MAINTAIN RECORDS OF
X	X	X	- initial determination
X	X	X	- exposure monitoring
	X	X	- medical surveillance
	X	X	- medical removal

This chart is intended to summarize the Lead in Construction Standard and is not to be interpreted as the complete requirements under the standard.

HEAT STRESS

RECOGNITION

Heat stress occurrences among the work force are fairly rare. The abatement business has made giant leaps with regard to engineering controls and work practices. The monitoring of acute hazards in this one area has not kept up with the rest of the general knowledge level among abatement contractors.

THE PROBLEM

- Excessive temperature
- High humidity
- Impermeable protective clothing

SOURCES OF HEAT

- Metabolic
- Radiant
- Convective

HEAT BALANCE WITHIN THE BODY

Metabolic heat is generated within the body system. Our blood carries heat from the core through the circulation system to the skin where it is exchanged into the atmosphere. The central nervous system acts similar to a thermostat to regulate the amount of blood flowing to the skin. The body has limits of how much heat it can tolerate.

Another factor that is important is the body can only sweat 8 to 10 liters per day. After this occurs the cooling mechanism breaks down and sweating stops.

ACCLIMATION

Allowing the body time to adjust to higher temperatures within the work area.

NIOSH recommends on hot jobs to work 50% of capacity during Day 1 and increase 10% everyday after.

HEAT STRESS ILLNESSES

HEAT CRAMPS

SYMPTOMS	TREATMENT
Cramping in arm and leg muscles	Fluids, rest, salt

HEAT EXHAUSTION

SYMPTOMS	TREATMENT
Profuse sweating Weakness, headaches Dizziness, rapid pulse	Fluids, rest

HEAT STROKE

SYMPTOMS	TREATMENT
Hot, dry skin Confusion Unconsciousness Delirium	Cool immediately

*HEAT STROKE IS A MEDICAL EMERGENCY

BUDDY SYSTEM

Most abatement work is done in teams of two. Make each person responsible for keeping an eye on his partner, looking for symptoms of heat stress. Prevention is the best possible cure.

PERSONAL FACTORS

AGE - Older workers will have more problems dealing with hot jobs.

MEDICATIONS - Diuretics for control of high blood pressure act to remove water from the body.

ALCOHOL - Causes the body to dehydrate.

OBESITY - Harder for the heat to escape the body.

HEAT STRESS EVALUATION

- Air Temperature
- Metabolic Rate
- Air Movement
- Humidity
- Radiant Energy

HEAT STRESS MEASUREMENTS

INSTRUMENTATION

- Botsball
- Wet bulb globe temperature index (WBGT)
- Oral, rectal thermometer
- Heat strips

HEAT BALANCE IN THE BODY

In order to determine how one body reacts to a hot environment, the following factors must be considered.

$$H = M \pm C \pm R - E$$

H = Heat Balance

M = Metabolic Heat (generated within the body)

C = Convective Heat (transmitted through the air)

R = Radiant Heat (electromagnetic radiation)

E = Evaporation (related to % of humidity)

CONTROLS

ELIMINATE - Wherever possible live mechanical systems should be shut down.

ENGINEERING - Use of negative pressure machines to purge the air and help lower the humidity.

Forcing cool air into the work area.

ADMINISTRATIVE - Adopting work/rest schedules.

Requiring workers to take longer showers.

PERSONAL PROTECTION - Cool vests

Vortex tube

Due to all the variables associated with heat stress and its effects on humans, there is no standard. NIOSH and others have developed a recommended criteria.

HOW TO IDENTIFY LEAD HAZARDS

LEAD PAINT HAZARD

FACT SHEET

A completed survey must be done to determine whether a Lead Paint Hazard exists in a home or building. Such a survey consists of sampling all painted surfaces on the interior and the exterior of the building. A one paint chip sample or a single composite sample of several different areas within a building does not give an accurate picture of what lead paint hazards exist or where they are located.

When is a survey necessary?

- when a child has been identified as having lead poisoning.
- when a property owner is concerned that a lead hazard exists and wishes to abate that hazard.
- when a property owner is required to test for lead in order to be in compliance with Housing and Urban Development Regulations.
- when a group day care center which may have lead paint is reviewed for licensing or plans renovations which may disturb lead paint.

Who can perform a survey?

- some state Environmental Departments
- some county health departments
- some housing authorities
- private testing companies

What type of analysis is used to test for lead?

- paint scrapings
- portable X-RF analyzer (x-ray fluorescence)
- Sodium sulfide solution 6-8%

(Note: Each method has specific limitations.)

Questions to ask if a private testing company is hired:

- Cost of a complete survey - cost for entire house
- Method used for analysis
- Previous experience with testing
- How will the information be reported to you?
- How detailed is the information?

If testing company is using an X-RF analyzer:

- Are they licensed by a State Division of Radiation Control?
- How many readings are taken for each sample? (Minimum of 3)
- What training have the technicians had?
- How many units can they do in a day? (Generally, it takes a minimum of two (2) hours to sample a three-bedroom home.)

METHODS OF LEAD ANALYSIS:

Advantages and Disadvantages

Methods	Advantages	Disadvantages
Paint Scrapings	1. Analyzed in laboratory 2. Results are usually very accurate 3. Results reflect lower as well as upper levels of paint.	1. Lengthy processing requires time in lab. 2. 30 to 70 samples to be taken 3. Lab costs can be high. 4. Quantitative results can be "falsely lowered" by many paint layers. 5. Destructive to painted surfaces
Portable X-RF	1. Performed on site 2. Less destructive to painted surfaces 3. Results are available as soon as the operator completes the survey report.	1. Equipment is expensive. 2. Requires trained operators 3. Will not read on all surfaces. 4. Some surface destruction is necessary if results are to be accurate.
Sodium Sulfide	1. Quick, on-site results. 2. Potential use as a screening tool for white paint with high lead content.	1. Other metals in paint can cause false positive readings. 2. Difficult to use with colored paint. Cannot be used with dark colored paint. 3. May fail to detect lead at low levels or in bottom layers of paint. 4. Some surface destruction necessary. 5. Not quantitative

CONTAINMENT OF LEAD BEARING DUST AND DEBRIS

LEAD PAINT HAZARD

FACT SHEET

By taking the steps listed on this sheet, you will keep lead dust, fumes, and debris from spreading outside of the work area. You will also make clean-up of the work area much easier. A safe, complete job cannot be done without containing all lead within the work area.

Any method of removing lead paint causes poisonous dust and debris to form. Using a heat gun will also create lead fumes. It is important to remember that lead fumes and dust are actually more dangerous than the large paint chips which are easy to see.

CONTAINMENT MATERIALS

1. Polyethylene (plastic) sheets which are 6 mil thick.
2. Spray poly which can coat surfaces and then be removed by peeling.
3. Heavy duty tape, such as duct tape, to fasten the plastic sheets.
4. Spray cement which comes in an aerosol can and is made to stick to polyethylene sheets.
5. Staple gun with industrial grade staples to fasten the plastic sheets.
6. Disposable booties to cover your shoes while you are in the work area.
7. Disposable coveralls.

CONTAINMENT STEPS

A. **Before You Begin Removing Lead Paint**

1. Remove all furniture and moveable items from the work area.
2. Cover all permanent items such as radiators and refrigerators with plastic sheets. Seal the sheets with heavy duty tape.
3. Remove all carpeting from the work area. Carpeting which already has lead dust in it should be cleaned or replaced with new carpet <u>after</u> the project has been <u>completed</u>.
4. Cover all floors and other exposed surfaces with plastic sheets. Fasten <u>all</u> edges of the sheets securely.
5. If the work area is one room or a group of rooms, seal off the work area from the non-work area with plastic, covering all openings, including doors and air ducts for heating and cooling system.

B. **While Work is in Progress**

6. Cover your shoes with disposable booties any time you enter the work area. Take the booties off every time you leave the work area.
7. Wear disposable coveralls in the work area to keep lead dust from collecting on your regular clothes. Remove the coveralls as you leave the job site at the end of the workday. Do <u>not</u> take lead dust home on your work clothes.
8. Carefully inspect plastic sheets for tears every day before you begin working. Repair or re-cover areas as soon as you notice a tear.

METHODS FOR ABATING OR REMOVING LEAD PAINT

LEAD PAINT HAZARD

FACT SHEET

CHOOSING A METHOD

No one method works best for lead paint abatement. Carefully plan the use of a method or combination of methods which suit your particular project. Consider the condition of the wood or other material under the paint. In many cases, it may be best to replace old deteriorated windows or doors.

METHODS FOR INTERIOR AREAS

WOODWORK:

Replacement - is the easiest and quickest way to get rid of lead paint. Windows and other woodwork which are in poor condition should be replaced with new materials.

Encapsulation - vinyl, aluminum or wood can be used to cover the woodwork. Seams must be caulked or sealed.

Off-Site Chemical Stripping - is recommended when it is desirable to keep old decorative trim, molding, and doors. Send these items from the work site to be placed in a dipping tank.

Electric Heat Guns - are useful to soften very thick paint on flat surfaces. However, care must be used to contain the old paint as it is removed. Workers must wear respirators to protect themselves from the fumes.

Caustic Strippers - may be effective on some surfaces. They are messy and usually must be followed by rinsing the wood surface with a vinegar/water solution to neutralize the wood surface before painting. This waste water must be contained and disposed of properly since it may contain enough lead to be classified as hazardous waste.

HIGH EFFICIENCY PARTICULATE AIR (HEPA) Sanders - use a special vacuum that filters out the very small lead particles that cause lead poisoning. Do not use any other type of sander or filter. Use on flat surfaces only.

Reversal of Wood Trim - Sometimes wood trim can be turned over so that the painted surface is no longer exposed. Seams must be sealed or caulked.

WALLS AND CEILINGS:

Encapsulation - wet and scrape loose paint and cover with durable material that will not tear, chip or peel. Caulk seams if paneling is used. Sheet rock, vinyl wall coverings, and wood paneling are among the material which you may select.

FLOORS:

Encapsulation - tile, wood, stone or vinyl coverings will seal lead paint on floors.

Heat Gun - is useful when floors need to be preserved for aesthetic reasons. This works best when paint is thick. Respirators are needed for worker protection.

Non-Flammable Chemical Strippers - When floors are to be preserved for aesthetic reasons, this method can be used with care. Liquid waste must be disposed of properly.

HEPA Sander - this is a sander used with a special vacuum that filters out the very small particles that cause lead poisoning. Do not use other types of sanders or filters on lead paint.

METHODS FOR EXTERIOR AREAS

Vacuum Blasting - this method can be used on a variety of surfaces. Works best on flat surfaces. Respirators may not be necessary.

Water Blasting - waste water must be contained and disposed of properly. Respirators may be necessary.

Methods used for interior areas are also acceptable for exterior areas.

RESTRICTED METHODS

- **DO NOT** use methods which produce uncontrolled dust or fumes.
- **DO NOT** sand (except with equipment using a HEPA filter, as noted above).
- **DO NOT** burn with an open flame torch.

CAUTION - any chemical which can remove paint is likely to be harmful if:

- it touches your skin;
- it gets in your eyes;
- it has toxic vapors which you breathe.

Be sure to carefully follow the printed directions which come with any paint remover. Most require good ventilation with open windows and exhaust fans. Some removers are highly flammable. Use removers containing methylene chloride only for touch-up work in well ventilated areas.

CLEAN UP OF LEAD BEARING DUST

LEAD PAINT HAZARD

FACT SHEET

A careful and complete cleaning of the work area is necessary to prevent exposure to lead for people, especially young children, who will use the area in the future. Lead dust that remains on surfaces can get onto toys, food, hands, or even a pet dog or cat. From there, lead dust can easily find its way into a child's mouth.

CLEAN UP MATERIALS

1. Plastic work gloves
2. Spray bottle with water
3. Heavy duty plastic bags - use single 6 mil bags
4. Cleaning solution containing Tri-Sodium Phosphate (TSP). At least one ounce of 5 percent TSP to each gallon of water used. Prepare with HOT water.
5. Buckets
6. Cleaning items: disposable lint-free towels, rags, sponges and mops.
7. HEPA Vacuum cleaner (special vacuum cleaner with a "High Efficiently Particulate Aerosol" filter).

CLEAN UP PROCEDURE

BEFORE YOU START: Review Health and Safety precautions.

1. Put on plastic gloves. This will protect hands from the TSP used in the cleanups.
2. Use the spray bottle to wet down all dust and debris with a fine mist of water. This will help control the dust during the cleanup.
3. Place large disposable items in plastic bags and tie the bags shut.
4. Wrap all debris in the plastic sheets used during the abatement. Place these sheets in the plastic bags and tie them shut.
5. HEPA vacuum ALL SURFACES in the work area including woodwork, walls, windows, window wells, and floors. Start at the ceilings and work down, cleaning the floors last.
6. Wash ALL SURFACES in the work area with the TSP solution, including the ceiling and areas that had been covered with plastic. Start with the ceiling and work down to the floors. Mix up a new solution of TSP frequently so it remains relatively clean.
7. Discard all items used for cleaning (towels, sponges, rags, mopheads) in a plastic bag.
8. After they have dried, HEPA vacuum ALL SURFACES a second time until no dust or residue can be seen.
9. At this time, before repainting, the abatement project should be inspected. After repainting, clean the area again following steps 4, 5, 6, 7 above.
10. To be sure that lead dust levels remain low, residents should clean these surfaces with a mild solution of TSP and hot water once a week.

DISPOSAL OF HAZARDOUS MATERIAL AND DEBRIS

LEAD PAINT HAZARD

FACT SHEET

ANYTHING which contains lead may become hazardous if it is not carefully managed. This is particularly true of wastes and debris generated by a lead abatement project. To protect the environment, these hazardous wastes and debris must be disposed of properly. Such lead hazards include:

- Old woodwork, plaster, windows, doors, and other painted components removed from the building.
- Plastic sheets and tape used to cover floors and other surfaces during lead paint removal.
- Sludge from paint removers used in the job.
- Liquid waste, such as wash water used to decontaminate wood after solvents or caustic paint strippers have been used.
- Rags, sponges, mopheads, HEPA filters, and other items used for cleanup.
- Disposable work clothes.

DISPOSAL PROCEDURES FOR HOUSEHOLDS CONDUCTING LEAD ABATEMENTS

Waste material and debris generated by a single residential structure, such as a house or apartment, may be classified as household waste and therefore will be exempt from the disposal requirements listed on the next page. The requirements for each state may vary; in Maryland, please contact the Maryland Department of the Environment (MDE), Hazardous and Solid Waste Management Administration at (301) 631-3343 if you have questions concerning whether your project qualifies for the household waste exemption. In order to comply with state and federal regulations, and to prevent lead contamination, all property owners and contractors conducting abatements of households must adhere to the following requirements:

- Put lead-containing debris into heavy duty 6 mil plastic bags.
- Provide short-term storage in a secure place until waste and debris can be transported safely. Provide for protection from children, animals, the weather and other sources of disturbance.
- Remove all lead waste from the abatement site within 48 hours following cleanup.
- Transport lead-containing solid waste materials and debris to a municipal or lined landfill, as required by state or local regulations.
- Transport windows, trim and other bulky items in a covered vehicle.
- DO NOT burn debris. Fumes from lead which is burned will contaminate the air; lead in ash can also contaminate the environment.

Disposal of liquid waste presents special problems. When possible, avoid using abatement methods which generate liquid waste. Liquid waste is best managed as indicated on the next page. Do not pour liquid waste on the ground or into storm drains. If you have questions regarding disposal of liquid waste, call the local Hazardous and Solid Waste Management Administration.

DISPOSAL PROCEDURES FOR ALL OTHER LEAD ABATEMENT PROJECTS

Any person conducting an abatement of lead hazards must comply with additional hazardous waste regulations if the abatement project involves:

1) Non-residential property, such as a group day care center, OR
2) More than one residential property (i.e., more than one house or apartment).

In such abatement projects, if more than 100 kilograms (220 pounds) of solid waste are generated per month, or if more than 100 kilograms are accumulated at any time, that waste must be tested to determine if it is hazardous.

- Solid waste suspected of being contaminated with lead must be tested using the E P Toxicity Test for Leachable Lead.
- Waste which FAILS the E P Toxicity test must be disposed of as hazardous waste.

Liquid waste from a lead paint abatement site, such as water used to clean and neutralize surfaces treated with a caustic stripper, can contain hazardous levels of lead and other toxic substances. In order to avoid the expense and other special problems associated with the disposal of liquid waste, consider using alternatives to caustic strippers when selecting a lead abatement method.

- If you do decide to use a caustic stripper or other method which generates toxic liquid waste, you should make arrangements for containment, transportation and disposal before you begin the project.
- Liquid waste from a lead abatement project must either be transported to an appropriate disposal site permitted to accept such waste or, under limited circumstances, be pretreated prior to disposal into a sanitary sewer. Learn if your county or city has an approved pretreatment program which permits the disposal of such liquid waste.

Organic solvents or caustic strippers used in the abatement project may also be regulated as hazardous waste. Check with the local Hazardous Waste Program to determine specific requirements for materials used in your lead abatement project.

You must obtain a HAZARDOUS WASTE GENERATOR NUMBER from the Hazardous Waste Program if either (1) the abatement project produces 100 kilograms (220 pounds) of hazardous waste (including liquid as well as solid waste) in a calendar month, or (2) your organization accumulates more than 100 kilograms at any time.

Lead abatement waste that has been determined to be hazardous waste may have to be transported by a certified hauler. To transport hazardous waste you must either obtain a certificate or contract with a certified hauler.

Hazardous waste can only be transported to a facility permitted to receive it.

Each shipment of hazardous waste must be accompanied by a hazardous waste manifest.

INSPECTION FOR LEAD PAINT ABATEMENT

LEAD PAINT HAZARD

FACT SHEET

INSPECTION PROCEDURES

Inspections are appropriate at any time during the course of an abatement project to assure that all work is conducted properly and that no problems develop. The inspector may specifically check to see that:

- Required records of the project are maintained
- Workers have received required health and safety training
- Safe work practices are being followed
- Abatement methods are appropriate for the project
- Dust and debris are contained within the work areas
- Cleanup is thorough and complete
- Regulations for disposal of hazardous lead waste are followed
- Lead dust levels following the final cleanup are below the standards listed on the next page.

Two inspections are specifically required for abatement projects ordered by your environmental or health agency.

1. A visual inspection following completion of all abatement work but <u>before</u> re-painting begins. This inspection will determine that all surfaces requiring abatement have been adequately abated.
2. Following the final cleanup and disposal of all debris, dust samples are collected. Because the test for lead levels in dust is crucially important, more detailed information follows.

WHY MEASURE LEAD IN HOUSE DUST?

The purpose of testing house dust for lead is to make sure that the home is safe for the family to return following the careful removal or abatement of lead paint.

House dust is a major source of lead exposure for young children. It is normal for babies and young children to put things, including dirty toys or fingers, in their mouths. Removing lead paint by any method will create lead dust. Many children take in dangerous amounts of lead <u>after</u> lead paint has been removed, if large amounts of lead dust remain in the environment.

WHEN TO TEST

Regulations require testing of dust lead levels following the final cleanup of an abatement project, but before the residents are permitted to return. If the abated surfaces do not pass a visual inspection (if they appear "dirty" and/or "dusty"), the cleanup procedure must be repeated before testing can be done. If the lead levels test high, further cleaning is required, followed by repeated testing until the levels are acceptable.

WHO WILL DO THE INSPECTION AND TESTING?

If a lead hazard abatement is ordered by governmental agency, that agency will assign an inspector (to handle the inspection, collect the dust samples and submit the samples to the State Laboratory or contracted laboratory).

WHERE TO TEST

Samples must be taken from <u>each</u> work area or room involved in the project. Samples are taken from the floors next to abated surfaces and from window sills and window wells. These three samples will usually provide a good representation of the lead levels in each room.

WHAT LEVELS ARE ACCEPTABLE

As part of a lead abatement project, all abated surfaces and floors must be finished to provide smooth and easily cleanable surfaces. This will enable the residents to keep surface lead dust levels low.

Following an abatement project, lead dust levels must meet the following environmental standards:

SURFACE	Micrograms of Lead Per Square Foot of Surface Area
Floors	Below 200
Window sills	Below 500
Window wells	Below 800

If tested lead dust levels meet this standard, an abatement project will be approved for reoccupancy. Once back in the home, residents should be encouraged to use the wet mop, wet wash procedures described previously to keep surfaces clean and dust-free.

APPENDIX A

MARYLAND REGULATIONS

TITLE 26
DEPARTMENT OF THE ENVIRONMENT

Subtitle 02 OCCUPATIONAL, INDUSTRIAL, AND RESIDENTIAL HAZARDS

26.02.07 Procedures for Abating Lead Containing Substances From Buildings

Authority: Environment Article ||1-404, and 7-206—7.208 Annotated Code of Maryland

.01 SCOPE

These regulations establish appropriate techniques for abatement of lead-containing substances from interior and certain exterior areas in group day care centers, in all residential property including owner-occupied residential property, and in buildings appurtenant to group day care centers and residential properties.

.02 DEFINITIONS

A. The following terms have the meanings indicated.

B. Terms Defined.

1. "Abate" or "Abatement" means the elimination of exposure to lead-based substances that may result in lead toxicity or poisoning, by the removal or encapsulation of lead-containing substances, by thorough cleanup procedures, and by post-cleanup treatment of surfaces.

2. "Business entity" means a partnership, firm, association, corporation, sole proprietorship, or other business unit and any employee of it.

3. "Child" means a person under the age of 6.

4. "Contractor" means any business entity, public unit, or person performing the actual abatement for a lead abatement project.

5. "Department" means the Maryland Department of the Environment.

6. "Encapsulate" or "Encapsulation" means to resurface or cover surfaces and to seal or caulk seams with durable material, so as to prevent or control chalking, flaking lead-containing substances from becoming part of house dust or accessible to children.

7. "HEPA" or "high efficiency particle air" means a filter capable of filtering out particles of 0.3 microns or greater from a body of air at 99.97 percent efficiency or greater.

8. "Lead abatement project: means any work performed in order to abate the presence of lead-containing substance.

9. "Lead-containing substance" means any paint, plaster or other surface coating material containing more than 0.05 percent lead by weight calculated as lead metal in the dried solid, or more than 0.7 milligrams per square centimeter by the X-ray fluorescence analyzer.

10. "Owner" means a person, firm, corporation, guardian, conservator, receiver, trustee, executor, or other judicial officer, who, alone or jointly or severally with others, owns, holds, or controls the whole or any part of the freehold or leasehold title to any property, with or without accompanying actual possession of it, and shall include in addition to the holder of legal title, any vendee in possession of it, but may not include a mortgagee or an owner of a reversionary interest under a ground rent lease.

11. "Public unit" means:

    a. Any agency, bureau, department, or instrumentality of State government;

    b. Any agency, bureau, department, or instrumentality of federal or local government;

    c. Any public, quasi-public, or municipal corporation.

12. "Woodwork" means all wooden or metal interior or exterior fittings or ornamentation, such as moldings, doors, staircases, and window sashes and trim.

13. Work Area.

    a. "Interior work area" means a hallway, room or group of rooms in which abatement takes place on the inside of a residential property, or group of day care center.

    b. "Exterior work area" means an outdoor porch, stairway, or other element of woodwork on the exterior of a residential property, a group day care center, or a building appurtenant to a residential property or group day care center, on which abatement takes place.

.03 METHODS OF ABATEMENT

A. A person performing abatement of lead-containing substances may not use the following methods:

    1. Open flame burning;

    2. Dry sanding, except as allowed in Paragraph B.2;

    3. Open abrasive blasting, except as allowed in Paragraph B.2;

    4. Uncontained hydro-blasting;

5. Methylene chloride for interior use except that methylene chloride may be used in interior work areas for localized touch up; or

6. Dry scraping.

B. A person performing abatement of lead-containing substances shall only use the following methods:

1. Replacement. Any component part of a building may be abated by replacement with a part free of lead-containing substances.

2. Removal.

a. Unless replaced, encapsulated, or reversed, woodwork and floors may only be abated by using the following techniques:

1) Off-site chemical stripping;

2) Heat gun;

3) Non-flammable chemical strippers which do not contain methylene chloride, except that chemical strippers containing methylene chloride may be used for localized touch ups.

4) Sander equipped with HEPA vacuum;

5) Vacuum-blasting in exterior work areas only; or

6) Contained hydro-blasting in exterior work areas only.

b. Unless replaced or encapsulated, walls or ceilings may only be abated by using the following techniques:

1) Wet-scraping of loose material if scraping is followed by encapsulation;

2) Vacuum-blasting in exterior work areas only; or

3) Contained hydro-blasting in exterior work areas only.

3. Encapsulation.

a. A wall or ceiling surface may be abated by encapsulation using only the following material:

1) Gypsum board;

2) Fiberglass mats;

3) Canvas backed vinyl wall coverings;

4) Formica;

5) Tile;

6) Paneling; or

7) Other durable material that does not readily tear, chip, or peel.

b. A floor surface may be abated by encapsulation using only the following materials:

1) Tile;

2) Vinyl flooring;

3) Wood; or

4) Stone.

c. A woodwork surface may be abated by encapsulation using only the following materials:

1) Plastic;

2) Metal; or

3) Wood.

4. Reversal. A woodwork surface may be abated by reversal of its component parts so long as no lead-containing surface remains exposed at the completion of the process, and all seams are caulked and sealed.

5. Windows. Generally windows, when abated, shall be completely treated, including inside, outside and sides of sashes. Window frames shall be abated to the outside edge of the frame, including slides, sash guides and window wells.

C. Alternative Procedures

1. The Department may, on a case-by-case basis, allow an alternative procedure for abatement of a lead paint hazard, provided that the owner or contractor who uses this procedure shall submit a written description of the alternative procedure to the Department which demonstrates to the satisfaction of the Department that the proposed alternative procedure provides the equivalent control and removal.

2. In all cases in which the Department allows the use of an alternative procedure under Paragraph C.1., the owner and resident shall, for a 1-year period after completion of the lead abatement project, permit the Department to enter the area where the abatement occurred in order to inspect the property for the purpose of determining the effectiveness and durability of the allowed alternative procedure. Before conducting such an inspection the Department shall give written notice to the owner and resident of the property.

.04 PERSONAL PROTECTION

A. A business entity or public unit shall ensure that its employees are protected in accordance with all applicable federal, state, and local standards, in particular those set forth in the Maryland Occupational Safety and Health (MOSH) regulations governing Occupational Exposure to Lead in Construction (COMAR 09.12.32).

B. All persons not covered by COMAR 09.12.32 and working on a lead abatement project shall, when present in the work site, wear disposable clothing, shoe covers and if a heat gun or sander equipped with HEPA vacuum is being used for abatement, a half-mask air purifying respirator equipped with high efficiency filters.

.05 CONTROL OF ACCESS

A. Except as provided in Paragraph F, a person or pet may not enter or remain in the work area of a group day care center, residential property, or building appurtenant to a group day care center or residential property, until the Department determines that the lead abatement project has been completed in a satisfactory manner under Regulation .12J, unless that person is:

1. The owner of the building or the owner's designee;

2. The contractor engaged for the lead abatement project and his employees;

3. A state, county, or local enforcement official or his designee;

4. An inspector who represents a lender with a security interest in the building which is being abated; or

5. A federal, state, or local official or his designee, engaged in research on lead buildings.

B. Exemption. If a renovation process is not reasonably expected to break or disturb any lead-based substance, then the requirements of Paragraph A do not apply.

C. Except as provided in Paragraph D, all persons entering a work area during a lead abatement project which involves the removal of lead paint shall wear:

1. Disposable shoe covers which shall be removed when leaving the work area; and

2. A half-mask air purifying respirator equipped with high efficiency filters during or after the use of a heat gun or sander equipped with HEPA vacuum.

D. Multiple Family Dwellings. At all times when a lead abatement project is being conducted in a common area of dwelling occupied by three or more households:

1. Residents and pets shall use alternative entrances and exits which do not require passage through the work area, when an entrance and exit exists;

2. The contractor shall use all reasonable efforts to create an uncontaminated passage for entrance and egress of all building occupants; and

3. If the entrance and egress in a building can only be through the work area, abatement in common areas shall be conducted between the hours of 9 a.m. to 3 p.m. only, and the work area shall be cleaned with a HEPA vacuum at the end of each working day until all surfaces are free of visible dust and debris.

.06 REMOVABLE OBJECTS

A. Except in an emergency, at least 7 days, but not more than 30 days before a contractor may commence a lead abatement project, the owner of the building where the lead abatement project is to take place shall notify all residents of:

1. The area which is to be abated;

2. The date abatement is to commence; and

3. The residents' obligation under Paragraph B to place all personal items in a box or other closed, easily handled container.

B. Every resident of an area, which is to be abated, who has received a notice under Paragraph A, shall be responsible for placing all personal items in boxes or other closed, easily handled containers, and shall pay the reasonable costs of packing and storage of any loose personal items remaining in the work area at the time designated for commencement of abatement in the notice issued under Paragraph A.

C. Before a contractor may commence a lead abatement project, the owner of the building where the lead abatement project is to take place shall remove all furniture and packed personal items from the work area and store them in a secure place.

.07 CONTROL OF EMISSIONS AND DUST

A. Caution Signs

1. At each separate work area, the contractor performing an abatement shall display a caution sign in the following manner wherever the treatment process is reasonably expected to break or disturb any lead-containing substances:

a. At least 3 days before removing or encapsulating lead paint, the contractor shall post signs immediately outside all entrances and exits to the work area except that in emergency situations, posting shall be done as soon as possible;

b. The contractor shall keep the signs posted until the Department issues the written notice of completion and compliance under Regulation .12.J; and

c. The contractor shall ensure that the sign required by Paragraph A.1. meets the following description:

1) The sign is at least 20" by 14", and states the date and place of the lead abatement project,

2) Except as provided in Paragraph A.1.c.3, the sign includes the phrase "Caution Lead Hazard, Keep Out" in bold lettering at least 2 inches high, and

3) In dwellings occupied by 3 or more households where common areas are to be abated the sign includes the phrase "Caution Lead Hazard, Do Not Remain in Work Area Unless Authorized" in bold lettering at least 2 inches high.

2. Multiple Family Dwellings

a. In dwellings occupied by three or more households, where common areas are to be abated, the contractor shall post a notice meeting the description in Paragraph A.2.b. on the door of each apartment in the building at least 3 days before a lead abatement project commences.

b. The notice required in Regulation .06.A.2.a shall contain:

1) The date of commencement of abatement and the area to be abated, and

2) The statement "Please observe caution signs, instruct children not to remain in work area."

B. Containment

1. Interior Containment. Before beginning to abate a lead-containing substance in an interior work area, the contractor performing an abatement shall:

a. Check to make sure that all movable objects have been removed from the work area as required by Regulation .06;

b. If the work area is a room or group of rooms within a building, seal the work area from all other portions of the building with plastic sheeting at least 6 mils thick, waterproof tape, and industrial staples;

c. Seal opening seams of all kitchen cabinets and refrigerators individually with tape;

d. Cover all non-movable objects, such as radiators, refrigerators, stoves, kitchen cabinets, built in furniture, and bookcases, with plastic sheeting at least 6 mils thick taped securely in place;

e. Cover floors in the work area with plastic sheeting at least 6 mils thick sealed with tape and staples;

f. Shut down all forced air ventilation in the work area and seal exhaust and intake points in the work area; and

g. Remove for professional cleaning, or replace, all carpeting present before abatement.

2. Exterior Containment. Before beginning to abate a lead-containing substance in an exterior work area, the contractor performing the abatement shall use the following procedures:

a. Liquid Waste Produced by Abatement Technique. For all situations, when liquid waste is produced by any abatement technique used, the contractor shall place plastic sheeting at least 6 mils thick on the ground as close as possible to the building foundation, or on the floor when applicable.

1) When sheeting is placed on the ground, it shall be raised at its edge and extend a sufficient distance to contain the liquid waste. Plastic sheeting may not be required to extend beyond the edge of the nearest sidewalk.

2) When sheeting is placed on an exterior floor, it shall cover the entire exterior floor.

b. Non-liquid waste produced by abatement technique. For all situations, when non-liquid waste is produced by any abatement technique used, the contractor shall place plastic sheeting at least 6 mils thick on the ground as close as possible to the foundation, or on the floor when applicable.

1. When sheeting is placed on the ground, it shall extend out from the foundation 3 feet per story being abated, with a minimum of 5 feet and a maximum of 20 feet. Plastic may not be required to extend beyond the edge of the nearest sidewalk.

2. When sheeting is placed on an exterior floor, it shall cover the entire exterior floor.

3. The contractor shall weight the sheeting at the foundations, and along all edges and seams.

4. If the constant wind speed is over 15 mph, exterior abatement producing dry waste may not be performed unless vertical shrouds are erected.

3.. For all sealing and covering the contractor shall use:

a. Plastic sheeting, at least 6 mils thick or equivalent;

b. Duct tape or equivalent waterproof tape;

c. Staples of industrial size; and

d. Other additional appropriate work practices to contain particulate lead or lead-containing liquids.

4. Exception. A surface or object may not be covered or sealed while that surface itself is actively being abated.

5. Alternative Procedures. The Department may, on a case-by-case basis, allow an alternative procedure for containment of lead within a work area, provided that the owner or contractor who uses this procedure shall submit a written description of the alternative procedure to the Department which demonstrates to the satisfaction of the Department that the proposed alternative procedure provides the equivalent containment.

.08 CLEANUP OF WORK AREA

A. Interior Cleanup. After completion of the removal, replacement, encapsulation or reversal involved in an abatement project, the contractor shall:

1. Deposit all lead waste, including sealing tape, plastic sheeting, mop heads, sponges, filters, and disposable clothing in double plastic bags of at least 4 mils thick, or single bags 6 mils thick, and seal the bags;

2. Before washing as required in Paragraph A.3., vacuum-clean all surfaces in the work area including woodwork, walls, windows, window wells, and floors with a HEPA vacuum;

3. After vacuum-cleaning as required in Paragraph A.2., wet wash all surfaces in the work area including woodwork, walls, windows, window wells, ceiling and floors with a solution containing at least 1 ounce of 5 percent trisodium phosphate to each gallon of water; and

4. After washing as required by Paragraph A.3., vacuum-clean all surfaces, after they have dried, as described in Paragraph A.2., with a HEPA vacuum until no visible residue remains.

B. Exterior Cleanup. After completion of the replacement, removal, encapsulation, or reversal involved in an exterior abatement project, the contractor shall:

1. Recover all visible debris from all exterior areas;

2. Vacuum all porches treated;

3. Wet wash all surfaces in the work area including woodwork, windows, window wells, and floors with a solution containing at least 1 ounce of 5 percent trisodium phosphate to each gallon of water.

C. Except as provide in G, after the cleaning outlined in A and B, after a satisfactory inspection under Regulation .12B, every contractor shall repaint with a paint containing not more than 0.06 percent lead in the dried solid or recoat all surfaces treated, except those encapsulated surfaces which have smooth easily cleanable factory-finished surfaces.

D. Before repainting or recoating under C, each contractor shall notify the Department that the cleanup required under A and B is completed, and shall undergo any inspection required by Regulation .12B.

E. After painting or coating as required under C, the contractor shall repeat the cleaning process set forth in A in all interior work areas.

F. After completion of the cleaning required under E, the contractor shall seal all floors in interior work areas with

1. Polyurethane;

2. Gloss deck enamel;

3. A tight fitting vinyl floor covering; or

4. An equivalent impermeable material if a smooth cleanable surface is not already present.

G. In owner-occupied dwellings in which a lead abatement project is being done by the owner and not by a hired contractor, after completion of the replacement, removal, encapsulation, or reversal involved in a lead abatement project, the owner may, instead of following the cleanup procedures set forth in A:

1. Deposit all waste, including sealing tape, plastic sheeting, mop heads, sponges, filters, and disposable clothing, in double plastic bags at least 4 mil thick or single plastic bags as least 6 mils thick, and seal the bags;

2. Wet wash all surfaces in the work area including woodwork, walls, windows, window wells, and floors with a solution containing at least 1 ounce of 5 percent trisodium phosphate in each gallon of water, twice; and

3. Wet vacuum-clean all surfaces in the work area including woodwork, walls, windows, window wells, and floors while surfaces are still wet.

H. Alternative Procedures. The Department may on a case- by-case basis allow an alternative procedure for cleanup of a lead abatement project, provided that the owner or contractor who uses this procedure shall submit to the Department a written description of the alternative procedure which demonstrates to the satisfaction of the Department that the proposed alternative procedure provides the equivalent degree of dust removal.

.09 WASTE DISPOSAL

A. Each owner or contractor engaged in a lead abatement project shall:

1. Remove lead waste from the site of a lead abatement project not later than 48 hours after completing the cleanup; and

2. Comply with applicable hazardous waste regulations.

B. Transport and Disposal. Each owner and contractor engaged in a lead abatement project shall transport and dispose of lead waste in a manner to prevent lead from becoming airborne.

.10 RECORDS

A. Each business entity and public unit shall make a record of the following information for every lead abatement project which it performs:

1. Name and address of the contractor responsible for the project;

2. The location and description of the project, and location of lead based substances within the work area which were abated;

3. Starting and completion dates of the lead abatement project; and

4. Summary of abatement techniques used to comply with Regulations .04-.08.

B. Each business entity and public unit shall:

1. Retain the record required to be made under A for 6 years from the date of the completion of the lead abatement project; and

2. Make this record available to the Department upon request.

C. This regulation does not apply to owner occupied dwellings in which abatement is being done by the owner.

.11 HEALTH AND SAFETY TRAINING

A. Within the 5 years immediately before beginning work on a lead abatement project, all inspectors involved in the enforcement of these regulations, and all workers involved in lead abatement project shall have taken a qualifying training course which meet the requirements set out in B, and have received a certificate of completion.

B. Qualifying Training Course. A training course in lead abatement shall:

1. Receive approval from the Department;

2. Provide at least 6 hours of instruction reflecting state of the art information on the following topics:

   a. Health effects of Lead exposure;

   b. Work practices necessary to minimize lead dust concentration, including work area preparation, work area decontamination, and waste disposal;

   c. Requirements of regulations and standards established by the:

      1) Maryland Department of the Environment, and

      2) Maryland Occupational Safety and Health Act and

   d. Worker protection, including respiratory protection, protective clothing, safety equipment, medical surveillance, and personal hygiene;

3. Require trainees to demonstrate proficiency in the skills necessary to perform lead abatement protects, before issuing a certificate under B.4; and

4. Issue a certificate of completion of training.

C. An inspector involved in the enforcement of these regulations and any worker involved in a lead abatement project shall make this certificate available to the Department upon request.

D. Every instructor at a qualifying lead abatement training course shall be an:

   1. Industrial hygienist certified by the American Board of Industrial Hygiene;

   2. Industrial hygienist in training designed by the American Board of Industrial Hygiene; or

   3. Individual with equivalent education or experience as determined by the Department.

E. Instructors at all qualifying lead abatement training courses shall;

   1. Maintain a list of students who have completed a training course in lead abatement and the dates on which training occurred;

   2. Make this list available to the Department upon request and

   3. Retain this list for at least 5 years.

.12 PROCEDURES FOR DETERMINING COMPLIANCE

A. The Department may inspect a work area at any time during a lead abatement project to determine compliance with this regulation.

B. After receipt of notice of completed cleanup required by Regulation .08.D the Department shall, within 24 hours, notify the contractor or owner of the time and date on which an initial inspection will take place; if one is to be made. If the contractor or owner is not reachable by telephone, notice shall be sent by first class mail. Any inspection performed under this subsection shall be completed within 2 working days of giving telephone notice to the contractor or owner. Notice by mail will require an additional 5 working days for completion of the inspection.

C. The inspection performed under B shall be a visual inspection to determine whether surfaces requiring abatement have been abated.

D. The inspector shall immediately notify the contractor or owner, if either is present, of the results of the inspection under B, and shall point out and describe any areas with inadequate treatment. If the contractor owner is not present during the inspection under B, the inspector shall notify the contractor and owner of the results of the inspection, and shall include the locations and characteristics of surfaces with inadequate treatment, by letter mailed within 24 hours of the inspection, by first class mail.

E. Before repainting or recoating under Regulation .08.C, the contractor shall receive notice of:

1. A satisfactory inspection under B; or

2. The decision not to conduct an inspection under B.

F. Upon completion of all requirements of Regulations .08 and .09, a contractor shall notify the Department of readiness for final inspection.

G. Within 24 hours of receipt of notice under F, the Department shall notify the contractor or owner of the time and date on which an inspection will take place, if one is to be made. If the contractor or owner is not reachable by telephone , notice shall be sent by first class mail. Any inspection performed under this section shall be completed within 2 working days of giving this notice to the contractor and owner. Notice by mail will require an additional 5 working days for completion of the inspection.

H. Every inspection performed under G shall include at least:

1. Dust sampling to be followed by analysis in accordance with I; and

2. Visual inspection.

I. All dust samples collected under H shall be analyzed for extractable lead by:

1. The Maryland Department of Health and Mental Hygiene, State Laboratories Administration; or

2. A laboratory approved by the Maryland Department of the Environment to perform the analysis.

J. The Department shall notify the owner and the contractor in writing, sent by first class mail, of the results of the final inspection within 24 hours of receiving the results of lead dust analysis conducted under I. If the results of the lead dust analysis conducted under I do not meet the standards set out in K, the contractor shall perform a further cleanup as described in Regulation .08.H. If results of the lead dust analysis meet the standards set out in K, the departmental notice shall state that the lead abatement project has been completed and complies with the standards set out in K. A statement of completion and compliance may not preclude the Department from taking any future enforcement action against the same group day care center, residential property, or building appurtenant to a group day care center or residential property.

K. A lead abatement project shall be deemed to be in compliance with these regulations if:

1. Floor lead dust levels are below 200 micrograms per square foot;

2. Windowsill lead dust levels are below 500 micrograms per square food;

3. Window well lead dust levels are below 800 micrograms per square foot; and

4. All abated surfaces and all floors have been treated to provide smooth and easily cleanable surfaces.

L. This regulation does not apply to abatement projects conducted in owner-occupied dwellings by the owner, unless the abatement is ordered by the Department, a local government unit, or a court of competent jurisdiction.

.13 LIABILITY OF DEPARTMENT

The issuance of a statement of completion and compliance under Regulation .12.J by the Department to an owner or contractor does not subject the Department to any claims for liability if the issuance of the statement was made in good faith.

.14 ENFORCEMENT

A person who violates any provision of this chapter shall be subject to all equitable, legal and administrative remedies set forth in Environment Article 7.258-7.268 inclusive, Annotated Code of Maryland.

Effective Date: August 8, 1989

APPENDIX B

ADMINISTRATION RESPIRATORY PROTECTION PROGRAM

ADMINISTRATIVE RESPIRATORY PROTECTION PROGRAM

GENERAL

The OSHA General Industry standard for respiratory protection 29 CFR 1910.134 requires that a respiratory protection program be established by an employer. The following procedures are based on the 11 commandments as established by the Occupational Health and Safety Administration.

GUIDELINES

1. The guidelines in this program are designed to help reduce employee exposures against occupational dusts, fumes, mists, radionuclides, gases and vapors.
2. The primary objective is to prevent excessive exposure to these contaminants.
3. Where feasible, exposure to contaminants will be eliminated by engineering controls (example, general and local ventilation, enclosure or isolation, and substitution of a less hazardous process or material).
4. When effective engineering controls are not feasible, use of personal respiratory protective equipment may be required to achieve this goal.

RESPONSIBILITIES

1. **Management**
   It is management's responsibility to determine what specific applications require use of respiratory equipment. Management must also provide proper respiratory equipment to meet the needs of each specific application. Employees must be provided with adequate training and instructions on all equipment.
2. **Management/Supervisory**
   Superintendents, supervisors, foremen, or group leaders of each area are responsible for insuring that all personnel under their control are completely knowledgeable of the respiratory protection requirements for the areas in which they work. They are also responsible for insuring that their subordinates comply with all facets of this respiratory program, including respirator inspection and maintenance.
3. **Employees**
   It is the responsibility of the employee to have an awareness of the respiratory protection requirements for their work areas (as explained by management). Employees are also responsible for wearing the appropriate respiratory equipment according to proper instructions and for maintaining the equipment in a clean and operable condition.

ADMINISTRATION

1. **Name:** ______________ **Signature:** ______________
   Management, Safety Department, Personnel
   is responsible for overall program administration.
2. **Name:** ______________ **Signature:** ______________
   Industrial Hygiene, Insurance Carrier or Consultant
   is responsible for contaminant identification and measurement, including technical support, air sampling, and laboratory analysis.
3. **Name:** ______________ **Signature:** ______________
   Physician, Occupational Health Nurse
   is responsible for monitoring the health of company employees via a comprehensive medical and health program, including physical examinations.
4. **Name:** ______________ **Signature:** ______________
   Engineering, Safety Department, Industrial Hygiene, Other
   is responsible for directing and coordinating engineering projects which are directly related to respiratory protection.
5. **Name:** ______________ **Signature:** ______________
   Safety Department, Industrial Hygiene, Other
   is responsible for selection, issuance, training, and fit testing of all respirators used in this company, including recordkeeping of "Respirator Issuance and Training" card and "Job Description — Respirator Specification" form.

RECOMMENDED RESPIRATORY PROTECTION PROGRAM

WORK AREA MONITORING

Although it is not specifically discussed in the 11 commandments, to assure the adequacy of a respiratory protection program, monitoring should be conducted on a periodic basis to provide for a continuing healthful environment for employees. Personal sampling equipment may be used in accordance with accepted industrial hygiene standards to sample each work area. Results of these samples will pinpoint areas where respiratory protection is required. A "Job Description — Respirator Specification" Form will also document what type of equipment should be worn for specific hazards present.

EMPLOYEE MEDICAL MONITORING

1. Pre-employment physical examinations are conducted on all employees to assure that they are in adequate healthy condition (physically able to perform their work and can use respiratory equipment as required).
2. Periodic physical examinations will be given to regular employees in order to assist them in maintaining their health. (At option of employer/physician or where such exams are required by Local, State, and/or Federal regulations.)

3. Biological monitoring in the form of blood and/or urinary analysis will be conducted on a periodic basis for all employees if appropriate (Employer/Physician determination).

RESPIRATOR SELECTION

Respirators are selected and approved by management. The selection is based upon the physical and chemical properties of the air contaminants and the concentration level likely to be encountered by the employee. A "Respirator Issuance and Training" card (see attached) is available for each job where respirators are required. This card specifies what respirator is required for each application. The respirator program administrator will make a respirator available immediately to each employee who is placed as a new hire or as a transferee in a job that requires respiratory protection. Replacement respirators/pre-filters will be made available as required.

Respirators currently approved by this company are:

1. ______________________ ______________
respirator *model*

2. ______________________ ______________
respirator *model*

3. ______________________ ______________
respirator *model*

4. ______________________ ______________
respirator *model*

EMPLOYEE TRAINING

Each employee, upon assignment to an area requiring respirators, must be instructed by his superintendent, supervisor, foreman, or group leader relative to their responsibilities in the respiratory program. The "Respirator Issuance and Training" card will be reviewed on a periodic basis with each employee. They will also be instructed in need, use, limitations, and care of their respirator(s). (3M recommends use of the 4 step-worker training and specific product training audio-visual programs.)

EMPLOYEE FIT TESTING

Employees required to wear a respirator must be fitted properly and tested for a face seal prior to use of the respirator in a contaminated area. Manufacturers provide fitting instructions and use limitations on the product packaging.

Qualitative fit testing is acceptable for most hazards in the workplace. (Refer to OSHA standards for specific direction.)

NOTE: Include the fit test method used on the "Respirator Issuance and Training" card. If it is determined that an individual cannot obtain an adequate fit or face seal with any negative pressure respirator, a powered air purifying or air supplied respirator may be required instead.

RESPIRATOR INSPECTION AND MAINTENANCE

The following points should be considered for respirator inspection and maintenance:

1. The wearer of a respirator will inspect it daily whenever it is in use.
2. Supervisor, foreman, or group leader will periodically spot check respirators for fit, usage, and condition.
3. Respirators not discarded after one shift use, will be cleaned on a daily basis, according to the manufacturer's instructions, by the assigned employee or other person designated by the respirator program coordinator.
4. Respirators not discarded after one shift use, will be stored in a suitable container away from areas of contamination.
5. Whenever feasible, respirators not discarded after one shift use, will be marked or stored in such a manner to assure that they are worn only by the assigned employee. If use by more than one employee is required, the respirator will be cleaned between uses.
6. Each area requiring the regular use of respirators will maintain a log book. Employees not discarding respirators after one shift should sign this log book daily in order to document the inspection and maintenance of their respirators.

EMERGENCY RESPIRATORY EQUIPMENT

Self-contained breathing apparatus may be required in specific areas for emergency use. This equipment will be used only by trained personnel when it is necessary to enter hazardous atmospheres. The following points should be considered:

1. All potential users will be fully trained in the use of this equipment.
2. When the equipment is used, it will be tested in an uncontaminated atmosphere prior to entering the hazardous area if possible.
3. An employee will not work with this apparatus in a hazardous atmosphere on an individual basis. At least one additional employee suitably equipped with a similar breathing apparatus must be in contact with the first employee and must be available to render assistance if necessary.
4. This equipment will be inspected monthly by trained department or group personnel. Inspection and maintenance information will be recorded in a log book.

OSHA'S REQUIREMENTS FOR A MINIMAL RESPIRATOR PROGRAM

1. "Written standard operating procedures (S.O.P.) governing the selection and use of respirators shall be established."
2. "Respirators shall be selected on the basis of hazards to which the worker is exposed."
3. "The user shall be instructed and trained in the proper use of respirators and their limitations."
4. [Reserved] "where practicable, the respirators should be assigned to individual workers for their exclusive use." (OSHA recommended only)
5. "Respirators shall be regularly cleaned and disinfected. Those used by more than one worker shall be thoroughly cleaned and disinfected after each use."
6. "Respirators shall be stored in a convenient, clean, and sanitary location."
7. "Respirators used routinely shall be inspected during cleaning. Worn or deteriorated parts shall be replaced. Respirators for emergency use, such as self-contained breathing devices, shall be thoroughly inspected at least once a month and after each use."
8. "Appropriate surveillance of work area conditions and degrees of employee exposure or stress shall be maintained."
9. "There shall be regular inspections and evaluations to determine the continued effectiveness of the program."
10. "Persons should not be assigned to tasks requiring use of respirators unless it has been determined that they are physically able to perform the work and use the equipment. The local physician shall determine what health and physical conditions are pertinent. The respirator user's medical status should be reviewed periodically (for instance, annually)."
11. "Approved or accepted respirators shall be used when they are available."

JOB DESCRIPTION — RESPIRATOR SPECIFICATION FORM

JOB DESCRIPTION

Contaminant | Concentration Level | ppm | mg/m^3

Recommended Respiratory Protection

First Choice: | Second Choice:

NIOSH Approval Numbers

OSHA Standard for Contaminant

RESPIRATOR ISSUANCE AND TRAINING

EMPLOYEE	EMPLOYEE NUMBER	TITLE	DATE

RESPIRATOR:
- ☐ Self-Contained
- ☐ Powered Air
- ☐ Supplied Air
- ☐ Chemical Cartridge
- ☐ Chemical Cartridge with pre-filter
- ☐ Dust/Mist Filter
- ☐ Dust/Fume/Mist Filter
- ☐ HEPA Filter

MODEL	APPLICATION	NIOSH APPROVAL NUMBER

LIMITATIONS: ☐ Beard ☐ Denture ☐ Glasses ☐ None

EXPLAIN

FITTING:
- ☐ Satisfactory Positive Pressure Test
- ☐ Satisfactory Isoamyl Acetate Test
- ☐ Satisfactory Negative Pressure Test
- ☐ Satisfactory Sweetener Test

MAINTENANCE:
Cleaning: ☐ Daily ☐ Weekly ☐ Other ______
Disposal: ☐ Daily ☐ Weekly ☐ Other ______
☐ Individual ☐ Plant ☐ Other

INDICATOR

EMPLOYEE SIGNATURE	DATE

APPROVED	DATE

APPENDIX C

HEPA VACUUM INSTRUCTIONS

IMPORTANT - PLEASE NOTE:
THIS INFORMATION IS PRESENTED AS AN EXAMPLE OF A HEPA VACUUM.
THIS IS NOT AN ENDORSEMENT OF A SPECIFIC BRAND OF EQUIPMENT.

INSTRUCTIONS FOR USE - NILFISK GS 82

Your new NILFISK industrial vacuum cleaner is a precision engineered instrument designed for exceptionally fine filtration. Ordinary vacuum cleaners do not have "absolute" filters, and cannot be used safely for hazardous dusts. This NILFISK cleaner is safe to use as a dust collector for finely ground materials as long as certain precautions are taken. Proper care of this cleaner is essential to the maintenance of its ultrafine filtering capabilities.

BEFORE USE: DO NOT ATTEMPT TO OPERATE THIS CLEANER UNTIL YOU HAVE INSTALLED ITS VARIOUS COMPONENTS ACCORDING TO THE FOLLOWING INSTRUCTIONS:

1. Before turning on the motors:

   Install the microfilters (P/N 613274 or 017220), the small white sock filters on the bottom of each motor by sliding the filter over the motor bottom and covering as much of the bottom as the depth of the filter will permit. Be sure the filter's collar is held snugly in place, by either the elastic collar (P/N 613274) or the steel band (P/N 017220).

   Next, mount the "absolute" or exhaust filter (P/N 115650 or 017104) according to the bulletin which is packed with each filter.

   Now place the motors back into the cavities on the top of the cleaner, and plug in the leads from the junction box.

2. Installing the optional manometer (P/N 215172):

   Remove one or more of the motors from the container lid as necessary to gain access to the container interior. Follow manometer mounting instructions packed with the gauge.

3. Installing the paper bag system (P/N 115830):

   Unsnap the four container clips located on the body of the cleaner, front and back. Lift off the top; and place carefully on the floor. Place the molded foam insert in the bottom of the container. Replace the standard inlet deflector with the new orifice (pointing downward) as the diagram indicates. Attach the bag protection discs on the bottom of the main filter (refer to diagram). Install a paper bag according to the illustrations printed on the bag itself.

4. Equip your NILFISK cleaner with whichever accessories have been supplied, according to the instructions found in the accompanying blue booklet.

IN USE: FOR MACHINES EQUIPPED WITH MANOMETERS

Regularly check the manometer to see if the indicator needle on the dial remains in the green zone. If in the red zone, turn off both motors and shake the filter with a vigorous up and down pumping of the filter shaking handle in the center of the vacuum cleaner lid. When the cleaner is re-started, the indicator should remain in the green zone. If it does not, turn off the motors again, and empty the container. With an empty container, and a properly shaken filter, the cleaner should perform satisfactorily. If it fails to generate strong suction at this point, the main filter must then be replaced.

FOR MACHINES WITHOUT MANOMETERS

Regularly turn off motors, and follow the filter shaking instruction above.

The use of a special two-ply disposable paper bag will decrease the amount of dust on the underside of the main filter. Some ultrafine particles will penetrate the paper bag however, but be retained safely below the main filter. Once the filter has been shaken, the motors can be turned on again.

EMPTYING:

In many cases, the material you will be collecting, will be hazardous to humans. It is therefore IMPORTANT that EXTREME CARE BE TAKEN in emptying and disposing of the cleaner's contents. In such cases, be sure to wear proper protective clothing and respiratory protection.

To empty the container and its contents, first turn off the motors. Allow the fine dust inside to settle for a minimum of 30 seconds, then unsnap the container side clips, and remove the container top. The top should be placed on a plastic sheet or in a large plastic bag so dust which falls from the top can be disposed of safely. Carefully slip the paper bag away from the inlet. Once free of the inlet, close the bag with the cap attached to it. Dispose of the bag in a sealed plastic liner. With a damp rag. wipe the inside of the container to collect any ultrafine dust which may have settled there, then install a new paper bag. Discard the wiper in the same plastic liner as the dust-filled paper bag.

DISPOSAL:

Depending on local regulations in force, and the composition of the materials you have collected, there could be a requirement for the special handling and labeling of the filled and sealed plastic bag. Consult your local Occupational Safety and Health Agency or Environmental Protection Agency officials for details.

FILTER REPLACEMENT:

To ensure that your NILFISK cleaner delivers the years of trouble-free operation for which it was designed, it is necessary to check and replace filters regularly.

1. Main Filter: The large cloth bag which is semi-permanently mounted inside the container will not require frequent replacement, PROVIDED it is shaken regularly to prevent fine dust from clinging to it. Main filters must be replaced when, even after vigorous agitation with the shaking handle, the manometer indicator needle fails to return to the green zone, or the cleaner does not recover its original strong suction.

12. Microfilters: These small filters will require regular inspection. Dark dust will discolor the white microfilter. Light colored dust will not show on the microfilter itself, but will be evident on the dark portion of the motor which extends down into the container. Change microfilters as soon as the discoloration becomes easily noticed.

Do not shake these microfilters since this can cause liberation of potentially harmful microscopic dust into the air. Remove carefully, and discard with collected debris in the plastic bag.

3. "Absolute" Exhaust Filter: These filters are mounted on the top of the motors, outside the container. If the main filter and microfilters are properly maintained, the glass fiber element in the exhaust filter should perform satisfactorily for at least a year. It cannot be renewed or restored by shaking.

Remove the protective aluminum cover, and replace the glass fiber element, according to the instructions enclosed in the package. Elements must be replaced more frequently if the cleaner has noticeably stronger suction with the element removed than with the element in place.

Tracor Technology Resources

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22 December 1989

Mr. Chip Harris
Dewberry & Davis
8401 Arlington Blvd.
Fairfax, VA 22031-4666

Dear Mr. Harris,

Attached are results of analyses performed on waste samples collected at lead abatement sites in Denver, Colorado. These samples were tested for one or more of the following hazardous waste characteristics as defined in the Code of Federal Regulations, Part 40:

> <u>Ignitability (40 CFR 261.21)</u> - to identify wastes that either present fire hazards under routine storage, disposal, and transportation or are capable of severely exacerbating a fire once started.
>
> <u>Corrosivity (40 CFR 261.22)</u> - to identify wastes that might pose a hazard to human health or the environment due to their ability to mobilize toxic metals if discharged into a landfill; corrode handling, storage, transportation, and management equipment; or destroy human or animal tissue in the event of inadvertent contact.
>
> <u>Reactivity (40 CFR 261.23)</u> - to identify wastes that, because of their extreme instability and tendency to react violently or explode, pose a problem at all stages of the waste management process.
>
> <u>Extraction Procedure (EP) Toxicity (40 CFR 261.24)</u> - designed to simulate the leaching a waste will undergo if disposed of in a sanitary landfill. If the extract obtained from the method contains any of the regulated substances (in this case, metals) in an amount equal to or exceeding specified levels, the waste possesses the characteristic of Extraction Procedure Toxicity and is a hazardous waste.

Based on our test results, the samples listed below would be classified as hazardous wastes because they possess the characteristic of EP Toxicity for lead. All other metals tested, as well as any of the other characteristics tested, were within specified limits for these samples.

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#1	4033 Vallejo	Non-filtered wash/rinse water
#2	4033 Vallejo	Paint debris from heat gun use
#3	4033 Vallejo	Paint debris from chemical stripper
#4	4033 Vallejo	Liquid on poly below chem stripper clean up
#5	4033 Vallejo	Paper towels used for chemical stripper clean up
#13	4033 Vallejo	Paint from piece of cedar shake
#15	2921 Curtis	Paint debris from chemical stripper
#24	2921 Curtis	Negative air prefilter impregnated dust
#28	2921 Curtis	Filtered TSP wash water

The remaining samples analyzed for ignitability, corrosivity, reactivity, and/or EP toxicity did not exceed regulated limits for characterizing hazardous wastes.

If you have any questions about this report, please call me at (301) 984-2827.

Yours truly,

Bonnie A. Barrows
Laboratory Manager

Enclosures

Tracor Technology Resources

HAZARDOUS WASTE CHARACTERISTICS

Characteristic	Regulatory Definition
Ignitability	flash point <60°C
Corrosivity	pH ≤ 2 or ≥ 12.5
Reactivity	cyanide ≥ 250 ppm sulfide ≥ 500 ppm
EP Toxicity	Arsenic ≥ 5.0 ppm Barium ≥ 100.0 ppm Cadmium ≥ 1.0 ppm Chromium ≥ 5.0 ppm Lead ≥ 5.0 ppm Mercury ≥ 0.2 ppm Selenium ≥ 1.0 ppm Silver ≥ 5.0 ppm

NOTES

< = less than
≤ = less than or equal to
> = greater than
≥ = greater than or equal to
ppm = parts per million
ppb = parts per billion
°C = degrees Centigrade

Ignitability - A liquid, other than an aqueous solution, containing less than 24% alcohol by volume and having a flash point less than 60°C.

Corrosivity - An aqueous solution having a pH ≤ 2 or ≥ 12.5.

Reactivity - In this case: a cyanide- or sulfide-bearing waste that, when exposed to pH conditions between 2 and 12.5, can generate toxic gases, vapors, or fumes in a quantity sufficient to present a danger to human health or to the environment.

Extraction Procedure (EP) Toxicity - An extraction procedure designed to simulate the leaching a waste will undergo if disposed of in a sanitary landfill.

REFERENCE

"Test Methods for Evaluating Solid Waste", SW-846, 3rd Edition, U.S. Environmental Protection Agency, Office of Solid Waste and Emergency Response, November 1986.

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SAMPLE I.D.:	#1 4033 Vallejo
DESCRIPTION:	Non-filtered wash/rinse water
TAL Log #:	89-5003

Corrosivity	11.7	
Reactivity	cyanide <1 ppm	
	sulfide <10 ppm	
	reactivity to water: none detected	
EP Toxicity	Arsenic, ppm	<0.05
	Barium, ppm	0.62
	Cadmium, ppm	0.14
	Chromium, ppm	0.77
	Lead, ppm	**77.0 ***
	Mercury, ppm	0.0021
	Selenium, ppm	<0.05
	Silver, ppm	<0.10

SAMPLE I.D.:	#2 4033 Vallejo
DESCRIPTION:	Paint debris from heat gun use
TAL Log #:	89-5004

Reactivity	cyanide <1 ppm	
	sulfide 30 ppm	
	reactivity to water: none detected	
EP Toxicity	Arsenic, ppm	<0.05
	Barium, ppm	<0.25
	Cadmium, ppm	0.16
	Chromium, ppm	<0.25
	Lead, ppm	**9.7 ***
	Mercury, ppm	0.0011
	Selenium, ppm	<0.05
	Silver, ppm	<0.10

SAMPLE I.D.:	#3 4033 Vallejo
DESCRIPTION:	Paint debris from chem stripper "Peel-Away"
TAL Log #:	89-5005

Ignitability	>75°C	
Corrosivity	11.9	
Reactivity	cyanide <1 ppm	
	sulfide <10 ppm	
	reactivity to water: none detected	
EP Toxicity	Arsenic, ppm	<0.05
	Barium, ppm	<0.25
	Cadmium, ppm	<0.05
	Chromium, ppm	<0.25
	Lead, ppm	**5.8 ***
	Mercury, ppm	<0.0005
	Selenium, ppm	<0.05
	Silver, ppm	<0.10

SAMPLE I.D.:	#4 4033 Vallejo	
DESCRIPTION:	Liquid on poly below chem stripper clean up (ext.)	
TAL Log #:	89-5006	
Ignitability	>75°C	
Corrosivity	11.8	
Reactivity	cyanide <1 ppm	
	sulfide <10 ppm	
	reactivity to water: none detected	
EP Toxicity	Arsenic, ppm	<0.05
	Barium, ppm	0.26
	Cadmium, ppm	0.05
	Chromium, ppm	0.34
	Lead, ppm	**69.0 ***
	Mercury, ppm	insufficient sample
	Selenium, ppm	<0.05
	Silver, ppm	<0.10

SAMPLE I.D.:	#5 4033 Vallejo	
DESCRIPTION:	Paper towels used for chem stripper clean up	
TAL Log #:	89-5007	
Reactivity	cyanide <1 ppm	
	sulfide <10 ppm	
	reactivity to water: none detected	
EP Toxicity	Arsenic, ppm	<0.05
	Barium, ppm	0.46
	Cadmium, ppm	0.22
	Chromium, ppm	<0.25
	Lead, ppm	**110.0 ***
	Mercury, ppm	<0.0005
	Selenium, ppm	<0.05
	Silver, ppm	<0.10

SAMPLE I.D.:	#6 4320 Zuni	
DESCRIPTION:	Filtered hand wash water - 20 & 5 micron filters	
TAL Log #:	89-5008	
Corrosivity	6.6	
Reactivity	cyanide <1 ppm	
	sulfide <10 ppm	
	reactivity to water: none detected	
EP Toxicity	Arsenic, ppm	<0.05
	Barium, ppm	<0.25
	Cadmium, ppm	<0.05
	Chromium, ppm	<0.25
	Lead, ppm	<1.0
	Mercury, ppm	<0.0005
	Selenium, ppm	<0.05
	Silver, ppm	<0.10

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SAMPLE I.D.: #7 4033 Vallejo
DESCRIPTION: TYVEK suit used during heat gun use
TAL Log #: 89-5009

EP Toxicity	Arsenic, ppm	<0.05
	Barium, ppm	<0.25
	Cadmium, ppm	<0.05
	Chromium, ppm	<0.25
	Lead, ppm	1.2
	Mercury, ppm	<0.0005
	Selenium, ppm	<0.05
	Silver, ppm	<0.10

SAMPLE I.D.: #8 4033 Vallejo
DESCRIPTION: Painted plastic tile and master from upstairs bathroom wall (paint only tested)
TAL Log #: 89-5010

EP Toxicity	Arsenic, ppm	<0.05
	Barium, ppm	<0.25
	Cadmium, ppm	<0.05
	Chromium, ppm	<0.25
	Lead, ppm	<1.0
	Mercury, ppm	<0.0005
	Selenium, ppm	<0.05
	Silver, ppm	<0.10

SAMPLE I.D.: #9 4320 Zuni
DESCRIPTION: Non-filtered hand wash water
TAL Log #: 89-5011

Corrosivity 6.3

Reactivity
cyanide <0.2 ppm
sulfide <10 ppm
reactivity to water: none detected

EP Toxicity	Arsenic, ppm	<0.05
	Barium, ppm	<0.25
	Cadmium, ppm	<0.05
	Chromium, ppm	<0.25
	Lead, ppm	<1.0
	Mercury, ppm	<0.0005
	Selenium, ppm	<0.05
	Silver, ppm	<0.10

SAMPLE I.D.:	#16 2921 Curtis	
DESCRIPTION:	Sand paper from use of HERA sander	
TAL Log #:	89-5018	
EP Toxicity	Arsenic, ppm	<0.05
	Barium, ppm	<0.25
	Cadmium, ppm	<0.05
	Chromium, ppm	<0.25
	Lead, ppm	<1.0
	Mercury, ppm	<0.0005
	Selenium, ppm	<0.05
	Silver, ppm	<0.10

SAMPLE I.D.:	#17 4320 Zuni	
DESCRIPTION:	Debris from use of heat gun	
TAL Log #:	89-5019	
Reactivity	cyanide <1 ppm	
	sulfide 73 ppm	
	reactivity to water: none detected	
EP Toxicity	Arsenic, ppm	<0.05
	Barium, ppm	0.89
	Cadmium, ppm	0.50
	Chromium, ppm	<0.25
	Lead, ppm	2.4
	Mercury, ppm	0.0014
	Selenium, ppm	<0.05
	Silver, ppm	<0.10

SAMPLE I.D.:	#18 2921 Curtis	
DESCRIPTION:	HEPA vac debris	
TAL Log #:	89-5020	
Reactivity	cyanide 2.5 ppm	
	sulfide <10 ppm	
	reactivity to water: none detected	
EP Toxicity	Arsenic, ppm	<0.05
	Barium, ppm	0.26
	Cadmium, ppm	0.05
	Chromium, ppm	<0.25
	Lead, ppm	2.6
	Mercury, ppm	0.0027
	Selenium, ppm	<0.05
	Silver, ppm	<0.10

SAMPLE I.D.:	#19 2921 Curtis	
DESCRIPTION:	Right half of suit worn during chemical stripper removal	
TAL Log #:	89-5021	
EP Toxicity	Arsenic, ppm	<0.05
	Barium, ppm	<0.25
	Cadmium, ppm	<0.05
	Chromium, ppm	<0.25
	Lead, ppm	<1.0
	Mercury, ppm	<0.0005
	Selenium, ppm	<0.05
	Silver, ppm	<0.10

SAMPLE I.D.:	#20 2921 Curtis	
DESCRIPTION:	Respirator filters used for heat gun and chemical - three weeks' use	
TAL Log #:	89-5022	
EP Toxicity	Arsenic, ppm	<0.05
	Barium, ppm	<0.25
	Cadmium, ppm	<0.50
	Chromium, ppm	<0.25
	Lead, ppm	<1.0
	Mercury, ppm	<0.0005
	Selenium, ppm	<0.05
	Silver, ppm	<0.10

SAMPLE I.D.:	#21 4320 Zuni	
DESCRIPTION:	Heat gun paint debris	
TAL Log #:	89-5023	
Reactivity	cyanide <1 ppm	
	sulfide 59 ppm	
	reactivity to water: none detected	
EP Toxicity	Arsenic, ppm	<0.05
	Barium, ppm	2.0
	Cadmium, ppm	0.31
	Chromium, ppm	<0.25
	Lead, ppm	1.4
	Mercury, ppm	0.0076
	Selenium, ppm	<0.05
	Silver, ppm	<0.10

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SAMPLE I.D.:	#10 2921 Curtis
DESCRIPTION:	Filtered hand wash water - 5 micron filter
TAL Log #:	89-5012

Corrosivity	6.5	
Reactivity	cyanide <0.2 ppm	
	sulfide <10 ppm	
	reactivity to water: none detected	
EP Toxicity	Arsenic, ppm	<0.05
	Barium, ppm	<0.25
	Cadmium, ppm	<0.05
	Chromium, ppm	<0.25
	Lead, ppm	<1.0
	Mercury, ppm	<0.0005
	Selenium, ppm	<0.05
	Silver, ppm	<0.10

SAMPLE I.D.:	#11 2921 Curtis
DESCRIPTION:	5 micron filter used during hand washing
TAL Log #:	89-5013

EP Toxicity	Arsenic, ppm	<0.05
	Barium, ppm	<0.25
	Cadmium, ppm	<0.05
	Chromium, ppm	<0.25
	Lead, ppm	<1.0
	Mercury, ppm	0.0018
	Selenium, ppm	<0.05
	Silver, ppm	<0.10

SAMPLE I.D.:	#12 4033 Vallejo
DESCRIPTION:	Respirator filters worn during heat gun use
TAL Log #:	89-5014

EP Toxicity	Arsenic, ppm	<0.05
	Barium, ppm	<0.25
	Cadmium, ppm	<0.05
	Chromium, ppm	<0.25
	Lead, ppm	<1.0
	Mercury, ppm	<0.0005
	Selenium, ppm	<0.05
	Silver, ppm	<0.10

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SAMPLE I.D.: #13 4033 Vallejo
DESCRIPTION: Piece of painted cedar shake (paint only tested)
TAL Log #: 89-5015

EP Toxicity	Arsenic, ppm	<0.05
	Barium, ppm	<0.25
	Cadmium, ppm	0.95
	Chromium, ppm	<0.25
	Lead, ppm	**18.0 ***
	Mercury, ppm	<0.0005
	Selenium, ppm	<0.05
	Silver, ppm	<0.10

SAMPLE I.D.: #14 2921 Curtis
DESCRIPTION: HEPA vac debris
TAL Log #: 89-5016

Reactivity
cyanide <1 ppm
sulfide <10 ppm
reactivity to water: none detected

EP Toxicity	Arsenic, ppm	<0.05
	Barium, ppm	<0.25
	Cadmium, ppm	<0.05
	Chromium, ppm	<0.25
	Lead, ppm	1.3
	Mercury, ppm	<0.0005
	Selenium, ppm	<0.05
	Silver, ppm	<0.10

SAMPLE I.D.: #15 2921 Curtis
DESCRIPTION: Paint debris from chemical stripper "Peel-Away"
TAL Log #: 89-5017

Reactivity
cyanide 88 ppm
sulfide <10 ppm
reactivity to water: none detected

EP Toxicity	Arsenic, ppm	<0.05
	Barium, ppm	<0.25
	Cadmium, ppm	<0.05
	Chromium, ppm	<0.25
	Lead, ppm	**5.6 ***
	Mercury, ppm	0.0007
	Selenium, ppm	<0.05
	Silver, ppm	<0.10

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SAMPLE I.D.:	#22 2921 Curtis	
DESCRIPTION:	Baseboard trim - paint only tested	
TAL Log #:	89-5024	
EP Toxicity	Arsenic, ppm	<0.05
	Barium, ppm	0.34
	Cadmium, ppm	0.08
	Chromium, ppm	<0.25
	Lead, ppm	1.3
	Mercury, ppm	0.0010
	Selenium, ppm	<0.05
	Silver, ppm	<0.10

SAMPLE I.D.:	#23 4320 Zuni	
DESCRIPTION:	Red carpet	
TAL Log #:	89-5025	
Reactivity	cyanide <1 ppm	
	sulfide <10 ppm	
	reactivity to water: none detected	
EP Toxicity	Arsenic, ppm	<0.05
	Barium, ppm	<0.25
	Cadmium, ppm	<0.50
	Chromium, ppm	<0.25
	Lead, ppm	<1.0
	Mercury, ppm	<0.0005
	Selenium, ppm	<0.05
	Silver, ppm	<0.10

SAMPLE I.D.:	#24 2921 Curtis	
DESCRIPTION:	Negative air prefilter impregnated dust	
TAL Log #:	89-5026	
EP Toxicity	Arsenic, ppm	<0.05
	Barium, ppm	<0.25
	Cadmium, ppm	<0.05
	Chromium, ppm	<0.25
	Lead, ppm	**7.5 ***
	Mercury, ppm	0.0007
	Selenium, ppm	<0.05
	Silver, ppm	<0.10

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SAMPLE I.D.:	#25 4320 Zuni	
DESCRIPTION:	Negative air filter	
TAL Log #:	89-5027	
EP Toxicity	Arsenic, ppm	<0.05
	Barium, ppm	0.27
	Cadmium, ppm	0.11
	Chromium, ppm	<0.25
	Lead, ppm	4.7
	Mercury, ppm	0.017
	Selenium, ppm	<0.05
	Silver, ppm	<0.10

SAMPLE I.D.:	#26 4320 Zuni	
DESCRIPTION:	Green carpet	
TAL Log #:	89-5028	
Reactivity	cyanide <1 ppm	
	sulfide <10 ppm	
	reactivity to water:	none detected
EP Toxicity	Arsenic, ppm	<0.05
	Barium, ppm	0.36
	Cadmium, ppm	<0.50
	Chromium, ppm	<0.25
	Lead, ppm	1.4
	Mercury, ppm	0.0010
	Selenium, ppm	<0.05
	Silver, ppm	<0.10

SAMPLE I.D.:	#27 4320 Zuni	
DESCRIPTION:	HEPA vac debris	
TAL Log #:	89-5029	
Reactivity	cyanide <1 ppm	
	sulfide 24 ppm	
	reactivity to water:	none detected
EP Toxicity	Arsenic, ppm	<0.05
	Barium, ppm	<0.25
	Cadmium, ppm	<0.05
	Chromium, ppm	<0.25
	Lead, ppm	<1.0
	Mercury, ppm	0.0007
	Selenium, ppm	<0.05
	Silver, ppm	<0.10

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SAMPLE I.D.: #28 2921 Curtis
DESCRIPTION: Filtered TSP wash water
TAL Log #: 89-5030

Corrosivity 11.8

Reactivity
cyanide 0.017 ppm
sulfide <10 ppm
reactivity to water: none detected

EP Toxicity

Arsenic, ppm	<0.05
Barium, ppm	<0.25
Cadmium, ppm	<0.05
Chromium, ppm	0.55
Lead, ppm	**45.0 ***
Mercury, ppm	0.010
Selenium, ppm	<0.05
Silver, ppm	<0.10

SAMPLE I.D.: #29 4033 Vallejo
DESCRIPTION: Red & black foam back carpet
TAL Log #: 89-5031

Reactivity
cyanide <1 ppm
sulfide <10 ppm
reactivity to water: none detected

EP Toxicity

Arsenic, ppm	<0.05
Barium, ppm	<0.25
Cadmium, ppm	<0.05
Chromium, ppm	<0.25
Lead, ppm	<1.0
Mercury, ppm	<0.0005
Selenium, ppm	<0.05
Silver, ppm	<0.10

SAMPLE I.D.: #30 4033 Vallejo
DESCRIPTION: Orange foam back and fiber back carpet
TAL Log #: 89-5032

Reactivity
cyanide <1 ppm
sulfide <10 ppm
reactivity to water: none detected

EP Toxicity

Arsenic, ppm	<0.05
Barium, ppm	<0.25
Cadmium, ppm	<0.05
Chromium, ppm	<0.25
Lead, ppm	<1.0
Mercury, ppm	<0.0005
Selenium, ppm	<0.05
Silver, ppm	<0.10

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SAMPLE I.D.:	#31 4033 Vallejo	
DESCRIPTION:	Tan/orange corrugated foam pad and tan/grey carpet- fiber back	
TAL Log #:	89-5033	
Reactivity	cyanide <1 ppm	
	sulfide <10 ppm	
	reactivity to water: none detected	
EP Toxicity	Arsenic, ppm	<0.05
	Barium, ppm	<0.25
	Cadmium, ppm	<0.05
	Chromium, ppm	<0.25
	Lead, ppm	<1.0
	Mercury, ppm	<0.0005
	Selenium, ppm	<0.05
	Silver, ppm	<0.10

Tracor Technology Resources

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1601 Research Boulevard
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Telephone 301: 984 2800
FAX 301: 984 2817

10 January 1990

Mr. Chip Harris
Dewberry & Davis
8401 Arlington Blvd.
Fairfax, VA 22031-4666

Dear Mr. Harris,

Attached are results of analyses performed on waste samples collected at lead abatement sites in Indianapolis and D.C./Baltimore. These samples were tested for either or both of the following hazardous waste characteristics as defined in the Code of Federal Regulations, Part 40:

Corrosivity (40 CFR 261.22) - to identify wastes that might pose a hazard to human health or the environment due to their ability to mobilize toxic metals if discharged into a landfill; corrode handling, storage, transportation, and management equipment; or destroy human or animal tissue in the event of inadvertent contact.

Extraction Procedure (EP) Toxicity (40 CFR 261.24) - designed to simulate the leaching a waste will undergo if disposed of in a sanitary landfill. If the extract obtained from the method contains any of the regulated substances (in this case, metals) in an amount equal to or exceeding specified levels, the waste possesses the characteristic of Extraction Procedure Toxicity and is a hazardous waste.

Based on our test results, the samples listed below would be classified as hazardous wastes because they possess the characteristic of EP Toxicity for lead. Analyses are continuing for the remainder of the metals and for corrosivity. Results will be reported at a later date.

If you have any questions about this report, please call me at (301) 984-2827.

Yours truly,

Bonnie A. Barrows
Laboratory Manager

Enclosures

Samples with characteristic of EP Toxicity for lead:

#1 615 Udel	HEPA vacuum contents
#5 615 Udel	HEPA filters from vacuum
#1 922 E. 42nd	Paint chips
#2 922 E. 42nd	HEPA cartridge
#3 922 E. 42nd	HEPA vacuum contents
#6 922 E. 42nd	Wiping of HEPA vac filter
#2 905 Drum	Vinegar and chem neutralizer wash (Peel-Away 1)
#3 905 Drum	Exterior heat gun chips (paint)
#5 6155 Parkway	TSP and neutralizer wash (Peel-Away)
#6 6155 Parkway	Wash used before neutralizer to clean gross chem from substrate (Peel-Away)
#6 905 Drum	Plastic from floor and bags
#7 905 Drum	Tyvek suit

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HAZARDOUS WASTE CHARACTERISTICS

Characteristic	Regulatory Definition
Corrosivity	pH $\leq$ 2 or $\geq$ 12.5
EP Toxicity	Arsenic $\geq$ 5.0 ppm Barium $\geq$ 100.0 ppm Cadmium $\geq$ 1.0 ppm Chromium $\geq$ 5.0 ppm Lead $\geq$ 5.0 ppm Mercury $\geq$ 0.2 ppm Selenium $\geq$ 1.0 ppm Silver $\geq$ 5.0 ppm

NOTES

$<$ = less than
$\leq$ = less than or equal to
$>$ = greater than
$\geq$ = greater than or equal to
ppm = parts per million

Corrosivity - An aqueous solution having a pH $\leq$ 2 or $\geq$ 12.5.

Extraction Procedure (EP) Toxicity - An extraction procedure designed to simulate the leaching a waste will undergo if disposed of in a sanitary landfill.

REFERENCE

"Test Methods for Evaluating Solid Waste", SW-846, 3rd Edition, U.S. Environmental Protection Agency, Office of Solid Waste and Emergency Response, November 1986.

SAMPLE I.D.:	#1 615 Udel	
DESCRIPTION:	HEPA vacuum contents	
TAL Log #:	89-5127	
EP Toxicity	**Lead, ppm**	**22.0 ***

SAMPLE I.D.:	#2 615 Udel	
DESCRIPTION:	Respirator filters	
TAL Log #:	89-5128	
EP Toxicity	Lead, ppm	2.1

SAMPLE I.D.:	#3 615 Udel	
DESCRIPTION:	Rinse/wash water supernatant	
TAL Log #:	89-5129	
EP Toxicity	Lead, ppm	<0.5

SAMPLE I.D.:	#4 615 Udel	
DESCRIPTION:	Composite poly & Tyvek suits	
TAL Log #:	89-5130	
EP Toxicity	Lead, ppm	3.2

SAMPLE I.D.:	#5 615 Udel	
DESCRIPTION:	HEPA filters from vacuum	
TAL Log #:	89-5131	
EP Toxicity	**Lead, ppm**	**95.0 ***

SAMPLE I.D.:	#6 615 Udel	
DESCRIPTION:	Rinse/wash water sludge	
TAL Log #:	89-5132	
EP Toxicity	Lead, ppm	0.7

SAMPLE I.D.:	#1 922 E. 42nd Street	
DESCRIPTION:	Paint chips	
TAL Log #:	89-5133	
EP Toxicity	**Lead, ppm**	**18.0 ***

SAMPLE I.D.:	#2 922 E. 42nd Street	
DESCRIPTION:	HEPA cartridge	
TAL Log #:	89-5134	
EP Toxicity	**Lead, ppm**	**27.0 ***

SAMPLE I.D.: #3 922 E. 42nd Street
DESCRIPTION: HEPA vacuum contents
TAL Log #: 89-5135

EP Toxicity **Lead, ppm** **13.0 ***

SAMPLE I.D.: #4 922 E. 42nd Street
DESCRIPTION: Filtered (5 micron) waste water
TAL Log #: 89-5136

EP Toxicity Lead, ppm <0.5

SAMPLE I.D.: #5 922 E. 42nd Street
DESCRIPTION: 5 micron filter with waste
TAL Log #: 89-5137

EP Toxicity Lead, ppm 0.5

SAMPLE I.D.: #6 922 E. 42nd Street
DESCRIPTION: Wiping of HEPA vac filter
TAL Log #: 89-5138

EP Toxicity **Lead, ppm** **97.0 ***

SAMPLE I.D.: #7 922 E. 42nd Street
DESCRIPTION: Blank of wipe "Diaparene"
TAL Log #: 89-5139

EP Toxicity Lead, ppm <0.5

SAMPLE I.D.: #1 905 Drum
DESCRIPTION: 5 micron filtered rinse water (Peel-Away 1), mainly chemical use
TAL Log #: 89-5159

EP Toxicity Lead, ppm 4.0

SAMPLE I.D.: #2 905 Drum
DESCRIPTION: Vinegar and chem neutralizer wash (Peel-Away 1)
TAL Log #: 89-5160

EP Toxicity **Lead, ppm** **620.0 ***

SAMPLE I.D.: #3 905 Drum
DESCRIPTION: Exterior heat gun chips (paint)
TAL Log #: 89-5161

EP Toxicity **Lead, ppm** **52.0 ***

SAMPLE I.D.: #4 905 Drum
DESCRIPTION: 5 micron rinse water filter (mainly chem use, Peel-Away)
TAL Log #: 89-5162

EP Toxicity Lead, ppm 1.4

SAMPLE I.D.: #1 6155 Parkway
DESCRIPTION: Chem sludge (Peel-Away 1) some rag dye and paper
TAL Log #: 89-5163

EP Toxicity Lead, ppm 1.0

SAMPLE I.D.: #2 6155 Parkway
DESCRIPTION: 5 micron filter/rinse water - mainly chem use (Peel-Away 1)
TAL Log #: 89-5164

EP Toxicity Lead, ppm 0.7

SAMPLE I.D.: #3 6155 Parkway
DESCRIPTION: 5 micron filtered rinse water - mainly chem use (Peel-Away 1)
TAL Log #: 89-5165

EP Toxicity Lead, ppm <0.5

SAMPLE I.D.: #4 6155 Parkway
DESCRIPTION: 5 micron filtered rinse water - mainly heat gun use
TAL Log #: 89-5166

EP Toxicity Lead, ppm <0.5

SAMPLE I.D.: #5 6155 Parkway
DESCRIPTION: TSP and neutralizer wash (Peel-Away)
TAL Log #: 89-5167

EP Toxicity **Lead, ppm** **50.0 ***

SAMPLE I.D.: #6 6155 Parkway
DESCRIPTION: Wash used before neutralizer to clean gross chem from substrate (Peel-Away)
TAL Log #: 89-5168

EP Toxicity **Lead, ppm** **5.7 ***

SAMPLE I.D.:	#1 5716 Sheridan		
DESCRIPTION:	5 micron filtered rinse water (sanding and Peel-Away 1)		
TAL Log #:	89-5169		
EP Toxicity	Lead, ppm	<0.5	

SAMPLE I.D.:	#3 5716 Sheridan		
DESCRIPTION:	PAPR filter - mainly sanding		
TAL Log #:	89-5170		
EP Toxicity	Lead, ppm	0.9	

SAMPLE I.D.:	#11 6155 Parkway		
DESCRIPTION:	PAPR filter - mainly heat gun use		
TAL Log #:	89-5171		
EP Toxicity	Lead, ppm	3.9	

SAMPLE I.D.:	#12 6155 Parkway		
DESCRIPTION:	PAPR filter - mainly chem stripper use (Peel-Away 1)		
TAL Log #:	89-5172		
EP Toxicity	Lead, ppm	<0.5	

SAMPLE I.D.:	#5 905 Drum		
DESCRIPTION:	Rug and pad		
TAL Log #:	89-5300		
EP Toxicity	Lead, ppm	<0.5	

SAMPLE I.D.:	#6 905 Drum		
DESCRIPTION:	Plastic from floor and bags		
TAL Log #:	89-5301		
EP Toxicity	**Lead, ppm**	**34.0**	*****

SAMPLE I.D.:	#7 905 Drum		
DESCRIPTION:	Tyvek suit		
TAL Log #:	89-5302		
EP Toxicity	**Lead, ppm**	**220.0**	*****

Tracor Technology Resources

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1 February 1990

Mr. Chip Harris
Dewberry & Davis
8401 Arlington Blvd.
Fairfax, VA 22031-4666

Dear Mr. Harris,

Attached are results of additional analyses performed on waste samples collected at lead abatement sites in Indianapolis and D.C./Baltimore. These samples were tested for the following hazardous waste characteristic as defined in the Code of Federal Regulations, Part 40:

> Extraction Procedure (EP) Toxicity (40 CFR 261.24) - designed to simulate the leaching a waste will undergo if disposed of in a sanitary landfill. If the extract obtained from the method contains any of the regulated substances (in this case, metals) in an amount equal to or exceeding specified levels, the waste possesses the characteristic of Extraction Procedure Toxicity and is a hazardous waste.

Based on our test results, the samples listed below would be classified as hazardous wastes because they possess the characteristic of EP Toxicity for lead (previously reported) and other metals.

If you have any questions about this report, please call me at (301) 984-2827.

Yours truly,

Bonnie A. Barrows

Bonnie A. Barrows
Laboratory Manager

Samples with characteristic of EP Toxicity for **lead**:

#1 615 Udel	HEPA vacuum contents
#5 615 Udel	HEPA filters from vacuum
#1 922 E. 42nd	Paint chips
#2 922 E. 42nd	HEPA cartridge
#3 922 E. 42nd	HEPA vacuum contents
#6 922 E. 42nd	Wiping of HEPA vac filter
#2 905 Drum	Vinegar and chem neutralizer wash (Peel-Away 1)
#6 6155 Parkway	Wash used before neutralizer to clean gross chem from substrate (Peel-Away)
#6 905 Drum	Plastic from floor and bags
#7 905 Drum	Tyvek suit

Samples with characteristic of EP Toxicity for **lead** and **mercury**:

#3 905 Drum	Exterior heat gun chips (paint)

Samples with characteristic of EP Toxicity for **lead** and **arsenic**:

#5 6155 Parkway	TSP and neutralizer wash (Peel-Away)

HAZARDOUS WASTE CHARACTERISTICS

Characteristic	Regulatory Definition
EP Toxicity	Arsenic ≥ 5.0 ppm
	Barium ≥ 100.0 ppm
	Cadmium ≥ 1.0 ppm
	Chromium ≥ 5.0 ppm
	Lead ≥ 5.0 ppm
	Mercury ≥ 0.2 ppm
	Selenium ≥ 1.0 ppm
	Silver ≥ 5.0 ppm

NOTES

< = less than
≤ = less than or equal to
> = greater than
≥ = greater than or equal to
ppm = parts per million

Extraction Procedure (EP) Toxicity - An extraction procedure designed to simulate the leaching a waste will undergo if disposed of in a sanitary landfill.

REFERENCE

"Test Methods for Evaluating Solid Waste", SW-846, 3rd Edition, U.S. Environmental Protection Agency, Office of Solid Waste and Emergency Response, November 1986.

SAMPLE I.D.:	#1 615 Udel	
DESCRIPTION:	HEPA vacuum contents	
TAL Log #:	89-5127	
EP Toxicity	Arsenic, ppm	<0.10
	Barium, ppm	<0.25
	Cadmium, ppm	<0.50
	Chromium, ppm	<0.25
	Lead, ppm	**22.0 ***
	Mercury, ppm	0.0016
	Selenium, ppm	<0.10
	Silver, ppm	<0.50

SAMPLE I.D.:	#2 615 Udel	
DESCRIPTION:	Respirator filters	
TAL Log #:	89-5128	
EP Toxicity	Arsenic, ppm	<0.10
	Barium, ppm	<0.25
	Cadmium, ppm	<0.50
	Chromium, ppm	<0.25
	Lead, ppm	2.1
	Mercury, ppm	insufficient sample
	Selenium, ppm	<0.10
	Silver, ppm	<0.50

SAMPLE I.D.:	#3 615 Udel	
DESCRIPTION:	Rinse/wash water supernatant	
TAL Log #:	89-5129	
EP Toxicity	Arsenic, ppm	<0.10
	Barium, ppm	<0.25
	Cadmium, ppm	<0.50
	Chromium, ppm	<0.25
	Lead, ppm	<0.5
	Mercury, ppm	0.0063
	Selenium, ppm	<0.10
	Silver, ppm	<0.50

SAMPLE I.D.:	#4 615 Udel	
DESCRIPTION:	Composite poly & Tyvek suits	
TAL Log #:	89-5130	
EP Toxicity	Arsenic, ppm	<0.10
	Barium, ppm	<0.25
	Cadmium, ppm	<0.50
	Chromium, ppm	<0.25
	Lead, ppm	3.2
	Mercury, ppm	insufficient sample
	Selenium, ppm	<0.10
	Silver, ppm	<0.50

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SAMPLE I.D.:	#5 615 Udel	
DESCRIPTION:	HEPA filters from vacuum	
TAL Log #:	89-5131	
EP Toxicity	Arsenic, ppm	<0.10
	Barium, ppm	<0.25
	Cadmium, ppm	<0.50
	Chromium, ppm	<0.25
	Lead, ppm	**95.0 ***
	Mercury, ppm	insufficient sample
	Selenium, ppm	<0.10
	Silver, ppm	<0.50

SAMPLE I.D.:	#6 615 Udel	
DESCRIPTION:	Rinse/wash water sludge	
TAL Log #:	89-5132	
EP Toxicity	Arsenic, ppm	<0.10
	Barium, ppm	<0.25
	Cadmium, ppm	<0.50
	Chromium, ppm	<0.25
	Lead, ppm	0.7
	Mercury, ppm	0.0046
	Selenium, ppm	<0.10
	Silver, ppm	<0.50

SAMPLE I.D.:	#1 922 E. 42nd Street	
DESCRIPTION:	Paint chips	
TAL Log #:	89-5133	
EP Toxicity	Arsenic, ppm	<0.10
	Barium, ppm	<0.25
	Cadmium, ppm	0.71
	Chromium, ppm	<0.25
	Lead, ppm	**18.0 ***
	Mercury, ppm	<0.0010
	Selenium, ppm	<0.10
	Silver, ppm	<0.50

SAMPLE I.D.:	#2 922 E. 42nd Street	
DESCRIPTION:	HEPA cartridge	
TAL Log #:	89-5134	
EP Toxicity	Arsenic, ppm	<0.10
	Barium, ppm	2.70
	Cadmium, ppm	<0.50
	Chromium, ppm	<0.25
	Lead, ppm	**27.0 ***
	Mercury, ppm	insufficient sample
	Selenium, ppm	<0.10
	Silver, ppm	<0.50

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SAMPLE I.D.:	#3 922 E. 42nd Street	
DESCRIPTION:	HEPA vacuum contents	
TAL Log #:	89-5135	
EP Toxicity	Arsenic, ppm	<0.10
	Barium, ppm	0.27
	Cadmium, ppm	0.67
	Chromium, ppm	<0.25
	Lead, ppm	**13.0 ***
	Mercury, ppm	<0.0010
	Selenium, ppm	<0.10
	Silver, ppm	<0.50

SAMPLE I.D.:	#4 922 E. 42nd Street	
DESCRIPTION:	Filtered (5 micron) waste water	
TAL Log #:	89-5136	
EP Toxicity	Arsenic, ppm	<0.10
	Barium, ppm	<0.25
	Cadmium, ppm	<0.50
	Chromium, ppm	<0.25
	Lead, ppm	<0.5
	Mercury, ppm	<0.0010
	Selenium, ppm	<0.10
	Silver, ppm	<0.50

SAMPLE I.D.:	#5 922 E. 42nd Street	
DESCRIPTION:	5 micron filter with waste	
TAL Log #:	89-5137	
EP Toxicity	Arsenic, ppm	<0.10
	Barium, ppm	<0.25
	Cadmium, ppm	<0.50
	Chromium, ppm	<0.25
	Lead, ppm	0.5
	Mercury, ppm	<0.0010
	Selenium, ppm	<0.10
	Silver, ppm	<0.50

SAMPLE I.D.:	#6 922 E. 42nd Street	
DESCRIPTION:	Wiping of HEPA vac filter	
TAL Log #:	89-5138	
EP Toxicity	**Lead, ppm**	**97.0 ***

SAMPLE I.D.:	#7 922 E. 42nd Street	
DESCRIPTION:	Blank of wipe "Diaparene"	
TAL Log #:	89-5139	
EP Toxicity	Lead, ppm	<0.5

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SAMPLE I.D.:	#1 905 Drum	
DESCRIPTION:	5 micron filtered rinse water (Peel-Away 1), mainly chemical use	
TAL Log #:	89-5159	
EP Toxicity	Arsenic, ppm	<0.10
	Barium, ppm	<0.25
	Cadmium, ppm	<0.50
	Chromium, ppm	<0.25
	Lead, ppm	4.0
	Mercury, ppm	<0.0010
	Selenium, ppm	<0.10
	Silver, ppm	<0.50

SAMPLE I.D.:	#2 905 Drum	
DESCRIPTION:	Vinegar and chem neutralizer wash (Peel-Away 1)	
TAL Log #:	89-5160	
EP Toxicity	Arsenic, ppm	<0.10
	Barium, ppm	3.20
	Cadmium, ppm	<0.50
	Chromium, ppm	<0.25
	Lead, ppm	**620.0 ***
	Mercury, ppm	insufficient sample
	Selenium, ppm	<0.10
	Silver, ppm	<0.50

SAMPLE I.D.:	#3 905 Drum	
DESCRIPTION:	Exterior heat gun chips (paint)	
TAL Log #:	89-5161	
EP Toxicity	Arsenic, ppm	<0.10
	Barium, ppm	<0.25
	Cadmium, ppm	<0.50
	Chromium, ppm	<0.25
	Lead, ppm	**52.0 ***
	Mercury, ppm	**1.80 ***
	Selenium, ppm	<0.10
	Silver, ppm	<0.50

SAMPLE I.D.:	#4 905 Drum	
DESCRIPTION:	5 micron rinse water filter (mainly chem use, Peel-Away)	
TAL Log #:	89-5162	
EP Toxicity	Arsenic, ppm	<0.10
	Barium, ppm	0.35
	Cadmium, ppm	<0.50
	Chromium, ppm	<0.25
	Lead, ppm	1.4
	Mercury, ppm	<0.0010
	Selenium, ppm	<0.10
	Silver, ppm	<0.50

SAMPLE I.D.:	#1 6155 Parkway	
DESCRIPTION:	Chem sludge (Peel-Away 1) some rag dye and paper	
TAL Log #:	89-5163	
EP Toxicity	Arsenic, ppm	<0.10
	Barium, ppm	0.47
	Cadmium, ppm	<0.50
	Chromium, ppm	<0.25
	Lead, ppm	1.0
	Mercury, ppm	0.0012
	Selenium, ppm	<0.10
	Silver, ppm	<0.50

SAMPLE I.D.:	#2 6155 Parkway	
DESCRIPTION:	5 micron filter/rinse water - mainly chem use (Peel-Away 1)	
TAL Log #:	89-5164	
EP Toxicity	Arsenic, ppm	<0.10
	Barium, ppm	<0.25
	Cadmium, ppm	<0.50
	Chromium, ppm	<0.25
	Lead, ppm	0.7
	Mercury, ppm	<0.0010
	Selenium, ppm	<0.10
	Silver, ppm	<0.50

SAMPLE I.D.:	#3 6155 Parkway	
DESCRIPTION:	5 micron filtered rinse water - mainly chem use (Peel-Away 1)	
TAL Log #:	89-5165	
EP Toxicity	Arsenic, ppm	<0.10
	Barium, ppm	0.28
	Cadmium, ppm	<0.50
	Chromium, ppm	<0.25
	Lead, ppm	<0.5
	Mercury, ppm	<0.0010
	Selenium, ppm	<0.10
	Silver, ppm	<0.50

SAMPLE I.D.:	#4 6155 Parkway	
DESCRIPTION:	5 micron filtered rinse water - mainly heat gun use	
TAL Log #:	89-5166	
EP Toxicity	Arsenic, ppm	<0.10
	Barium, ppm	<0.25
	Cadmium, ppm	<0.50
	Chromium, ppm	<0.25
	Lead, ppm	<0.5
	Mercury, ppm	<0.0010
	Selenium, ppm	<0.10
	Silver, ppm	<0.50

SAMPLE I.D.:	#5 6155 Parkway	
DESCRIPTION:	TSP and neutralizer wash (Peel-Away)	
TAL Log #:	89-5167	
EP Toxicity	**Arsenic, ppm**	**43.00 ***
	Barium, ppm	0.38
	Cadmium, ppm	0.50
	Chromium, ppm	<0.25
	Lead, ppm	**50.0 ***
	Mercury, ppm	<0.0010
	Selenium, ppm	<0.10
	Silver, ppm	<0.50

SAMPLE I.D.:	#6 6155 Parkway	
DESCRIPTION:	Wash used before neutralizer to clean gross chem from substrate (Peel-Away)	
TAL Log #:	89-5168	
EP Toxicity	Arsenic, ppm	0.52
	Barium, ppm	<0.25
	Cadmium, ppm	<0.50
	Chromium, ppm	<0.25
	Lead, ppm	**5.7 ***
	Mercury, ppm	<0.0010
	Selenium, ppm	<0.10
	Silver, ppm	<0.50

SAMPLE I.D.:	#1 5716 Sheridan	
DESCRIPTION:	5 micron filtered rinse water (sanding and Peel-Away 1)	
TAL Log #:	89-5169	
EP Toxicity	Arsenic, ppm	<0.10
	Barium, ppm	<0.25
	Cadmium, ppm	<0.50
	Chromium, ppm	<0.25
	Lead, ppm	<0.5
	Mercury, ppm	<0.0010
	Selenium, ppm	<0.10
	Silver, ppm	<0.50

SAMPLE I.D.:	#3 5716 Sheridan	
DESCRIPTION:	PAPR filter - mainly sanding	
TAL Log #:	89-5170	
EP Toxicity	Arsenic, ppm	<0.10
	Barium, ppm	0.69
	Cadmium, ppm	<0.50
	Chromium, ppm	<0.25
	Lead, ppm	0.9
	Mercury, ppm	insufficient sample
	Selenium, ppm	<0.10
	Silver, ppm	<0.50

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SAMPLE I.D.:	#11 6155 Parkway	
DESCRIPTION:	PAPR filter - mainly heat gun use	
TAL Log #:	89-5171	
EP Toxicity	Arsenic, ppm	0.17
	Barium, ppm	0.47
	Cadmium, ppm	<0.50
	Chromium, ppm	<0.25
	Lead, ppm	3.9
	Mercury, ppm	<0.0010
	Selenium, ppm	<0.10
	Silver, ppm	<0.50

SAMPLE I.D.:	#12 6155 Parkway	
DESCRIPTION:	PAPR filter - mainly chem stripper use (Peel-Away 1)	
TAL Log #:	89-5172	
EP Toxicity	Arsenic, ppm	<0.10
	Barium, ppm	0.76
	Cadmium, ppm	<0.50
	Chromium, ppm	<0.25
	Lead, ppm	<0.5
	Mercury, ppm	<0.0010
	Selenium, ppm	<0.10
	Silver, ppm	<0.50

SAMPLE I.D.:	#5 905 Drum	
DESCRIPTION:	Rug and pad	
TAL Log #:	89-5300	
EP Toxicity	Lead, ppm	<0.5

SAMPLE I.D.:	#6 905 Drum	
DESCRIPTION:	Plastic from floor and bags	
TAL Log #:	89-5301	
EP Toxicity	Arsenic, ppm	<0.10
	Barium, ppm	<0.25
	Cadmium, ppm	<0.50
	Chromium, ppm	<0.25
	Lead, ppm	**34.0 ***
	Mercury, ppm	<0.0010
	Selenium, ppm	<0.10
	Silver, ppm	<0.50

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SAMPLE I.D.:	#7 905 Drum	
DESCRIPTION:	Tyvek suit	
TAL Log #:	89-5302	
EP Toxicity	Arsenic, ppm	<0.10
	Barium, ppm	<0.25
	Cadmium, ppm	<0.50
	Chromium, ppm	<0.25
	Lead, ppm	**220.0 ***
	Mercury, ppm	<0.0010
	Selenium, ppm	<0.10
	Silver, ppm	<0.50

Tracor Technology Resources

Tracor Technology Resources, Inc.
a subsidiary of Tracor, Inc.
1601 Research Boulevard
Rockville, Maryland 20850
Telephone 301: 984 2800
FAX 301: 984 2817

2 February 1990

Mr. Chip Harris
Dewberry & Davis
8401 Arlington Blvd.
Fairfax, VA 22031-4666

Dear Mr. Harris,

Attached are results of analyses performed on waste samples collected at lead abatement sites in Birmingham, Alabama and Denver, Colorado (a sample of cedar shake). These samples were tested for one or more of the following hazardous waste characteristics as defined in the Code of Federal Regulations, Part 40:

> <u>Corrosivity (40 CFR 261.22)</u> - to identify wastes that might pose a hazard to human health or the environment due to their ability to mobilize toxic metals if discharged into a landfill; corrode handling, storage, transportation, and management equipment; or destroy human or animal tissue in the event of inadvertent contact.
>
> <u>Extraction Procedure (EP) Toxicity (40 CFR 261.24)</u> - designed to simulate the leaching a waste will undergo if disposed of in a sanitary landfill. If the extract obtained from the method contains any of the regulated substances (in this case, metals) in an amount equal to or exceeding specified levels, the waste possesses the characteristic of Extraction Procedure Toxicity and is a hazardous waste.

Based on our test results, the samples listed on the next page would be classified as hazardous wastes because they possess the characteristic of EP Toxicity for metals (primarily lead).

If you have any questions about this report, please call me at (301) 984-2827.

Yours truly,

Bonnie A. Barrows

Bonnie A. Barrows
Laboratory Manager

Enclosures

Tracor Technology Resources

Samples with the characteristic of EP toxicity for metals:

4033 Vallejo	cedar shake, wall 1, 2nd level
#2 1778 Jefferson	remove and replace samples (window frame & trim)
#5 1778 Jefferson	heat gun sludge
#8 4101 Main Street	heat gun sludge

HAZARDOUS WASTE CHARACTERISTICS

Characteristic	Regulatory Definition
Corrosivity	pH ≤ 2 or ≥ 12.5
EP Toxicity	Arsenic ≥ 5.0 ppm Barium ≥ 100.0 ppm Cadmium ≥ 1.0 ppm Chromium ≥ 5.0 ppm Lead ≥ 5.0 ppm Mercury ≥ 0.2 ppm Selenium ≥ 1.0 ppm Silver ≥ 5.0 ppm

NOTES

< = less than
≤ = less than or equal to
> = greater than
≥ = greater than or equal to
ppm = parts per million
ppb = parts per billion

Corrosivity - An aqueous solution having a pH ≤ 2 or ≥ 12.5.

Extraction Procedure (EP) Toxicity - An extraction procedure designed to simulate the leaching a waste will undergo if disposed of in a sanitary landfill.

REFERENCE

"Test Methods for Evaluating Solid Waste", SW-846, 3rd Edition, U.S. Environmental Protection Agency, Office of Solid Waste and Emergency Response, November 1986.

SAMPLE I.D.:	4033 Vallejo		
DESCRIPTION:	Cedar shake, wall 1, 2nd level		
TAL Log #:	90-145		
EP Toxicity	Arsenic, ppm	0.18	
	Barium, ppm	0.25	
	Cadmium, ppm	**4.90**	*
	Chromium, ppm	<0.25	
	Lead, ppm	**140.0**	*
	Mercury, ppm	<0.0005	
	Selenium, ppm	<0.05	
	Silver, ppm	<0.10	

SAMPLE I.D.:	#1 3425 38th Place		
DESCRIPTION:	Remove & replace (window, attic vent, door frame)		
TAL Log #:	90-146		
EP Toxicity	Lead, ppm	0.72	

SAMPLE I.D.:	#2 1778 Jefferson		
DESCRIPTION:	Remove & replace samples (window frame and trim)		
TAL Log #:	90-147		
EP Toxicity	**Lead, ppm**	**8.0**	* ✓

SAMPLE I.D.:	#3 1778 Jefferson		
DESCRIPTION:	Heat gun - respirator filter		
TAL Log #:	90-148		
EP Toxicity	Lead, ppm	0.54	

SAMPLE I.D.:	#4 1778 Jefferson		
DESCRIPTION:	Heat gun - Tyvek suit and rubber gloves		
TAL Log #:	90-149		
EP Toxicity	Lead, ppm	<0.50	

SAMPLE I.D.:	#5 1778 Jefferson		
DESCRIPTION:	Heat gun sludge		
TAL Log #:	90-150		
EP Toxicity	**Lead, ppm**	**12.0**	*

SAMPLE I.D.:	#6 4101 Main Street		
DESCRIPTION:	Heat gun - respirator filter		
TAL Log #:	90-151		
EP Toxicity	Lead, ppm	0.55	

SAMPLE I.D.:	#7 4101 Main Street		
DESCRIPTION:	Heat gun - Tyvek suit and rubber gloves		
TAL Log #:	90-152		
EP Toxicity	Lead, ppm	<0.50	

SAMPLE I.D.:	#8 4101 Main Street	
DESCRIPTION:	Heat gun sludge	
TAL Log #:	90-153	
EP Toxicity	**Lead, ppm**	**40.0 ***

SAMPLE I.D.:	#9 1415 30th Street	
DESCRIPTION:	Chemical treatment sludge	
TAL Log #:	90-154	
Corrosivity	11.9	
EP Toxicity	Lead, ppm	1.22

SAMPLE I.D.:	#10 1415 30th Street	
DESCRIPTION:	Chemical treatment - respirator filter	
TAL Log #:	90-155	
EP Toxicity	Lead, ppm	<0.50

SAMPLE I.D.:	#11 1415 30th Street	
DESCRIPTION:	Chemical treatment - Tyvek suit and rubber gloves	
TAL Log #:	90-156	
EP Toxicity	Lead, ppm	0.53

SAMPLE I.D.:	#12 4340 Greenwood	
DESCRIPTION:	Chemical treatment sludge	
TAL Log #:	90-157	
Corrosivity	11.9	
EP Toxicity	Lead, ppm	0.64

SAMPLE I.D.:	#13 4340 Greenwood	
DESCRIPTION:	Chemical treatment - respiratory filter	
TAL Log #:	90-158	
EP Toxicity	Lead, ppm	0.68

SAMPLE I.D.:	#14 4340 Greenwood	
DESCRIPTION:	Tyvek suit and gloves	
TAL Log #:	90-159	
EP Toxicity	Lead, ppm	0.99

TRACOR ANALYTICAL LABORATORIES
1601 RESEARCH BLVD.
ROCKVILLE, MD 20850
(301) 984-2827

SAMPLE RECEIVING AND TRACKING INFORMATION | YEAR 90 | LABORATORY NUMBER 145

RECEIVING INFORMATION

DATE/TIME REC'D: 01/08/90 3:30 PM BY: BB

DELIVERED VIA: Mail

DATE/TIME LOGGED: 01/09/90 10:30 AM BY: MA

CLIENT NAME, ADDRESS, PHONE NUMBER

Mr. Chip Harris
Dewberry & Davis
8401 Arlington Blvd.
Fairfax, VA 22031-4666
(703) 849-0380

SAMPLE DESCRIPTION AND CONDITION

X ROOM TEMP ___COOL ___FROZEN

MATRIX cedar shake

1 CONTAINERS MAKE UP 1 SAMPLES

ANALYSIS REQUESTED

Extraction Procedure Toxicity for lead
(need for other metals to be determined)

LOCATION

ROOM TEMP RT01 E REFRIGERATOR________ FREEZER________ OTHER________

COMMENTS

DATE REPORT DUE
01/29/90

DATE PHONE REPORTED

DATE REPORT WRITTEN

ASSIGNMENTS ISSUED		SUPERVISOR:
ANALYST	ANALYST	ANALYST
FUNCTION	FUNCTION	FUNCTION
ANALYST	ANALYST	ANALYST
FUNCTION	FUNCTION	FUNCTION
ANALYST	ANALYST	ANALYST
FUNCTION	FUNCTION	FUNCTION

SAMPLE RECEIPT NOTIFICATION: SAMPLES WERE RECEIVED AS DESCRIBED ABOVE. PLEASE REVIEW THIS INFORMATION AND CONTACT THE SAMPLE COORDINATOR IF THERE ARE ANY DISCREPANCIES. USE THE LABORATORY NUMBER GIVEN ABOVE IN ANY CORRESPONDENCE ABOUT THESE SAMPLES.

SAMPLE COORDINATOR Bonnie G. Barrows DATE 1/9/90

COPY TO: SAMPLE RECEIVING________ CLIENT ✓ PROJECT SUPERVISOR________

TRACOR ANALYTICAL LABORATORIES
1601 RESEARCH BLVD.
ROCKVILLE, MD 20850
(301) 984-2827

SAMPLE RECEIVING AND TRACKING INFORMATION

YEAR	LABORATORY NUMBER
90	146-159

RECEIVING INFORMATION

DATE/TIME REC'D 01/09/90 1:00 PM **BY** BB

DELIVERED VIA Mail

DATE/TIME LOGGED 01/09/90 2:00 PM **BY** MA

SAMPLE DESCRIPTION AND CONDITION

X ROOM TEMP ___COOL ___FROZEN

MATRIX various

14 CONTAINERS MAKE UP 14 SAMPLES

CLIENT NAME, ADDRESS, PHONE NUMBER

Mr. Chip Harris
Dewberry & Davis
8401 Arlington Blvd.
Fairfax, VA 22031-4666
(703) 849-0380

ANALYSIS REQUESTED

Extraction Procedure Toxicity for lead
(need for other metals to be determined)

LOCATION

ROOM TEMP RT01 E REFRIGERATOR________ FREEZER________ OTHER________

COMMENTS

DATE REPORT DUE 01/30/90

DATE PHONE REPORTED

DATE REPORT WRITTEN

ASSIGNMENTS ISSUED **SUPERVISOR:**

ANALYST	ANALYST	ANALYST
FUNCTION	FUNCTION	FUNCTION
ANALYST	ANALYST	ANALYST
FUNCTION	FUNCTION	FUNCTION
ANALYST	ANALYST	ANALYST
FUNCTION	FUNCTION	FUNCTION

SAMPLE RECEIPT NOTIFICATION: SAMPLES WERE RECEIVED AS DESCRIBED ABOVE. PLEASE REVIEW THIS INFORMATION AND CONTACT THE SAMPLE COORDINATOR IF THERE ARE ANY DISCREPANCIES. USE THE LABORATORY NUMBER GIVEN ABOVE IN ANY CORRESPONDENCE ABOUT THESE SAMPLES.

SAMPLE COORDINATOR [signature] DATE 1/9/90

COPY TO: SAMPLE RECEIVING________ CLIENT ✓ PROJECT SUPERVISOR________

Product Name	Contact	Telephone	Spec
Paint	Curtis L. Hickcox P.O. Box 460 Watertown, CT 06795	(203)274-6701	A
Encapsulant	Pro So Co, Inc. P.O. Box 171677 775 Minnesota Avenue Kansas City, KS 66117	(913) 281-2700	
Chemical	Diedrich Chemicals- Restoration Technologies, Inc. 300 E. Oak Street Oak Creek, WI 53154	(414) 764-0058	
Durex	Richard S. Will 165 Lee Highway, Suite 200 Warrenton, VA 22186	(703)347-4500	A
Encap	Roy Johnson 4500 Lee Road Cleveland, OH 44128	(216)662-6414	J,G,A
Tasso	John Sodervall 1239 E. Newport Center Dr. Suite 118 Deerfield Beach, FL 33442	(800)888-2776	J
Wallcovering	Donald W. Collier 400 S. 13th Street P.O. Box 1439 Louisville, KY 40201	(502)588-9200	J
Blasting	David M. Collins LTC 101 G Executive Dr. Sterling, VA 22170	(800)822-2332	B
Chemical	Donnie Bohrandt 3M Center Building 233-45-01 St. Paul, MN 51440	(612)736-1825	D
Certane	Peter Relick Certified Technologies 7404 Washington Avenue Minneapolis, MN 55344	(800)433-1892	A
Encapsulant	Dean O. Skinner Pentagon Plastics 3755 Fiscal Court Rivera Beach, FL 33804	(407)881-8995	A

LIST OF PRODUCT MANUFACTURERS

Product Name	Contact	Telephone	Spec
American Coatings	Mr. John Richards 8129 Austin Avenue Morton Grove, IL 60053	(800) 323-7580	A
Audax	S. William Feiss, Tr. 811 Morris Avenue Lutherville, MD 21093	(301)561-5040	A
Quickcrete	Michael Brown 932 Professional Place P.O. Box 1846 Chesapeake, VA 23320	(804)547-9411	A
Flex-Wall	William Levy Flex-Wall Systems P.O. Box 477 Liberty, SC 29657	(803)843-9318	J
Flame-Stop	James C. Bower Flame Stop Inc. P.O. Box 888 Roanoke, TX 76262	(817)431-3747	A
Pyrotite	Peter Policastro Arnold Greenfield 10330 USA Today Way Miramar, FL 33025	(305)436-2003	A
Senerflex	William Egan 1367 Elmwood Avenue Cranston, RI 02910	(401)467-2600	A
Fiber Tec	George F. Skinner 2631 Tuskaseegee Road Charlotte, NC 28208	(704)398-2758	A
Peel Away	Hyc Dumond 7501 Broadway New York, NY 10036	(212)869-6350	D
Serpiflex	Roger J. Rossignac International Protective Coatings 725 Carol Avenue Ocean, New Jersey 07712	(201)531-3666	A
Kapsulkote	Colin D. Penny P.O. Drawer E Hampton, VA 23669	(804)723-6524	A

Product Name	Contact	Telephone	Spec
Pipewrap	Karena S. Casey 3M St. Paul, MN	(612)733-1140	A
Thoro-Systems	Larry Miller Thoro-Systems Products 7800 NW 38th Street Miami, FL 33166	(305)592-2081	A&J
L&L Coatings	L&L Coatings Corporation 5102 Santa Fe Road Tampa, FL 33619	(813) 248-3704	A
Safe-Tex	Daniel T. Waterman Textilglas Inc. 200 W. 12th Street Waynesboro, VA 22980	(703) 949-4211	A&J

QUALITY ASSURANCE PROJECT PLAN
FOR COLLECTION AND ANALYSIS
OF AIR AND WIPE SAMPLES

Prepared by:

TRACOR TECHNOLOGY RESOURCES, INC.

Date Submitted:

June 16, 1989

QUALITY ASSURANCE PROJECT PLAN

FOR COLLECTION AND ANALYSIS

OF AIR AND WIPE SAMPLES

Prepared by:

Bonnie A. Barrows
Laboratory Manager
Tracor Technology Resources, Inc.

Approved by:

Daniel O. Chute Project Manager Tracor Technology Resources, Inc.	6-16-89 Date
Stephen S. Olin Quality Assurance Officer Tracor Technology Resources, Inc.	6/14/89 Date
William Fry Project Manager Dewberry & Davis	6/16/89 Date

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1.0 INTRODUCTION

The Department of Housing and Urban Development plans to conduct a major demonstration program involving lead-based paint in response to research and reporting requirements of Section 566 of the Housing and Community Development Act of 1987. The program necessitates the collection of data on exterior and interior abatement of lead-based paint in approximately 165 to 173 HUD-owned housing units. The objectives of the demonstration program are to obtain management, abatement, and data collection services to assist HUD in determining the effectiveness and costs of available lead abatement methods and in meeting reporting requirements of the Housing and Community Development Act by collecting data associated with this demonstration.

As part of the multi-disciplinary team participating in this demonstration program, Tracor Technology Resources has the following responsibilities:

- Develop worker protection and safety protocols;
- Develop and conduct worker protection and safety training sessions for abatement contractors;
- Carry out environmental and personnel monitoring;
- Monitor data collection and cleanup/waste disposal;
- Review technical information on new products for health, safety, and environmental concerns;
- Perform laboratory analysis of air and wipe samples collected during the study;
- Conduct final testing of all abated units.

This document serves as the approved quality assurance project plan only for the field work, sample collection, and analytical services required of Tracor Technology Resources under the terms of this contract. Issues to be addressed in the sections which follow include project planning; sample collection; analyses and measurements; statistical data processing and analysis; system, performance, and data audits; and quality assurance deliverables.

2.0 PROJECT PLANNING

2.1 Project Description

Tracor Technology Resources has the responsibility for collecting data on: 1) levels of surface lead dust before and after abatement of each unit processed, 2) amount of airborne lead dust in rooms or areas adjacent to rooms or areas where abatement is being conducted, and 3) lead dust levels in air in workers' breathing zones during abatement. Data on surface wipe samples will be used to compare levels of lead dust on surfaces before and after abatement. Information on pre-abatement wipe samples may be used to determine the relationship between the presence of lead-based paint in a unit and the levels of lead dust on surfaces. Post-abatement samples will be taken to monitor the efficacy of cleanup in the units. Airborne lead dust levels found in areas adjacent to abatement activity will serve as indicators of the effectiveness of containment procedures in use. Personal air monitoring data will provide information on potential worker exposure to lead dust during abatement.

2.2 Project Organization and Management

2.2.1 Project Responsibilities and Authority

The key individuals described below have major responsibilities for the successful conduct of this study. A company organization chart illustrating relationships among these personnel is provided in the Appendix.

Dan Chute, CIH - Mr. Chute is Director of Industrial Hygiene Services and TTR's Project Manager for this task. As such, he is responsible for overall project coordination in-house and serves as liaison between Tracor and the Prime Contractor. He will arrange for distribution of final data reports and monitor project status.

Stephen Olin, Ph. D - Dr. Olin is Director of Technical Operations, overseeing the Health Sciences and Laboratories Divisions at Tracor Technology Resources. As Acting Quality Assurance Officer for TTR, he is responsible for overall quality assurance for this project.

Stephen Schanamann, CIH - Mr. Schanamann is Manager of Technical Operations, Industrial Hygiene Services Department. He will assist Dr. Olin in the conduct of system, performance, and data audits for this project.

Bonnie Barrows, Laboratory Manager- Ms. Barrows is Manager of TTR's Analytical Laboratory. She is responsible for laboratory analysis design, operations, and quality control. Her duties include training of technical personnel involved in analysis of samples collected in the field.

Rene Filipowski, Industrial Hygienist - Ms. Filipowski supervises the field personnel and sampling teams utilized for this study. She is responsible for field sampling design and operations and sampling quality control.

2.2.2 Personnel Qualifications

Brief summaries of qualifications are given below for key individuals involved in this study. Resumes are provided in the Appendix.

Mr. Chute has been employed as an Industrial Hygienist for approximately eight years. His range of experience includes collection, analysis, interpretation, and reporting of industrial hygiene data; evaluation and management of health hazards in the work environment; asbestos monitoring and field surveys; recommendation and evaluation of control measures adopted in accordance with applicable OSHA standards and sound IH practices; development and conduct of worker training programs; and management of a variety of industrial hygiene projects. Mr. Chute played a major advisory role in the development of lead abatement regulations for the State of Maryland's Department of Health and Mental Hygiene. He has a M.S. in Industrial Hygiene and a B.S. in Environmental Health, and is a Board Certified Industrial Hygienist.

Dr. Olin has 28 years of experience as a chemist and manager. He is responsible for oversight and direction of all technical programs within the company, and is scientific advisor on various projects for Federal, State, and local government agencies. Programs under his management have included health hazard and risk assessments, toxicology evaluations, industrial hygiene, quality assurance audits, database development, health effects research, and others. Dr. Olin was part of a team which wrote "Procedure for Evaluation of Environmental Monitoring Laboratories" for the U.S. Environmental Protection Agency. He has a Ph. D in Organic Chemistry and a B.S. in Chemistry.

Mr. Schanamann recently joined the staff of the Industrial Hygiene Services Department at Tracor Technology Resources, bringing with him nine years of experience in the areas of analytical chemistry, asbestos abatement and regulations, and industrial hygiene. Prior to his arrival at TTR, Mr. Schanamann was employed by the U.S. EPA Office of Toxic Substances. He is currently responsible for project development and management and supervision of several IH tasks and surveys. Mr. Schanamann has a B.S. in Russian Language and Area Studies, with graduate work toward a degree in Environmental Science. He is a Board Certified Industrial Hygienist.

Ms. Barrows has worked in laboratory settings for approximately 11 years. Her areas of expertise include analytical chemistry, microbiology, aquatic toxicology, and environmental fate testing. She is experienced in trace analysis of metals by both flame and graphite furnace atomic absorption spectrophotometry, and in other instrumental and wet chemical techniques. Ms. Barrows has a M.S. in Oceanography and a B.S. in Biology.

Ms. Filipowski has been employed as an Industrial Hygienist at Tracor Technology Resources since 1988 and is involved with supervision of asbestos and lead abatement projects, indoor air quality assessments, hazard abatement, and health and safety training for lead and asbestos. She has seven years' experience in the fields of tissue and cell culture, in vitro assays, and molecular biology. Her degrees include a M.S. in Cellular Biology and a B.S. in General Biology.

The following individuals will primarily serve as Field Teams for the collection of samples before, during, and after lead abatement activities. They have received health and safety training in lead paint abatement. As work load increases, additional personnel will be trained to ensure that timely collection and processing of samples will be maintained.

Charles Wiles - Mr. Wiles has four years experience in field supervision of asbestos survey teams, calculation of cost estimates, and preparation of drawings to indicate location of asbestos hazards. He was employed for twelve years as a Field Engineer at Bechtel Power Corporation.

Lloyd Fox - Mr. Fox has been a member of TTR's Industrial Hygiene Services staff since 1988. His duties include on-site inspection and supervision of asbestos abatement projects and conduct of comprehensive building surveys. Mr. Fox has a B.S. in Zoology and an A.A. in Science-Math Education.

David Ward - Mr. Ward has six years of experience in the operation and maintenance of both mainframe and mini computers. His current duties as an Industrial Hygienist include indoor air quality assessments, HVAC system analysis, supervision of asbestos abatement projects, collection of samples, and review of Federal and state environmental regulations to determine client compliance. Mr. Ward's undergraduate studies were in the fields of Biology and Computer Science.

Ron Rosso - Mr. Rosso joined TTR's Industrial Hygiene Services staff in 1988. He provides asbestos abatement contractor supervision and collects and analyzes airborne asbestos samples on site. Prior to being employed by Tracor Technology Resources, Mr. Rosso worked for nine years as a carpenter for various companies involved in residential and commercial building construction. He has an A.S. in Construction Technology.

2.3 Experimental Design

2.3.1 Field Studies

2.3.1.1 Design of Field Studies

The parameters of concern in this study are levels of lead dust in air and amounts of residual lead on surfaces, both before and after abatement. Suitable sampling protocols which will be followed are provided in 1) NIOSH Method 7082 for collection of lead-containing dusts and aerosols, 2) the method for dust sample collection outlined in M. Fartel's doctoral thesis "Evaluation of Health and Environmental Effects of Two Methods of Residential Lead Paint Removal", and 3) the National Institute of Building Sciences "Guidelines for Testing, Abatement, Clean Up, and Disposal of Lead-Based Paint in Housing". Copies of these protocols may be found in the Appendix.

Questions concerning the number of samples to be collected and frequency of sampling required to meet the objectives of the overall project remain to be answered as part of this pilot study. Suggestions based on best available information were given in a letter dated 14 March 1989 to Mr. Chip Harris of Dewberry and Davis (see Appendix). It is anticipated that, as data become available, modifications to the program will be made in order to improve the usefulness of information generated.

The issue of samples lost or damaged during collection and shipment is a critical one, since the ongoing nature of the abatement process precludes resampling once a task is completed. A lost sample cannot be replaced, nor can data from a damaged sample be considered reliable. Tracor Technology Resources will report any incidents which result in loss of samples, and will routinely reject for analysis any damaged samples unless specifically authorized to proceed otherwise.

All field teams will be instructed to note and record any unusual occurrences or observations which could impact sample integrity or the quality of data ultimately generated. These comments could cover items such as environmental conditions at the abatement site or changes made in abatement procedures. This information will be included as part of required reports to the client.

2.3.1.2 Design of Quality Control Procedures for Sample and Data Collection

The nature of this study not only precludes resampling, but also obviates the preparation of true replicates, splits, or spikes in the field. Tracor Technology Resources proposes to collect side by side wipes and air samples at a rate of one for every ten samples collected as a measure of quality control in field procedures. It should be noted, however, that irregularities in surfaces or in distribution of dust could cause discrepancies in the results obtained from replicates taken in the manner described.

Field worksheets have been developed to facilitate the recording of sampling information. Items to be recorded include air flow, time and date of sample collection, sample type (background, personal, area, or final), sample description and location, technician's name, comments. A copy of the field forms are provided in the Appendix.

2.3.2 <u>Measurement Processes</u>

2.3.2.1 Instrument and Method Performance Characteristics

The use of internal quality control measures helps assure generation of quality data. Written laboratory Standard Operating Procedures (SOP's) describe minimum requirements for analytical quality control. These measures include the use of reference samples, duplicates, sample and matrix spikes, analysis of reagent blanks, and monitoring of analytical performance through the use of control charts.

Control charts are used to evaluate percent recoveries on quality control standards. These charts are prepared by determining the mean and standard deviation in percent recovery for a set of analyses run on known reference samples. The upper and lower control limits for the mean are set at ± 2 times the standard deviation of the data set. Once these levels have been calculated, the control chart is completed by drawing in lines indicating the position of the mean and the control limits. Percent recoveries for individual QC standards are then marked on the chart as the data becomes available.

An out-of-control situation is indicated when a point falls outside the control limit or when several points successively fall on one side of the mean. When these situations occur, the problem must be identified and resolved. Control charts are reviewed and updated periodically, particularly after changes are made in analytical methods.

The precision and accuracy of the analytical method and the instrumentation used will be monitored through the use of reference standards. Method performance can be characterized by processing a known standard along with the samples through any digestion or pretreatment steps required to get the samples in a form which can be read by the instrument. Instrument performance can be monitored through direct analysis of an otherwise untreated reference standard, with results compared to historical data on control charts. The two types of results (method QC and instrument QC) will have to be evaluated together to determine the source of any poor recoveries obtained.

Limit of detection is determined by the amount of baseline noise in the instrument reading. The less baseline noise present, the lower the limit of detection attainable. For AAS work, the limit of detection is defined as two times the baseline noise reading for a particular analysis.

2.3.2.2 Design of Measurement Processes

Analytical standards serve two purposes in the laboratory: calibration and internal quality control. Standards may be prepared from in-house materials (for calibration) or obtained from outside sources as reference materials (for quality control). Standards must be prepared freshly as often as needed to guarantee the quality of the material. Lead standards, for example, are good for up to six months if prepared and preserved properly.

A standard curve is prepared for each set of samples analyzed. For lead analyses, four standards are used to generate a calibration curve. If there are several samples to be analyzed, the calibration run is repeated at regular intervals during the analyses. For graphite furnace work, for example, recalibration would be scheduled about every two hours (approximately the time needed for a complete autosampler run). Recalibration is particularly necessary if the analyses will require several hours to complete or if there is drift in instrument response over that time period. Additional standards must be run whenever a problem is suspected in order to verify instrument performance or method reproducibility. A new standard curve must be established with each new batch of reagents.

Conversion of instrument readings to concentration values is automatically performed by the AA spectrophotometers that will be used for this project. The instrument records the values obtained from the calibration standards, then fits a curve to those points. Sample results are then computed by linear regression. The final value for each sample is corrected by the analyst if background corrections or dilution factors are involved.

Comparability of data is ensured through the use of standardized reporting formats, bench sheets, and consistent reporting units. Flame AAS results are recorded in bound notebooks, along with technician name, date of analysis, sample log number, comments on sample preparation or unusual observations, etc. Graphite furnace AAS raw data are printed out as hard copy by the instrument and are transcribed to bench sheets for further calculations.

2.3.2.3 Design of Quality Control Procedures for Measurement Processes

Each analytical run includes a dilution water blank, reagent blank, one QC standard, one spike to measure recovery, and one set of duplicate analyses. If there are more than ten samples in a run, then additional standards, spikes, and duplicates shall be processed at a rate of one set for every ten samples.

As with the field samples, true replicates and spikes cannot be run on samples which are consumed in their entirety in order to prepare them for instrumental analysis. Replicates and spikes can be run on digested, diluted samples at the rates specified in the preceding paragraph. A related problem is the lack of suitable reference standards (i.e., those which have the same matrix). In-house standards will be prepared by spiking filters and wipes with a known amount of a lead atomic absorption standard and processing them along with actual samples.

If quality control procedures indicate that there is a loss of statistical control in the measurement process, samples and reference standards will be reanalyzed. Since a reference standard will be run as a marker for every ten samples, the number of samples requiring reanalysis should be kept to a minimum; in other words, only those samples which fall between a good standard and a bad standard in the analytical sequence must be checked. An important point to bear in mind again is that, once samples are discarded, no opportunity exists for reprocessing them. Hence, quality control results must be evaluated prior to discarding digested samples. In practice, an experienced analyst uses this kind of "real time" monitoring of instrument performance routinely to alert him to problems before verifying them on a control chart.

2.3.2.4 Corrective Actions

Whenever data quality problems are known or suspected, the individuals responsible for instituting remedial actions will be notified immediately. This notification will almost always be verbal first, followed up in writing as part of the quality assurance record keeping process. Copies of written notification will be provided to the TTR Project Officer and Quality Assurance Officer. Any changes in procedures must be reviewed by project management and approved for use by the client. The client also has the right to be informed immediately (again, verbal notice being the fastest method of communication) of loss of data.

3.0 SAMPLE COLLECTION

3.1 Sampling Procedure

Air and wipe samples in the field will be collected in accordance with the NIOSH Method 7082 protocol for collection of lead-containing dusts and aerosols, the method for dust sample collection outlined in M. Fartel's doctoral thesis "Evaluation of Health and Environmental Effects of Two Methods of Residential Lead Paint Removal", and the National Institute of Building Sciences "Guidelines for Testing, Abatement, Clean Up, and Disposal of Lead-Based Paint in Housing". Copies of these protocols may be found in the Appendix. Air filter cassettes will be sealed, labelled, and placed in ziplock bags for transport to the laboratory. Wipe samples will be placed in labelled plastic coin tubes prior to shipment.

3.1.1 Description of Samples to be Collected

As discussed in Section 2.0, some of the questions on requisite numbers of field blanks, replicates, and sampling sites are being addressed as part of this pilot study. Please refer to the letter dated 14 March 1989 to Mr. Chip Harris provided in the Appendix. Based on available literature, the number of field blanks for air samples ranges from two to ten per batch of samples collected. At least one blank wipe sample will be provided with each set of samples submitted to the laboratory. It is anticipated that, as data are collected, more or fewer blanks may need to be run.

The number of replicates to be collected will be one side by side air or wipe sample for every ten samples collected. This target range may also be adjusted, but in no case shall fewer than one replicate be taken for every twenty samples.

The number of sampling sites to be tested is dependent upon the number of substrates being abated and the method used for abatement. Again, this issue will be addressed more precisely as project data become available.

3.1.2 Equipment

A lead abatement equipment checklist is provided in the Appendix. Air pumps will be checked in house to ensure that they are operational before being issued for use in the field. Pumps are charged daily and their filters changed as needed. Defective pumps are usually replaced rather than repaired since it tends to be more cost effective to do so. Rotometers and pumps will be checked against a primary standard at the beginning of the project and periodically thereafter, and performance information recorded and filed. For daily use, pumps are calibrated in the field against secondary standards (rotometers).

3.1.2.1 Equipment Performance Requirements

The preliminary calibration of pumps and rotometers against a primary standard will be used to develop performance requirements for the field equipment. Primary standards include a bubble buret, the Buck Calibrator, and the Gilibrator. The frequency of primary standard checks will be determined by usage patterns or occurrence of field accidents (such as dropping a pump).

Once standards for performance have been set, the equipment should not deviate more than 15% from those standards.

3.1.2.2 **Preventive Maintenance**

Most of the equipment to be used in the field are rugged and relatively maintenance free. The need to replace air lines and filters on sampling pumps will be determined through routine visual examination of the equipment before use.

3.1.2.3 **Corrective Action**

For field equipment, corrective action is clearly indicated when a piece of equipment breaks down or fails to perform properly based on the user's experience. The choice of action to take (repair or replace) will primarily be selected on the basis of time involved and cost effectiveness.

3.1.3 Sample Containers, Glassware, and Miscellaneous Supplies

Sample containers and miscellaneous supplies are listed on the Lead Abatement Equipment Checklist provided in the Appendix. The basis for selection of these materials is availability, ruggedness, reliability, and cost.

3.1.4 Contamination Avoidance

Since lead is a pervasive element, extra care must be taken by field teams to avoid contamination of samples. Data on field blanks will be used to monitor the incidence of contamination. Attention to housekeeping should eliminate most problems; practical steps include washing or wiping hands clean between samples, keeping wipe and cassette containers closed and protected from dust when not in use, wiping down templates and other equipment used on site, and wearing disposable clothing.

3.1.5 Methodology

The methods to be used for sample collection have previously been referenced (Sections 2.3.1.1 and 3.1). Copies are provided in the Appendix. Any deviations from established and approved methods will be documented in the field notes.

3.2 Sampling Sites and Site Access Approvals

Sampling sites include areas or rooms where abatement activity is occurring (for air samples) and the substrates being abated or which are exposed to dust from abatement activities (for wipe samples). Since the properties to be tested are owned by local offices of HUD, it is not anticipated that getting approval for site access will be a difficulty.

3.3 Sample Handling

3.3.1 Sample Identification and Sample Tracking

For this study, a sample identification code has been developed to uniquely identify each sample. The code consists of the following:

- A letter designation for air (A) or wipe (W),
- A one digit number as a city code,
- Unit number, and
- Sample number (consecutive within each unit).

This label is attached directly to each sample after collection. A second label is attached to each bag containing all samples from one unit. The information on this label includes:

- Air or Wipe (A or W) designation,
- City code number,
- Unit code number,
- Total number of samples,
- Date collected,
- Name of team leader, and
- Date samples are submitted to TTR's analytical laboratory.

Copies of both labels are provided in the Appendix. Copies of sample data forms are also included.

3.3.2 Shipping and Storage

Samples will be sealed in a polybag, packed in a cardboard box, then shipped daily to the analytical laboratory. For local tasks, field personnel may elect to hand carry samples to the Rockville facility.

Unlike many other types of environmental samples, lead dust on filters and wipes is stable. The most likely source of loss of sample integrity would be damage to samples during shipment. This possibility can be averted by working with a reliable carrier, using sturdy packing materials, and taking care that samples are packed with sufficient material to protect them from crushing.

3.4 Documentation of Work

Sample data will be recorded in ink on standard field forms and on abatement checklists (copies in the Appendix). Notes on daily activities will be recorded in bound notebooks issued for use by field personnel. Particular emphasis will be placed on the importance of recording deviations from standard procedures or unusual observations made on site.

4.0 ANALYSES AND MEASUREMENTS

4.1 Analysis Procedures

4.1.1 Reference Materials

As previously noted, there is a lack of suitable matrix-matched reference materials for use in internal quality control procedures. One alternative which will be used is to prepare in house QC standards by spiking filters and wipes with known amounts of a lead atomic absorption calibration standard. These standards can then be processed along with field samples. Another alternative will be to spike digested samples with a reference standard solution prepared from ampuled concentrates supplied by the U.S. Environmental Protection Agency's Environmental Monitoring and Support Laboratory (EMSL) located in Cincinnati, OH. These standards are used by laboratories nationwide for quality control programs and are verified through round robin testing.

Reference and calibration materials will be acquired from reliable laboratory suppliers and agencies. Lead standards and prepared reference materials will be stabilized by the addition of acid as a preservative. Preserved aqueous solutions are stable for up to six months and can be stored at room temperature. All prepared materials will be marked with preparation and expiration dates, storage requirements, initials of preparer, and analyte concentration.

4.1.2 Instrumentation

The following instruments will be used in the analytical laboratory for this project:

- Perkin Elmer Model 3030 Flame Atomic Absorption Spectrophotometer,
- Perkin Elmer Zeeman Model 3030 Graphite Furnace Atomic Absorption Spectrophotometer,
- Fisher Isotemp Model 186A Muffle Furnace,
- IEC Model HN-SII Centrifuge,
- Sartorius Model 1712 MP8 Analytical Balance,

Each type of laboratory equipment has a written standard operating procedure (SOP) which describes the methods for routine inspection, cleaning, maintenance, testing, calibration, and/or standardization of that instrument. Frequency of those checks varies depending upon the type of instrument and its usage pattern. Therefore, the SOP includes a realistic schedule for the procedures described. For example, the analytical balance is checked against Class S weights on the day of use. A calibration curve is prepared a minimum of once per day when the AA spectrophotometers are in use. Results of performance checks are recorded in log books or checked against control charts of reference standard recoveries.

Written records are maintained to document all inspection, maintenance, testing, calibration, and/or standardizing procedures. The records include a complete date, a description of the activity and actual findings, and the name or initials of the person performing the operation. This information is kept in a log book or in laboratory files.

4.1.2.1 Instrument Performance Requirements

The following performance requirements are expected to be obtainable for lead analyses with the AA spectrophotometers used in the laboratory:

Flame AAS:

Detection limit of 0.1 mg/l; sensitivity of 0.5 mg/l; optimum concentration range of 1 to 20 mg/l.

Graphite Furnace AAS:

Detection limit of 1 ug/l; optimum concentration range of 5 to 100 ug/l.

4.1.2.2 Demonstration of Achievement of Instrument Performance

Control charts are used to evaluate percent recoveries on quality control standards and hence the performance of the instrument. These charts are prepared by determining the mean and standard deviation in percent recovery for a set of analyses run on known reference samples. The upper and lower control limits for the mean are set at ± 2 times the standard deviation of the data set. Once these levels have been calculated, the control chart is completed by drawing in lines indicating the position of the mean and the control limits. Percent recoveries for individual QC standards are then marked on the chart as the data become available. Since reference samples will be processed with actual field samples, data on instrument performance will be collected each day that the instrument is in use.

4.1.2.3 Preventive Maintenance

The instruments to be utilized for the analytical portion of this project are generally not user serviceable, forestalling much in the way of routine maintenance. Parts such as graphite tubes, gaskets, and contact rings are replaced on an as needed basis. Both AA spectrophotometers will be checked by a trained service representative within the next month to ascertain that they meet manufacturer operation specifications.

4.1.2.4 Corrective Action

In the event of equipment failure or malfunction, the instrument will be taken out of use until the source of difficulties can be identified and resolved. Repairs performed as a result of equipment malfunction will be documented with a description of the defect and any remedial action taken.

Control charts designed to track trends in reference standard recoveries may also be used to monitor trends indicating deterioration in instrument function. An out-of-control situation is indicated when a point falls outside the control limit or when several points successively fall on one side of the mean. When these situations occur, the problem must be identified and resolved.

Equipment maintenance and calibration programs will be regularly monitored through inspections of instruments and log books during quality assurance audits. Deviations from established SOP's will be communicated to the supervisor who is responsible for taking required corrective action.

4.1.3 Instrument Calibration

For lead analyses by either graphite or flame AAS, four standards are used to generate a calibration curve. Standards for flame AAS are prepared directly from a 1000 ppm stock solution and fall within the linear range of the analysis (1 to 20 ppm). Graphite furnace AAS calibration standards are prepared by serial dilution of a 50 ppb stock solution. The dilutions are made by the programmable autosampler. The standards are selected so as to fall within the linear range of lead analysis by graphite furnace AAS (5 to 100 ppb). Additional standards may be utilized at the analyst's discretion, and must be run if linearity is not maintained.

4.1.4 Solvents, Reagents, and Chemicals

Reagents are available in many grades and qualities, including:

Technical - used for cleaning or non-quantitative purposes.

Purified - used for some qualitative analytical work where purity is not critical and specific contamination is noted to be absent.

ACS reagent - used for analytical work.

SpectroGrade - used in IR, AA, and UV applications.

Pesticide grade - used for pesticide determinations and other GC applications.

Primary - used for calibration, standardization, and preparation of standards.

The chemicals listed below are those most frequently used for the analyses required under the terms of this contract. Reagent grade chemicals will be purchased from a reputable supplier. Only acids marked as suitable for use in trace metal analyses will be used.

- Nitric Acid, 1 + 1
- Hydrochloric Acid, 1 + 1
- Hydrogen Peroxide, 30%
- Magnesium Nitrate, solution
- Ammonium Phosphate, solution

- Lead Reference Standard, 1000 ppm
- Compressed Air, in house source
- Acetylene, AAS grade, compressed
- Argon, high purity, compressed

The quality of all chemicals used in the analysis of filters and wipe samples will be evaluated from data collected on reagent blank analyses and quality control reference samples processed with test samples. Care is taken to avoid contamination of chemicals and reagents from spatulas, atmospheric dust, and moisture. Purchased reagents and chemicals are dated upon receipt and when opened. If expiration dates are listed on the supplier's label, the material is not used after that date. Oldest materials are used first before opening new bottles.

All prepared solutions and reagents are labelled to indicate identity, concentration or titer, storage requirements, and expiration date. Other information such as date prepared, solvent used, initials of preparer, etc., may be added if appropriate. No materials may be used after reaching the expiration date.

4.1.5 Glassware and Miscellaneous Supplies

Glassware and supplies to be used for analytical work include:

- Griffin beakers, glass, various sizes;
- Watch glasses;
- Pipettes, both volumetric and serological;
- Eppendorf pipettes, various sizes, with plastic disposable tips;
- Centrifuge tubes, plastic and/or glass, graduated;
- Volumetric flasks, various sizes;
- Hot plates/stirring plates;
- Electodeless discharge lamp, lead;
- Aluminum and plastic weighing dishes;
- Spatulas.

Additional materials are available in laboratory stock if needed.

4.1.6 Contamination Avoidance

As with field sampling, contamination of samples in the laboratory must be carefully avoided. Since the laboratory has been processing lead-containing samples (wipes, air filters, and paint chips) for several months, the most likely causes of contamination are bad housekeeping and insufficient cleaning of glassware.

Bench tops, hoods, instruments, and other surfaces will be cleaned frequently to remove dust, dirt, or spilled chemicals and reagents. Sample containers will be kept closed and the samples stored in secure areas when not in use. Analysts will be instructed to wash their hands frequently both for health reasons and to prevent cross contamination of samples.

All glassware used in the analysis of trace metals is washed in a detergent solution, then rinsed several times with tap water. Pipettes are soaked in a detergent solution, then rinsed with tap water in a pipette washer. The glassware and pipettes are rinsed once or twice with deionized water, then with a 1+1 nitric acid solution, followed by a final deionized water rinse. Effectiveness of cleaning will be evaluated from results on reagent blanks processed with the samples.

4.1.7 Methodology

The analytical method for the analysis of lead dust on filters is outlined in NIOSH Method 7082 in the Appendix. Exceptions to the protocol include:

- Reductions in the quantity of acid used during the digestion step - Experience has shown that smaller amounts of acid are sufficient to completely digest the filter.

- Reductions in the number of times that acid is added to the sample during digestion - Same reason as cited above.

- Elimination of the ashing step - Since the filters digest easily, we judge it unnecessary to take the samples to dryness during digestion.

- Substitution of graphite furnace AAS for flame techniques - It is anticipated that the higher sensitivity of furnace AAS will be necessary to detect the low levels of lead in many, if not most, of the air samples. Flame AAS will be used for any high level samples encountered.

The analytical method for the analysis of dust on wipe samples is similar to that used for air samples, with one major addition to the protocol. Samples are ashed at 550-600°C in a muffle furnace for approximately 2 hrs, then the residue left behind is acid digested as for air samples. Volumes of acid used will be adjusted as needed to ensure complete digestion of the residue. These samples occasionally require centrifugation as a final clearing step after digestion and dilution. The choice between flame and furnace techniques will be dictated by levels of lead expected in the samples.

4.1.8 Sample Identification and Sample Tracking

Incoming samples are received at the laboratory by the sample coordinator or designated alternate. This individual is responsible for obtaining any shipping documents and signing for the samples when required.

Sample information (client, analysis requested, matrix, date and time received, sample identification) is entered in the sample logging book. Each sample is assigned a unique serial log number and a storage location. The log number is carried through in all bench sheets, notebooks, reports, and other paperwork involving the samples. A sample receiving and tracking sheet is then prepared for each set of samples. One copy is forwarded to the client as sample receipt notification. A second copy is forwarded to the supervisor in charge of testing. The original tracking sheet and any shipping documents are filed in the sample receiving ring binder.

The supervisor prepares a laboratory assignment sheet for each analyst who will be working on the samples. The assignment sheet lists sample log numbers, project number, client name, sample location, date of receipt, and date results are due. The analyst is responsible for obtaining the correct samples from the receiving area and for maintaining custody of them while they are in his possession. Samples are signed in and out by initialing and dating the appropriate line in the log book.

When the analyst's assignment is completed, he must return any unused samples to the sample receiving area. He records the location of the raw data on his assignment sheet and returns it to the sample supervisor. The completed sheet is attached to the supervisor's copy of the tracking sheet and filed in a ring binder. This procedure facilitates locating raw data for preparation of reports and for quality assurance audits. Use of unique log numbers to identify samples received at the laboratory also permits tracking of the sample from time of receipt to generation of a final report.

4.1.9 Calculations

Once calibrated, the AA spectrophotometers automatically convert instrument readings to preliminary results (expressed as concentration). Additional calculations that will be required are corrections for dilution factors and blank corrections. Final results must be expressed as weight of lead per volume of air sampled or as weight of lead per surface area sampled. Examples of calculations follow.

Convert ppb to ug/l of air:

$$\frac{(\text{ Sample conc., ug/ml })(\text{ Sample vol., ml })(\text{ Dilution factor })}{\text{Volume of air sampled, l}}$$

Convert ug/l of air to ug/m^3 of air:

$$(\text{Conc. in air, ug/l})(1000\ \text{l/m}^3)$$

Convert ug/ft^2 to mg/cm^2:

$(ug/ft^2)(mg/1000\ ug)\ [(2.54\ cm/in)(12\ in/ft)]^2$

Convert ppm to mg/cm^2:

$$\frac{(\text{Sample conc., mg/l})(\text{Sample vol., ml})(\text{Dil. factor})(1/1000\ \text{ml})}{(\text{Area sampled, ft}^2)(929\ \text{cm}^2/\text{ft}^2)}$$

Convert ppb to mg/cm^2:

$$\frac{(\text{Sample conc., ug/l})(\text{Sample vol., l})(\text{Dil. factor})(\text{mg/1000 ug})}{(\text{Area sampled, ft}^2)(929\ \text{cm}^2/\text{ft}^2)}$$

4.2 Quality Control

4.2.1 Quality Control Samples

Each analytical run will include a dilution water blank, reagent blank, one quality control sample (known reference standard), one spike to measure recovery, and one set of duplicate analyses. If there are more than ten samples in a run, then additional standards, spikes, and duplicates shall be processed at a rate of one set for every ten samples.

For this project, true replicates and spikes cannot be run on the samples because they are completely consumed during sample pretreatment. Replicates and spikes can be run on digested, diluted samples at the rates specified in the preceding paragraph. A related problem is the lack of suitable reference standards (i.e., those which have the same matrix). In-house standards will be prepared by spiking filters and wipes with a known amount of a lead atomic absorption standard and processing them along with actual samples.

4.2.2 Method Performance Requirements

Matrix, dilution water, and reagent blanks will ideally contain no lead. Dilution water blanks used for AAS work must have a reading of 0.005 absorbance units or less. Reagent blanks frequently give readings higher than those obtained for the dilution water blanks. If the reading is less than 0.50 ppm (flame AAS) prior to any corrections for dilution, it is considered acceptable. Comparable acceptance limits for these types of samples have not yet been determined for graphite furnace AAS.

Sample and matrix spikes are expected to result in 90 to 110% recovery. Recoveries outside this range may indicate the presence of interferences of some kind in the sample or matrix.

Acceptable recoveries for reference standards run with air and wipe samples will be determined through the use of quality control charts. In practice, the analyst will be alerted to a problem if the recoveries are greater than 110% or less than 90%.

4.2.3 Control Charts

Copies of control charts for analysis of lead by atomic absorption are provided in the Appendix.

4.3 Documentation of Work

All measurements, analytical results, field notes, and any other observations relevant to this project will be recorded either in bound notebooks or on field/laboratory worksheets designed for this project. The information must be recorded in ink, with corrections made by single line cross out dated and initialed by the individual making the change. Descriptions of activities and methods should be sufficiently detailed to allow an auditor to reconstruct how a particular analysis or measurement activity was done. If standard procedures are followed, the person recording the information need only reference the source of the procedure (generally a written document) and note any deviations from that procedure.

5.0 STATISTICAL DATA PROCESSING AND ANALYSIS

The terms of this contract do not require Tracor Technology Resources to perform any statistical processing or analysis of reported data. Arrangements for statistical manipulation of reported data will be made by the Prime Contractor.

6.0 SYSTEM, PERFORMANCE, AND DATA AUDITS

Quality assurance is a monitoring system used to evaluate the effec_ tiveness of a quality control program. Adherence to established procedures in the field and laboratory are assessed during periodic system, performance, and data audits by the Quality Assurance Unit (QAU).

6.1 System Audits

The system audit is a qualitative inspection and review of the quality control system, both in the field and the laboratory. It includes both operational and non-operational elements such as standard operating procedures, record keeping, chain of custody procedures, instrument calibration, sample identification, data validation, personnel training, and others. The system audit ensures that quality assurance standards for the project can be met.

A preliminary system audit will be performed shortly after the initiation of work under this contract. A second audit may be performed approximately halfway through the project to ensure continued compliance with quality assurance standards. All audits will performed without prior notice to the laboratory or field personnel.

The Quality Assurance Unit will schedule and perform inspections as noted above. Written and signed records of each inspection will be maintained by the QAU. Records must show date of inspection, what was inspected, person performing the inspection, findings and problems, and action recommended to resolve problems.

Upon completion of the audit, the QAU will prepare and deliver a report of the results and/or findings to company management. A copy of the worksheet used during the audit is provided in the Appendix. The QAU completes the information at the top of the form, then lists comments and findings in the left-hand column. The report is circulated for replies from lab and field personnel and management. The original form is then returned to the QAU for filing. Audit reports may also be prepared in the form of memoranda for distribution to all affected parties. Corrective actions taken by management or laboratory personnel will be documented and the report filed.

6.2 Performance Audits

The performance audit is used to evaluate data generation activities in the field and the laboratory. This type of audit may take any of the following forms:

- o Worksheet reviews - The auditor checks lab and field worksheets and notebooks for completeness and accuracy of recorded information. The review may cover sample collection, receiving, and handling; analytical procedures; data recording; identification of instrument charts, etc.

- o Oral reviews - This form of audit is similar to the worksheet review in topic coverage, but the information is obtained through discussions with laboratory and field personnel. For example, an analyst may be asked to describe procedures followed and explain test results.

- o Work review - The auditor directly observes both field and laboratory procedures on site and notes adherence to or deviation from established practices.

Performance audits will be scheduled regularly by the Quality Assurance Unit at approximately two month intervals upon initiation of the project. All audits will performed without prior notice to the laboratory or field personnel. As with system audits, written and signed records of each inspection will be maintained by the QAU. Records must show date of inspection, what was inspected, person performing the inspection, findings and problems, and action recommended to resolve problems.

Upon completion of the audit, the QAU will prepare and deliver a report of the results and/or findings to company management. A copy of the worksheet used during the audit is provided in the Appendix. The QAU completes the information at the top of the form, then lists comments and findings in the left-hand column. The report is circulated for replies from lab and field personnel and management. The original form is then returned to the QAU for filing. Audit reports may also be prepared in the form of memoranda for distribution to all affected parties. Corrective actions taken by management or laboratory personnel will be documented and the report filed.

6.3 Data Audits

The data audit is a quantitative evaluation of the data measurement, processing, and analysis steps to verify that no systematic errors are being introduced at any point in the generation of data. This audit is used to verify the accuracy of mathematical and computer operations performed at every step from the generation of raw data to final statistical analyses.

A preliminary data audit will be performed by the Quality Assurance Unit shortly after initiation of the project and then at approximately two month intervals thereafter. All audits will performed without prior notice to the laboratory or field personnel. Written and signed records of each inspection will be maintained by the QAU. Records must show date of inspection, what was inspected, person performing the inspection, findings and problems, and action recommended to resolve problems.

Upon completion of the audit, the QAU will prepare and deliver a report of the results and/or findings to company management. If data handling deficiencies are discovered, the QAU will also schedule a meeting with appropriate personnel immediately after the audit in order to promptly resolve any problems. Copies of all reports and documentation of corrective actions will be kept on file by the Quality Assurance Unit.

6.4 Audit Responsibility, Results, and Remedial Action

The Quality Assurance Officer has primary responsibility for scheduling and conducting system, performance, and data audits. The QAO may select and train additional individuals to assist him in the performance of his duties. All audit reports must be reviewed and signed by the QAO, the auditor, the Director of Technical Operations, the Laboratory Manager (for audits of laboratory activities), the Director of Industrial Hygiene Services (for field audits), and the Project Manager. When deficiencies are found, remedial actions must be initiated by the supervisor directly responsible for the area for which deficiencies have been reported.

The conduct of audits, content of reports, and communication of results and findings are described in Sections 6.1, 6.2, and 6.3 above. In brief, a written report is generated and circulated for comments. All individuals who review the report must sign or initial it once their review is complete.

When remedial action is required, the form taken will depend upon the nature of the problem reported; examples include repair of equipment, additional training of personnel, modification of procedures, etc. The managers of laboratory and field personnel are responsible for initiating remedial action for problems in their respective areas. They must also ensure that the actions are taken to completion. The Project Manager has the authority to require verification of successful resolution of problems encountered during this study.

7.0 QUALITY ASSURANCE DELIVERABLES

The following quality assurance documents are deliverables under the terms of this contract:

- Quality assurance project plan;
- Results of system, performance, and data audits;
- Results of quality control analyses such as spikes, blanks, and reference samples.

An approved original copy of the quality assurance project plan will be delivered to the Dewberry and Davis Project Manager prior to commencement of the study. Additional copies will be forwarded to the following personnel at Tracor Technology Resources: Director of Technical Operations, Director of Industrial Hygiene Services Department, Project Quality Assurance Officer, Analytical Laboratory Manager, and Field Supervisor.

Results of system, performance, and data audits will be reported to the Project Manager upon completion of each audit. Inspection reports must be submitted in writing within one week after the audit; debriefing meetings may be scheduled immediately after the audit is completed to review any problems requiring prompt action. Copies of reports must be kept on file by the Quality Assurance Officer.

Results of quality control analyses performed in the laboratory will be provided along with analytical results for each set of samples submitted for analysis. The reporting schedule will depend upon the frequency of receipt of samples, but at minimum should be delivered monthly.

8.0 REFERENCES

1. Buxton, B., J. Orban, J.S. Warner. OTS Guidance Document for the Preparation of Quality Assurance Project Plans. Battelle Columbus Division, Columbus, OH., September 1987.

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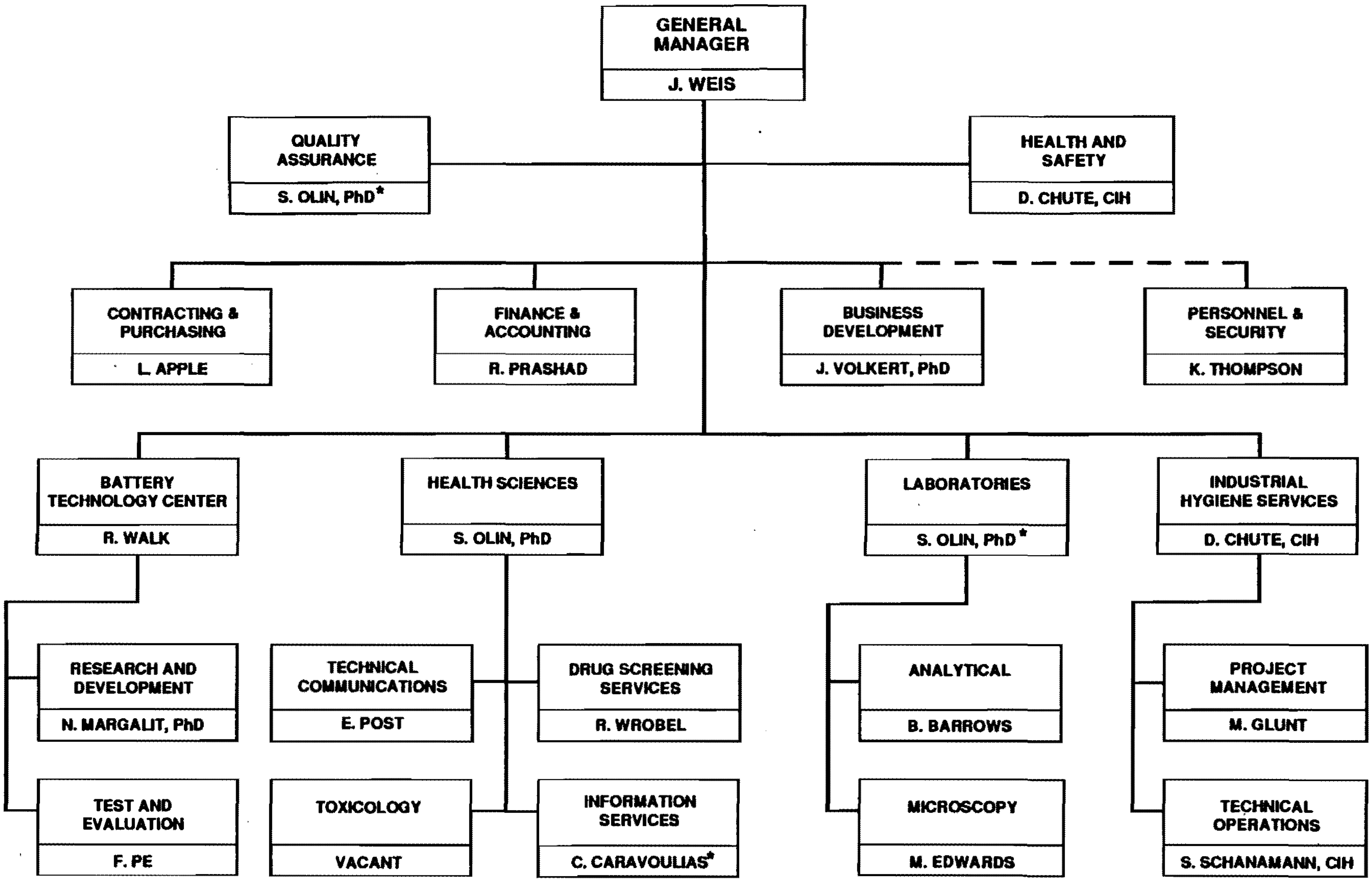
6. Methods for Chemical Analysis of Water and Wastes. EPA-600/4-79-20, Revised March 1983.

7. National Institute of Building Sciences. Guidelines for Testing, Abatement, Clean Up, and Disposal of Lead-Based Paint in Housing. Washington, D.C. 1989.

8. NIOSH Manual of Analytical Methods, Third Edition. U.S. Dept. of Health and Human Services, Public Health Service, Centers for Disease Control, National Institute for Occupational Safety and Health, February 1989 (First supplement dated May 1985, second supplement dated August 1987).

APPENDIX

TRACOR TECHNOLOGY RESOURCES ORGANIZATION



*ACTING

Approved MARCH 1989
J. Weis

DANIEL O. CHUTE, CIH

Education: M.S., Industrial Hygiene, Texas A&M University, College Station, TX, 1981.
B.S., Environmental Health, Old Dominion University, Norfolk, VA, 1977.

Experience:

1986 – Present Director, Industrial Hygiene Services, Tracor Technology Resources, Inc. (formerly Tracor Jitco, Inc.), Rockville, MD. Manage various industrial hygiene projects including safety and compliance consultations, indoor air quality assessments, radon testing asbestos identification and abatement monitoring and litigation support. Responsible for the management of nationwide lead abatement project in conjunction with HUD. Direct the activities of ten industrial hygienists with active projects in five states. Course Director for EPA-approved asbestos training programs under AHERA. Training Instructor for Lead Paint Abatement Health and Safety Training course.

1985 – 1986 Senior Industrial Hygienist, Industrial Hygiene Department, Newport News Shipbuilding and Dry Dock Company, Newport News, VA. Duties included conducting surveys and directing projects to evaluate the quality and consistency of industrial hygiene services delivered company-wide, affecting approximately 30,000 employees. This included evaluation of respiratory protection, protective clothing, chemical labeling; development and delivery of industrial hygiene presentations for new and experienced production and management employees; Coordinator for company compliance with OSHA Hazard Communication Standard; assigning handling requirements for chemical products used, updating and editing company safety and health procedures, and directing evaluations regarding the use of specific chemical compounds using in-house computerized data base. Also responsible for conducting industrial hygiene field evaluations at NNS satellite operations nationwide. Supervised asbestos survey and abatement activities at NNS.

1982 – 1985 Industrial Hygienist, Newport News Shipbuilding and Dry Dock Co., Newport News, VA. Responsible for identification of potential health hazards by sampling and analysis of appropriate data. This included recommendations of technologically and economically feasible control methods to management in accordance with applicable OSHA standards and sound industrial hygiene practices. Duties also included investigation of workers' compensation claims and responding to requests by physicians and other personnel for industrial hygiene services, and training other industrial hygiene personnel in the use of special environmental instrumentation so that all industrial hygiene instruments were used effectively and valid readings were obtained. Conducted regular evaluations of noise, heat stress, lead work, radiological control procedures, respiratory protection, welding, spray painting, machine shop and foundry operations, abrasive blasting and chemical handling. Conducted asbestos surveys, performed numerous microscopic analyses for asbestos, monitored asbestos concentrations in air during abatement projects.

1981 – 1982 Associate Industrial Hygienist, Newport News Shipbuilding and Dry Dock Co., Newport News, VA. Responsibilities included collec- tion, analysis, interpretation and reporting of industrial hygiene data necessary for the evaluation and management of health hazards in the work environment; writing and revising procedures for working with and handling toxic materials; participation in the design and application of work support equipment such as ventilation systems,, heating, lighting and personal protective equipment. Participated in shipboard asbestos inspection and abatement monitoring.

1980 Industrial Hygienist (summer position), Norfolk Naval Shipyard, Portsmouth, VA. Responsibilities included air sampling, hazard evaluations, noise monitoring and conducting training sessions.

1978 – 1979 Water Quality Specialist, Division of Environmental Services, City of Norfolk, VA. Responsible for the detection and abatement of pollutional hazards to the public potable water system. Emphasis placed on commercial cross–connection control.

1977 – 1978 Rodent Control Technician, Department of Public Health, City of Norfolk, VA. Conducted surveys of target urban areas for infestations and submitted regular written reports on findings, assisted in tabulation of data, and initiated abatement procedures.

Certifications:

Certified Industrial Hygienist, Comprehensive Practice (American Board of Industrial Hygiene Certificate No. 2969).

Supervision of Asbestos Abatement Projects, Georgia Institute of Technology, 1987.

Microscopical Identification of Asbestos, McCrone Institute, 1986.

AHERA Inspection/Management Planning–Asbestos Abatement. Certificate Granted, 1988.

Commonwealth of Virginia Asbestos Licenses for Project Designer, Inspector, Management Planner, and Supervisor.

State of Rhode Island, Dept. of Health Certification for Asbestos Consultant Services.

Lead Abatement Worker Training (Supervision of Lead Projects), Leadtec Services, Inc. Certification, 1989–1994.

Registered Environmental Assessor, State of California.

Professional Affiliations:

Member, Potomac Chapter, American Industrial Hygiene Association.

Full Member, American Industrial Hygiene Association (National Organization).

Faculty Member, Medical College of Virginia, Asbestos Training Programs.

STEPHEN S. OLIN

<u>Education</u>:

Ph.D., Organic Chemistry, Columbia University, 1967.
B.S. (with Distinction), Chemistry, Purdue University, 1963.
Industrial Toxicology Short Course, Wayne State University, Detroit, MI, November, 1978.
Chemical Carcinogenesis Short Course, San Francisco ACS Meeting, Sponsored by American Chemical Society, August 1976.
Wiswesser Line Notation Short Course, Sponsored by Maryland Section, American Chemical Society, April 1975.

<u>Experience</u>:

1986 – Present: Director of Technical Operations, Tracor Technology Resources, Inc. (formerly Tracor Jitco, Inc.), Rockville, MD. Responsible for oversight and direction of all technical programs within the company. Scientific advisor on various projects for Federal, State, and local government agencies.

1984 – Present: Principal Investigator, NCI/DCE Information Resource Contract, Tracor Jitco, Inc. Support for NCI Chemical Selection Process, preparation of drafts of IARC/WHO Monographs on the Evaluation of the Carcinogenic Risk of Chemicals to Man, participation in IARC expert working group meetings, and development and maintenance of the NCI/NLM Chemical Carcinogenesis Database (CCRIS).

1983 – 1986: Director, Office of Engineering and Health Sciences, Tracor Jitco, Inc. Administered programs of Engineering and Health Sciences Office, including health hazard and risk assessments, toxicology evaluations, industrial hygiene, quality assurance audits, and management and policy analysis.

Principal Investigator, NCI/NTP Carcinogenesis Testing Program, Tracor Jitco, Inc. Directed the final months of this program, overseeing all technical and fiscal activities during the phase-out period. Manager of Tracor Jitco quality assurance support contract activities. Technical advisor for development of EPA Gastrointestinal Absorption Database.

1981 – 1983: Deputy Director, Sciences Division, Tracor Jitco, Inc. Responsible under the Director for technical and fiscal management of the Sciences Division, comprising over 40 professionals and support staff. Program administration, new business development, personnel management, budget projections, technical oversight.

1978 – 1983: Associate Director, Tracor Jitco, Inc. Prime Contract to manage the National Cancer Institute/National Toxicology Program Carcinogenesis Testing Program. Responsible, under the Director, for scientific management of all phases of the $100 million program in which chemicals are tested in rodent bioassays for acute and chronic toxicity and oncogenicity. Supervised the work of 20 senior scientists (doctorate level) and a support staff of approximately 15. Program leader at onsite inspections of laboratories. Manager, NTP Technical Reports Group. Evaluated the physical/chemical properties, toxicity, and potential health effects of over 400 chemicals from all structure/use categories.

Project Manager, EPA (Office of Toxic Substances) Contract for Acute Health Hazard Assessment. Produced state-of-the-art reports on Eye Irritation Testing Methods and Dermatotoxicity Testing Methods. Assisted EPA (OTS) in the establishment of on-line data bases on aquatic toxicity and dermal absorption, including literature search and acquisition, organization, and data extraction and evaluation.

1974 - 1978 Senior Staff Scientist, Tracor Jitco, Inc., chief chemist, National Cancer Institute Carcinogenesis Bioassay Program Prime Contract. Member and Consultant, Chemical Selection Working Group (selects chemicals for testing in the Program). Co-chairman/executive secretary, Experimental Design Group. Responsible for procurement and analysis of all chemicals entering the Program. Developed Dosage Analysis and Chemical Reanalysis Programs. Wrote and reviewed Chemistry sections of Summary Reports on the bioassay results. Head, Toxicology and Safety Information Search Group. Wrote the draft NCI Guidelines for Inhalation Carcinogenesis Bioassay. Project officer for two analytical subcontracts and two bioassay subcontracts. Monitored the analytical work of 20 subcontract laboratories.

Chemist on the three-man team which wrote the Procedure for Evaluation of Environmental Monitoring Laboratories for the U.S. Environmental Protection Agency, EPA Contract No. 68-03-2171. Involved visiting a number of EPA labs, identification of apparatus and procedural requirements for the proper analysis of all EPA specified water and air parameters, and development of a manual for use in evaluating and rating environmental monitoring laboratories.

EPA Symposium on Biological Test Methods, Las Vegas, Nevada. (September, 1977). Chairman, Working Group on Chemical/Physical Methods.

1969 - 1974 Assistant Professor, Department of Chemistry, University of Maryland, College Park, Maryland. Carbenes, thermal rearrangements of strained hydrocarbons, photochemical transformations. Taught Courses in organic chemistry (undergrad) and spectroscopic methods (graduate); coordinated Undergrad Research Course. Developed non-thesis Masters Program in Chemistry.

1967 - 1969 Postdoctoral Research, University of Wisconsin, Department of Chemistry, Madison, Wisconsin, under Prof. Jerome A. Berson (now at Yale University). Thermo and photochemistry of some cyclic azo compounds.

1963 - 1967 Ph.D. Research, Columbia University, Department of Chemistry, New York, New York, under Prof. Ronald Breslow. Free-radical cyclization of terpenes.

Teaching Assistant, Organic and General Chem Labs (including Head of Organic Labs, 1964-1965).

1963 Shell Research Labs, Wood River, Illinois. Autoxidation of esters.

1962	Eli Lilly Co., Indianapolis, Indiana. Synthesis of some heterocyclic potential CNS depressants.
1961	Purdue University, Department of Chemistry, W. Lafayette, Indiana. Dithiocarbamates and related sulfur compounds as oxygen radical scavengers in radiation protection.

Fellowships, Scholarships, and Research Grants:

09/71 – 12/73	American Chemical Society – Petroleum Research Fund, Type AC Grant
09/70 – 02/72	Research Corporation Frederick Gardner Cottrell Grant
06/70 – 09/70	Maryland Research Board Summer Fellowship
12/67 – 08/69	National Cancer Institute Postdoctoral Fellowship
09/65 – 08/67	Public Health Service Biochemistry Traineeship
09/64 – 06/65	DuPont Teaching Fellowship in Organic Chemistry
06/64 – 09/64	National Science Foundation Summer Fellowship
09/59 – 06/63	Alfred P. Sloan Undergraduate Scholarship

Memberships/Societies:

Alpha Chi Sigma, Sigma Xi, Phi Lambda Upsilon, Delta Rho Kappa (Purdue), Phi Eta Sigma, American Association for Laboratory Animal Science, American Chemical Society (Divisions of Organic Chemistry and Chemical Health and Safety), American Industrial Hygiene Association (Potomac Section).

Publications:

Stephen S. Olin, "Data Evaluation and Management", Chapter in Chemistry for Toxicity Testing, eds. C.W. Jameson and D. Walters, Butterworth, 1984.

E. A. Murrill, E. J. Woodhouse, S. S. Olin, and C. W. Jameson, "Carcinogenesis Testing and Analytical Chemistry", Analytical Chem., 52, 1188A (1980).

Stephen S. Olin and Richard M. Venable, "Rearrangements of Bicyclic Cyclopropylcarbenes. Stereochemistry of the Fragmentation Reaction", J.C.S. Chem. Comm., 273 (1974).

J. A. Berson, S. S. Olin, E. W. Petrillo, and P. Bickart, "Stereochemistry and Mechanism of the ($\sigma 2 + \sigma 2 + \sigma 2$)Cycloreversion", Tetrahedron, 30, 1639–1649 (1974).

Stephen S. Olin and Richard M. Venable, "Rearrangements of Bicyclic Cyclopropylcarbenes. Temperature Dependence of Product Ratios", J.C.S. Chem. Comm., 104 (1974).

J. A. Berson and S. S. Olin, "Nonreversal of Stereochemistry in the Photochemical Counterpart of a Thermal Retrograde Cycloaddition", J. Amer. Chem. Soc., 92, 1086 (1970).

J. A. Berson and S. S. Olin, "The Geometry of the Transition State of the Retrograde Homo Diels–Alder Reaction. A Stereo-specific Conversion of 1,3- to 1,4-Dienes", J. Amer. Chem. Soc., 91, 777 (1969).

R. Breslow, S. S. Olin, and J. T. Groves, "Oxidative Cyclization of Farnesyl Acetate by a Free Radical Path", Tetrahedron Letters, 1837 (1968).

R. Breslow, J. T. Groves and S. S. Olin, "A Novel Oxidative Terpene Cyclization", Tetrahedron Letters, 4717 (1966).

Presentations:

T. Cameron, M. Stump, D. Tidwell, S. Olin, T. Junghans, and C. Cueto, "CCRIS: Chemical Carcinogenesis Research Information System", Poster Session and Demonstration, Society of Toxicology, 26th Annual Conference, Washington, D.C. (February 1987).

S. S. Olin, "Asbestos Survey Procedures", Paper presented at the National Conference of State General Service Officers, Baltimore, MD (April 1987).

C.M. Auer, L. Blaine, and S.S. Olin, "The Dermal Absorption/Toxicity Data Base," Poster Session, Third Annual Meeting, Society of Environmental Toxicology and Chemistry, Arlington, VA (November, 1982).

R.C. Russo, C.M. Auer, L. Blaine, and S.S. Olin, "AQUIRE: The Aquatic Information Retrieval Data Base", Poster Session, Third Annual Meeting, Society of Environmental Toxicology and Chemistry, Arlington, VA (November, 1982).

S. S. Olin, "Data Evaluation and Management," Invited Paper at the 183rd National Meeting of the American Chemical Society, Symposium on Chemistry and Safety for Toxicity Testing of Environmental Chemicals, Las Vegas, Nevada (March, 1982).

K. J. Falahee, C. S. Rose, S. S. Olin, H. E. Seifried, N. P. Page, and D. Sawhney, "Evaluation of Eye Irritation Testing," Paper No. 483, Society of Toxicology 21st Annual Conference, Boston, Massachusetts (February, 1982).

Stephen S. Olin and Richard M. Venable, "Rearrangements of Bicyclic Cyclopropylmethylenes. Stereochemistry and Substituent Effects", Abstracts of Papers, 164th Meeting, American Chemical Society, New York (Fall, 1972), ORGN 119.

R. E. Davis, A. Cohen, S. Molnar and S. S. Olin, "Reactions of Antiradiation Drugs with Peroxides and Free Radicals", Abstracts of Papers, 141st Meeting, American Chemical Society, Washington, D.C. (March, 1962), p. 36 N (Anti-Radiation Symposium).

STEPHEN R. SCHANAMANN, CIH

Education: Work towards M.S. Degree in Environmental Science, Florida Institute of Technology, Melbourne, FL, 1976–1978.
Undergraduate courses in Math and Science to prepare for graduate work, George Mason University, Fairfax, VA, 1974–1976.
B.S., Russian Language and Area Studies, University of Illinois, Champaign, IL, 1967–1971.

Employment:

1989 – Present Manager, Technical Operations, Industrial Hygiene Service Department, Tracor Technology Resources, Inc., Rockville, MD. Responsible for project development, management and overall supervision on asbestos abatement projects, environmental risk assessment surveys, lead abatement, PCB abatement, and indoor air quality assessments. Supervise eight Industrial Hygienists.

1988 – 1989 President, Atlantic Asbestos Abatement and Consulting, Inc., Miami, FL. A company which offers asbestos and environmental inspection, consultation, management, and training services for the East coast. During 1989, the company performed AHERA inspections and developed management plans for over 125 school systems, developed, received EPA approval for and taught a AHERA Asbestos Abatement Worker Training Course, developed abatement specifications, and provided project management for abatement projects across Florida.

1984 – 1988 Environmental Protection Specialist, U.S. Environmental Protection Agency. Coordinated $3.6M of grants to States for asbestos contractor, inspector, and management planner programs; assisted in drafting of rivised NESHAP rule; assisted in drafting and negotiating AHERA asbestos regulation; managed and edited asbestos supervisor, inspector and management planner training courses; taught asbestos training courses at four universities; provided technical assistance on asbestos in public presentations, written and telephone communications.

1980 – 1984 Industrial Hygienist, Virginia State Health Department. Development and monitoring of worker protection programs on sites contaminated with hazardous or toxic materials; consultation in residential and commercial buildings on indoor air quality; conducted commercial and industrial health inspections; enforced City and State noise, air pollution, water pollution, and hazardous substance ordinances; gave public presentations on toxic, hazardous and radioactive materials programs.

1979 – 1980 Chemist, City of Tampa, FL. Analyzed drinking water, industrial effluents, and wastewater for compliance with City and State regulations; performed tests using wet chemistry, atomic absorption spectroscopy, and automatic analyzers.

1978 – 1979 Carpenter, employed by several companies. Duties: ship repair, layout carpentry, general carpentry.

Certifications:

Board Certified, Comprehensive Practice, American Board of Industrial Hygiene. Certificate No. 3821, December 1987.

Certified EPA Project Officer, May 1985.

Accredited, Asbestos Building Inspector, U.S. Environmental Protection Agency, Certificate No. 078, per Georgia Institute of Technology, October 1987.

Accredited, Asbestos Management Planner, U.S. Environmental Protection Agency, Certificate No. 069, per Georgia Institute of Technology, October 1987.

Accredited, Supervisor and Designer of Asbestos Abatement Projects, U.S. Environmental Protection Agency, per Georgia Institute of Technology, and Medical College of Virginia, December 1984 and March 1988.

Re-Accredited, Asbestos Inspector and Management Planner, TREEO Center, University of Florida at Gainesville. Certification No. R9214-9008 for Inspector and R9214-9009 for Management Planner, April 1988.

Re-Accredited, Asbestos Inspector and Management Planner for the State of Virginia, Medical College of Virginia, Richmond, VA. Certificate Nos. (for both accreditations) 226-68-0862, May 1989,

Industrial Hygiene Training:

Graduate courses in Environmental Science including: Fresh Water Chemistry, Hazardous Waste Management, Environmental Statistics, Computer Statistical Analysis, Health Physics, Air Pollution, Water Pollution, Industrial Cost Engineering, 1976-1978.

"Industrial Hygiene for Health Professionals," Johns Hopkins University, Baltimore, MD, April 1981.

Plant Inspection and Evaluation Course, PEDCO Environmental, Inc. on contract to EPA, December 1981.

Radiation Defense Officer Course, FEMA, May 1983.

"Noise Abatement Fundamentals" and "Advanced Noise Abatement Procedures," Noise Technical Assistance Center, University of Maryland, College Park, MD, August 1983.

"Visible Emissions Evaluation Course - Percent Opacity Technique," Virginia State Air Pollution Control Board, April and October 1983.

Indoor Air Pollution Conference, American Industrial Hygiene Association, Atlanta, GA, March 1984.

"Supervision of Asbestos Abatement Projects," Georgia Institute of Technology, December 1984.

"Comprehensive Review of Industrial Hygiene," RMCOEH, University of Utah, Salt Lake City, August 1985.

"Inspecting Buildings for Asbestos-Containing Materials" and "Managing Asbestos in Buildings," Georgia Institute of Technology, October 1987.

"Supervision of Asbestos Abatement Projects," Medical College of Virginia, (update), March 1988.

"NIOSH 593, Occupational Respiratory Protection," National Institute for Occupational Safety and Health, Cincinnati, OH, November 1988.

"NIOSH 582, Sampling and Analysis of Airborne Asbestos," Deep South Center for Occupational Safety and Health, University of Alabama at Birmingham, Birmingham, AL, January, 1989.

Publications:

Schanamann, S. Air Monitoring is not Enough to Estimate Future Asbestos Hazards, Occupational Health and Safety, August 1986, pp. 31-35,

Schanamann, S. AHERA'S Impact on Industrial Hygienists, Applied Industrial Hygiene, July 1987, pp. F24-F28.

Schanamann, S. Trends in the Asbestos Industry. In: The Asbestos Abatement Industry Directory, published by the National Insulation Contractor's Association, April 1988, pp. 7-8.

Guidance for Controlling Asbestos-Containing Materials in Buildings (also known as the Purple Book), USEPA, 1985; Member of work group that developed the document.

Simplified Sampling Scheme for Friable Surfacing Materials, USEPA, 1986; Member of work group that developed the document.

Model Guide Specifications: Asbestos Abatement in Buildings, National Institute of Building Sciences, July 1986; Represented EPA in work group that produced the specifications.

BONNIE A. BARROWS

Education:	M.S., Oceanography, Old Dominion University, 1983. B.S., Biology, College of William and Mary, 1976.

Experience:

1985 – Present	Associate Scientist, Tracor Technology Resources, Inc. (formerly Tracor Jitco, Inc.), Rockville, MD. Chairman, Tracor Jitco Health and Safety Committee. Responsible for management and technical supervision of Tracor Analytical Laboratories, set up to analyze EPA hazardous wastes/priority pollutants and provide R and D and analytical support in the development of chemical warfare agent simulants for the Navy. Oversee all aspects of laboratory design and function, including selection and purchase of equipment and furniture, preparation of laboratory standard operating procedures according to EPA/FDA Good Laboratory Practice standards, development of a quality assurance program, and review of analytical procedures. Evaluate and prepare technical proposals, and direct laboratory marketing activities. Analyze samples by atomic absorption and UV/VIS spectrophotometry, gas chromatography, and wet chemical methods.
1984 – 1985	Study Director, Environmental Chemistry Laboratory, Biospherics, Inc., Rockville MD. Planned, set-up, and conducted environmental fate studies and aquatic toxicity tests of materials regulated under TSCA, FIFRA, and OECD guidelines. Coordinated internal analytical support for fate/toxicity studies. Worked closely with clients to establish testing schedule and design. Supervised activities in Microbiology Laboratory to ensure compliance with Maryland State Certification requirements for drinking water analyses. Coordinated preparation of materials for industrial hygiene microbial surveys.
1983 – 1984	Supervisor/Project Leader, Water/Wastewater Laboratory, Biospherics, Inc., Rockville, MD. Served as analytical chemist and bench supervisor for a staff of chemists and technicians. Prepared work assignments, resolved technical problems with analytical methods, and trained analysts in wet chemistry procedures. Operated, maintained and repaired a Technicon AutoAnalyzer. Assumed management role with the 1983–1984 Montgomery County analytical chemistry contract, acting as primary liaison between Biospherics and Montgomery County officials. Responsible for timeliness and accuracy of data reports and accounting of billing revenues.
1981 – 1983	Laboratory Supervisor, The Bionetics Corporation, Hampton, VA. Supervised technical staff and coordinated flow of analytical work in water/wastewater laboratory. Assisted Laboratory Manager with his duties and with training of personnel. Performed both wet chemical and advanced instrumental analyses.
1978 – 1981	Laboratory Technician, The Bionetics Corporation, Hampton, VA. Performed a wide variety of standard analytical tests on water and wastewater samples. Techniques mastered included both wet chemical determinations and microbiological analyses. Responsibilities included

preparation and standardization of reagents, calibration of instruments, and data reduction.

1976 – 1977 Animal Technician, St. Lukes' Hospital, Cleveland, OH. Cared for small laboratory animals needed for lung disease studies run in the Department of Pathology Research. Developed a breeding program to maintain a strain of mice bearing unusual genetic characteristics. Assisted at necropsies and with experimental procedures.

Special Skills:

Strong technical capabilities in the areas of wet chemistry, instrumental analyses, toxicity testing, and environmental fate studies. Comprehensive educational background coupled with hands-on experience in the field of aquaculture, aquatic biology, and oceanography. Experienced in dealing effectively with clients and coworkers.

Training:

Atomic Absorption Spectrophotometry, basic and advanced techniques, 1986 (through Perkin-Elmer, Inc., Rockville, MD).
Radiation Safety Officer Training Program, 1985, Dorsey, MD (through RSO, Inc., Laurel, MD).
Basic Programming, 1985, Montgomery County Department of Parks and Recreation, introductory adult education course, Rockville, MD.
Computer Concepts, 1984, Montgomery College, continuing education course, Rockville, MD.
Basic Gas Chromatography, 1983, Old Dominion University, Norfolk, VA.

Memberships/Societies:

Society of Environmental Toxicology and Chemistry
American Association of Zoological Parks and Aquariums.

RENE M. FILIPOWSKI

Education:	M.S., Cellular Biology, The Catholic University of America, Washington, DC, 1985. B.S., General Biology, The Catholic University of America, Washington, DC, 1981.

Experience:

1988 – Present	Industrial Hygienist, Tracor Technology Resources, Inc. (formerly Tracor Jitco, Inc.), Rockville, MD. Conduct comprehensive building surveys to identify and quantify hazardous materials. Provide site inspection and contractor supervision of asbestos abatement projects including qualitative respirator fit testing and on-site analysis of airborne asbestos. Conduct indoor air quality assessments, including lead in air monitoring and assist with environmental assessments. Prepare comprehensive industrial hygiene reports outlining hazard abatement techniques. Prepare proposals and project specifications for various government and commercial clients. Develop and provide instructions for lead paint abatement health and safety training course approved the State of Maryland, the Department of the Environment. Participate in and provide technical assistance for NIDA Drug Testing Program. Project Coordinator. Responsible for project orgainization and logistics, budget tracking, personnel training, and project specifications and protocols for HUD Lead Demonstration Project.
1985 – 1988	Director of Laboratory Operations, L.A.O. Enterprises, Gaithersburg, MD. Oversee and participated in lab procedures including setup and maintenance of a tissue culture lab. Direct testing of serum, media, and new lab procedures for biotechnology clients using established or newly designed protocols. Trained and directed new employees. Served as instructor/lecturer in workshops given by L.A.O. Enterprises and their clients.
1984 – 1986	Technical Assistant to the Director, The Center for Advanced Training in Cell and Molecular Biology, Washington, DC. Organized inventory for cell and molecular biology workshops. Developed lab exercises for specific workshops. Instructed and demonstrated various tissue culture-related skills during workshops. Served as course instructor (1983–1985) for specialty sponsored course "Introduction to Tissue Culture and In Vitro Toxicity Testing."
1981 – 1984	Laboratory Manager, Department of Biology, The Catholic University of America, Washington, DC. Ordered materials for research in developing an in vitro screening program for neurotoxins. Assisted in experimental assays, prepared media, cell culture stocks, and laboratory materials as needed.
1980, 1981	(Summers). Field Biology Instructor, Alpine Environmental Studies Program, Waterloo Community Schools, Waterloo, Iowa. Supervised and instructed high school students in the areas of Field Biology, Geology, and Ecology while backpacking in Gunnison National Forest, Colorado.

Certificates and Licenses:

Airborne Asbestos Sampling and Evaluation Techniques, OMC, Inc., Washington, DC. Certificate Granted, 1988.

Asbestos Abatement Monitoring and Supervision, Biospherics, Inc., Beltsville, MD. Certificate Granted, 1988.

Lead Paint Abatement Worker Training (Supervision of Lead Projects), Leadtec Services, Inc. Certification, 1989-1994.

Virginia Asbestos License - Supervisor License, Commonwealth of Virginia, Department of Commerce, Richmond, VA.

Virginia Asbestos License - Project Designer, Commonwealth of Virginia, Department of Commerce, Richmond, VA.

SARA 313 Training for Assessment for Hazardous Chemicals, 1989.

Accredited for Building Inspector under Asbestos Hazard Emergency A=Response Act (AHERA), Section 206/TSCA Title II, 1989.

OSHA and Hazard Communications, Frederick Community College, continuing education course, 1989.

Professional Affiliations:

Education Committee, National Capital Area Branch, Tissue Culture Association, 1986-Present.

Program Committee, National Capital Area Branch, Tissue Culture Association, 1984-1986.

Member, American Industrial Hygiene Association, Potomac Section.

Awards:

Who's Who Among College and University Students, 1981

Society of Collegiate Journalists

Sigma Epsilon Phi

Sigma Xi, Affiliate Member

CHARLES E. WILES, JR.

Education: Self Trained on CADD.
Bechtel Pipe Support Engineering Training, 1981.
Drafting Training, Governor Thomas Johnson H.S., Frederick, MD, 1971.

Experience:

1987 – Present Industrial Hygienist, Tracor Technology Resources, Inc. (formerly Tracor Jitco, Inc.), Rockville, MD. Site manager asbestos abatement, Western Maryland Center, Springfield Hospital Center, and VA Hospital Center – Huntington, West Virginia and Aspenwall PA. Duties and responsibilities include liaison between State representative, contractor, and facility personnel; representative on-site to insure compliance to the scope of work as outlined in the contract; enforcement of State, EPA, and OSHA regulations regarding the safe practices for asbestos abatement; specification writing, air monitoring for safe fiber levels; sample analysis and record maintenance.

1986 – 1987 Field Supervisor, Tracor Jitco, Inc., Rockville, MD. Supervised eight field survey teams working on the State of Maryland asbestos survey. Conducted analysis of all phases of field operations including identification of piping systems, trouble-shooting and quality control. Calculated cost estimates for asbestos removal and replacement and operations and maintenance (O & M); specific supervisory tasks included maintaining a budget, conducting employee interviews, performance appraisals, and expense and timesheet authorization.

1985 – 1986 Field Surveyor, Tracor Jitco, Inc., Rockville, MD. Conducted survey of state-owned buildings to sample and identify asbestos containing materials; provided drawings of sample locations and various types of asbestos containing materials. Identified fire doors.

1972 – 1984 Design/Field Engineer, Bechtel Power Corporation. Design and detailing of critical and non-critical pipe supports on condensate, hot and cold reheat, feedwater and main steam systems of nuclear and fossil-fuel power plants; designed supports from field input, coordinating with piping layout, civil, stress and the field; resolved field discrepancies on supports and piping; revised and reissued non-critical pipe support standards; performed on-site engineering surveillance of piping systems and related hangers in accordance with NRC regulations/codes; checked as-built isometrics and hangers for accuracy and completeness; responsible for checking details for proper welds, materials, and suppliers for fabrication of large pipe hangers.

As field engineer duties included preparation of spool drawings for on-site fabrication shop; developed technical data sheets for material take-off in accordance with construction schedule; reviewed small pipe isometrics and initiated field change reports if discrepancy with pipe specifications existed; maintained and tracked status of piping components against requirements of the construction schedule; coordinated with engineering and construction personnel on documentation of material.

Certificates and Licenses:

Airborne Asbestos Sampling and Evaluation Techniques, OMC, Inc., Washington, DC. Certificate Granted, October 1987.

Asbestos Abatement Procedures and Practices (Supervisors Course and Exam), Institute for Environmental Education, Massachusetts. Certification #73104-113, October 1987.

Health and Safety Training Asbestos Abatement, Med-Tox Associates, Inc., Virginia. Certification #48-00-10, 1987.

OSHA and Hazard Communication, Frederick Community College, Frederick, MD. Certificate Granted, February 1989.

Lead Paint Abatement Health and Safety Training Course, Tracor Technology Resources, Inc., Rockville, MD. Certificate Granted, 1989.

Virginia Asbestos License - Supervisor License, Commonwealth of Virginia, Department of Commerce, Richmond, VA, 1988-1989.

Virginia Asbestos License - Project Designer, Commonwealth of Virginia, Department of Commerce, Richmond, VA, 1988-1989.

Asbestos Surveys: Performed at various sites throughout DC, Maryland, Pennsylvania, Virginia, and West Virginia.

LLOYD FOX

Education: B.S., Zoology, University of Maryland, College Park, MD, 1981.
A.A., Science-Math Education, Montgomery College, Rockville, MD, 1978.

Experience:

1988 - Present Industrial Hygienist, Tracor Technology Resources, Inc. (formerly Tracor Jitco, Inc.), Rockville, MD. Provide on-site inspection and supervision of asbestos abatement projects including compliance with federal, state, and local regulations. Conduct comprehensive building surveys to identify and quantify hazardous materials. Prepare project specifications and proposals for various government and commercial clients.

1986 - 1988 Operator, Rockville Crushed Stone, Rockville, MD. Maintained and operated pug mill plant.

1984 - 1986 Installer, ABBA Door Co., Rockville, MD. Installed and repaired garage doors. Responsible for trouble-shooting and repair of electric door motors.

1977 - 1984 Supervisor, Dart Drug, Rockville, MD. Supervised floor personnel and was responsible for bank deposits, stock ordering and inventory. Store redesign.

Certificates and Licenses:

Asbestos Contractor/Supervisor Training, Hall-Kimbrell Environmental Services, Laurel, MD. Certificate Granted, 1988.

Airborne Asbestos Sampling and Evaluation Techniques, OMC, Inc., Washington, DC. Certificate Granted, 1988.

EPA Inspection Program, Aerosol Monitoring and Analysis, Inc., Towson, MD, 1988.

Lead Paint Abatement Worker Training, (Supervision of Lead Projects), Leadtec Services, Inc., Rockville, MD. Certification, 1989-1994.

Virginia Asbestos License - Project Designer, Commonwealth of Virginia, Department of Commerce, Richmond, VA.

Virginia Asbestos License - Supervisor, Commonwealth of Virginia, Department of Commerce, Richmond, VA.

Virginia Asbestos License - Inspector, Commonwealth of Virginia, Department of Commerce, Richmond, VA.

OSHA and Hazard Communications, Frederick Community College, continuing education course, 1989.

Professional Affiliations:

Member, American Industrial Hygiene Association, Potomac Section.

Member, Phi Sigma Honor Society.

Member, Phi Theta Kappa Honor Society.

DAVID L. WARD

Education: Undergraduate Studies in Biology and Computer Science, Old Dominion University, Norfolk, VA, 1979–1982.
Frederick High School, Frederick, MD, Honor graduate, 1978.

Experience:

1988 – Present Industrial Hygienist, Tracor Technology Resources, Inc. (formerly Tracor Jitco, Inc.), Rockville, MD. Conduct facility-wide indoor air quality assessments to determine potential health impact of air contaminants to occupants, including quantitative analysis of HVAC systems. Provide on-site inspection and contractor supervision of asbestos abatement projects including on-site analysis of airborne asbestos. Conduct sampling and identification for the presence of lead paint in buildings. Prepare comprehensive industrial hygiene reports outlining hazard abatement techniques. Develop proposals for various government and commercial clients. Conduct research to determine commercial client compliance to federal and state environmental regulations.

1983 – 1988 Advanced Systems Operator, Ferranti Healthcare Systems, Norfolk, VA. A centralized data processing facility for hospitals throughout Virginia. Maintained continuous, efficient operation of eight on-site systems, both mainframe and mini-computers. Responsible for the operation of financial, patient data management, pharmacy and lab systems, the output of resultant reports and routing to user hospitals. Performed standard preventive maintenance and diagnostics on mainframes. Served as customer support representative for users on all hardware and software systems. Was liaison between users and programming staff.

1979 – 1980 Computer Operator A, Tidewater Community College, Portsmouth, VA. Responsible for operation of on-site computers, maintenance of back up files, and production of financial reports for accounting staff. Performed analysis of system failures to inform system engineers. Served as customer support for students and faculty.

Computer Languages:

Basic, Fortran, Pascal, 8086, Assembler, PDP-11 Assembler.
Working knowledge of MUMPS and ADA computer languages.

Certificates and Licenses:

Airborne Asbestos Sampling and Evaluation Techniques, OMC, Inc., Washington, DC. Certificate Granted., 1988.

Asbestos Hazards, Abatement and Protection, Biospherics, Inc., Beltsville, MD. Certificate Granted, 1988.

Lead Paint Abatement Worker Training (Supervision of Lead Projects), Leadtec. Certification 1989–1994.

Virginia Asbestos License, Supervisor License, Commonwealth of Virginia, Department of Commerce, Richmond, VA, 1988–1989.

Virginia, Asbestos License, Project Designer, Commonwealth of Virginia, Department of Commerce, Richmond, VA, 1988–1989.

Professional Affiliations:

Member, American Industrial Hygiene Association, Potomac Section.

RONALD ROSSO

Education: A.S., Construction Technology, Community College of Allegheny County, Pittsburgh, PA, 1986.

Experience:

1988 – Present	Industrial Hygienist, Tracor Technology Resources, Inc. (formerly Tracor Jitco, Inc.), Rockville, MD. Provide asbestos abatement contractor supervision including on-site sample collection and analysis of airborne asbestos. Ensure contractor compliance with applicable federal, state, and local regulations. Provide documentation concerning asbestos abatement projects to government and commercial clients.
1987 – 1988	Carpenter, Caswell Construction, Wilton, NH. Foreman for a crew of 4–5 persons responsible for the construction of commercial structures. Additional responsibilities included estimating and ordering of building materials.
1985 – 1987	Carpenter, LeDonne Contractors, Inc., Pittsburgh, PA. Crew member on framing, trimming, and concrete pouring projects. Also was the Lead Man on siding projects.
1983 – 1985	Carpenter, Rosso Construction, Monaca, PA. Foreman on crew responsible for the construction of residential housing. Responsible for ordering building materials and preparing job bids. Interfaced frequently with clients.
1982 – 1983	Carpenter, Centric Corporation, Denver, CO. Responsible for the construction of wooden forms used to construct the framework of multi-storied buildings.
1979 – 1982	Carpenter, Rosso Construction, Monaca, PA. Responsible for the construction of residential housing. Interfaced frequently with clients.

Certificates and Licenses:

Asbestos Abatement Monitoring and Supervision, Biospherics, Inc., Beltsville, MD. Certificate Granted, 1988.

Airborne Asbestos Sampling and Evaluation Techniques, OMC, Inc., Washington, DC. Certificate Granted, 1988.

Virginia Asbestos License Supervisor, Commonwealth of Virginia, Department of Commerce, Richmond, VA.

Lead Paint Abatement Health and Safety Training Course, Tracor Technology Resources, Inc., Rockville, MD. Certificate Granted, 1989.

FORMULA: Pb

LEAD

METHOD: 7082
ISSUED: 2/15/84

M.W.: 207.19 (Pb); 223.19 (PbO)

OSHA: 0.05 mg/m³
NIOSH: 0.05 mg/m³ [1]
ACGIH: 0.15 mg/m³; STEL 0.45 mg/m³

PROPERTIES: soft metal;
d 11.3 g/cm³; MP 327.5 °C;
valences +2, +4 in salts

SYNONYMS: vary depending upon the chemical form (elemental lead and lead compounds except alkyl lead); CAS #1317-36-8 (PbO); CAS #7439-92-1 (Pb).

SAMPLING	MEASUREMENT
SAMPLER: FILTER (0.8-µm cellulose ester membrane)	TECHNIQUE: ATOMIC ABSORPTION, FLAME
	ANALYTE: lead
FLOW RATE: 1 to 4 L/min	
	ASHING: conc. HNO_3, 6 mL; 140 °C
VOL-MIN: 200 L @ 0.05 mg/m³; -MAX: 1200 L	FINAL SOLUTION: 10% HNO_3, 10 mL
SHIPMENT: routine	FLAME: air-acetylene, oxidizing
SAMPLE STABILITY: stable	WAVELENGTH: 283.3 nm
BLANKS: 2 to 10 field blanks per set	BACKGROUND CORRECTION: D_2 or H_2 lamp
	CALIBRATION: Pb^{++} in 10% HNO_3
ACCURACY	RANGE: 10 to 200 µg per sample [3,8]
RANGE STUDIED: 0.13 to 0.4 mg/m³ [2]; 0.15 to 1.7 mg/m³ (fume) [3]	ESTIMATED LOD: 2.6 µg per sample [9]
BIAS: not significant [2]	PRECISION (s_r): 0.03 [2]
OVERALL PRECISION (s_r): 0.072 [2]; 0.068 (fume) [3]	

APPLICABILITY: The working range is 0.025 to 0.5 mg/m³ for a 400-L air sample. The method is applicable to elemental lead, including Pb fume, and all other aerosols containing lead. This is an elemental analysis, not compound specific. Aliquots of the samples can be analyzed separately for additional elements.

INTERFERENCES: Use D_2 or H_2 continuum background correction to control flame or molecular absorption. High concentrations of calcium, sulfate, carbonate, phosphate, iodide, fluoride, or acetate can be corrected.

OTHER METHODS: This method combines and replaces P&CAM 173 [8] and S341 [7,9] for lead. Method 7300 (ICP-AES) is an alternate analytical method.Method 7505 is specific for lead sulfide. The following have not been revised: the dithizone method, which appears in P&CAM 102 [4] and the lead criteria document [1]; P&CAM 191 (ASV) [5]; and P&CAM 214 (graphite furnace-AAS) [6].

REAGENTS:
1. Nitric acid, conc.
2. Nitric acid, 10% (w/v). Add 100 mL conc. HNO_3 to 500 mL water; dilute to 1 L.
3. Hydrogen peroxide, 30% H_2O_2 (w/w), reagent grade.
4. Calibration stock solution, 1000 µg Pb/mL. Commercial standard or dissolve 1.00 g Pb metal in minimum volume of (1+1) HCl and dilute to 1 L with 1% (v/v) HCl. Store in a polyethylene bottle. Stable $\geq$ one year.
5. Air, compressed, filtered.
6. Acetylene.
7. Distilled or deionized water.

EQUIPMENT:
1. Sampler: Cellulose ester filter, 0.8-µm pore size, 37-mm diameter; in cassette filter holder.
2. Personal sampling pump, 1 to 4 L/min, with flexible connecting tubing.
3. Atomic Absorption Spectrophotometer with an air-acetylene burner head.
4. Lead hollow cathode lamp or electrode dischargeless lamp.
5. Regulators, two-stage, for air and acetylene.
6. Beakers, Phillips, 125 mL, or Griffin, 50 mL with watchglass covers.*
7. Volumetric flasks, 10- and 100-mL.*
8. Assorted volumetric pipets as needed.*
9. Hotplate, surface temperature 140° C.
10. Bottles, polyethylene, 100-mL.

*Clean all glassware with conc. nitric acid and rinse thoroughly with distilled or deionized water before use.

SPECIAL PRECAUTIONS: Perform all acid digestions in a fume hood.

SAMPLING:
1. Calibrate each personal sampling pump with a representative sampler in line.
2. Sample at an accurately known flow rate between 1 and 4 L/min for up to 8 hrs for TWA measurements. Do not exceed a filter loading of ca. 2 mg total dust.

SAMPLE PREPARATION:

NOTE: The following sample preparation gave quantitative recovery (see EVALUATION OF METHOD) [9]. Steps 4 through 9 of Method 7300 or other quantitative ashing techniques may be substituted, especially if several metals are to be determined on a single filter.

3. Open the cassette filter holders and transfer the samples and blanks to clean beakers.
4. Add 3 mL conc. HNO_3, and 1 mL 30% H_2O_2 and cover with a watchglass. Start reagent blanks at this step.
   NOTE: If PbO_2 is not present in the sample, the 30% H_2O_2 need not be added [3,9].
5. Heat on hotplate (140 °C) until most of the acid has evaporated.
6. Repeat two more times using 2 mL conc. HNO_3 and 1 mL 30% H_2O_2 each time.
7. Heat on 140 °C hotplate until a white ash appears.
8. When sample is dry, rinse the watchglass and walls of the beaker with 3 to 5 mL 10% HNO_3. Allow the solution to evaporate to dryness.
9. Cool each beaker and dissolve the residues in 1 mL conc. HNO_3.
10. Transfer the solution quantitatively to a 10-mL volumetric flask and dilute to volume with distilled water.
    NOTE: If the concentration (M) of any of the following is expected to exceed the lead concentration (M) by 10-fold or more, add 1 mL 1 M Na_2EDTA to each flask before dilution to volume: $CO_3^=$, $PO_4^{\equiv}$, I^-, F^-, CH_3COO^-. If Ca^{++} or $SO_4^=$ are present in 10-fold excess, make all standards and samples 1% (w/w) in La^{++} [8].

CALIBRATION AND QUALITY CONTROL:

11. Prepare a series of working standards covering the range 1 to 20 µg Pb/mL (1 to 200 µg Pb per sample) by adding aliquots of calibration stock solution to 100-mL volumetric flasks. Dilute to volume with 10% HNO_3. Store the working standards in polyethylene bottles and prepare fresh weekly.
12. Analyze the working standards together with the blanks and samples (steps 17 and 18).
13. Prepare a calibration graph of absorbance vs. solution concentration (µg/mL).
14. Aspirate a standard for every 10 samples to check for instrument drift.
15. Check recoveries with at least one spiked media blank per 10 samples.
16. Use method of additions occasionally to check for interferences.

MEASUREMENT:

17. Set spectrophotometer as specified by the manufacturer and to conditions on page 7082-1.
    NOTE: An alternate wavelength is 217.0 nm [10]. Analyses at 217.0 nm have slightly greater sensitivity, but poorer signal-to-noise ratio compared to 283.3 nm. Also, non-atomic absorption is significantly greater at 217.0 nm, making the use of D_2 or H_2 continuum background correction mandatory at that wavelength.
18. Aspirate standards, samples, and blanks. Record absorbance readings.
    NOTE: If the absorbance values for the samples are above the linear range of the standards, dilute with 10% HNO_3, reanalyze, and apply the appropriate dilution factor in the calculations.

CALCULATIONS:

19. Using the measured absorbances, calculate the corresponding concentrations (µg/mL) of lead in the sample, C_s, and average media blank, C_b, from the calibration graph.
20. Using the solution volumes (mL) of the sample, V_s, and media blanks, V_b, calculate the concentration, C (mg/m³), of lead in the air volume sampled, V (L):

$$C = \frac{C_s V_s - C_b V_b}{V}, \text{ mg/m}^3.$$

EVALUATION OF METHOD:

Method S241 [7] was issued on October 24, 1975, and validated over the range 0.13 to 0.4 mg/m³ for a 180-L air sample, using generated atmospheres of lead nitrate [2]. Recovery in the range 18 to 72 µg Pb per sample was 98%, and collection efficiency of 0.8-µm mixed cellulose ester filters (Millipore Type AA) was 100% for the aerosols. Subsequent studies on analytical recovery of 200 µg Pb per sample gave the results [3,9]:

Species	Digestion Method	Analytical Recovery, %
Pb metal	HNO_3 only	92 ± 4
Pb metal	$HNO_3 + H_2O_2$	103 ± 3
PbO	HNO_3 only	93 ± 4
PbS	HNO_3 only	93 ± 5
PbO_2	HNO_3 only	82 ± 3
PbO_2	$HNO_3 + H_2O_2$	100 ± 1
Pb in paint*	HNO_3 only	95 ± 6
Pb in paint*	$HNO_3 + H_2O_2$	95 ± 6

*Standard Reference Material #1579, U.S. National Bureau of Standards.

Additional collection efficiency studies were also done using Gelman GN-4 filters for the collection of Pb fume, which had geometric mean diameter of 0.1 µm [3]. Mean collection efficiency for 24 sampling runs at flow rates between 0.15 and 4.0 L/min was >97 ± 2%. Overall precision, s_r, was 0.072 for lead nitrate aerosol [2,7] and 0.068 for Pb fume [3,9].

REFERENCES:

[1] Criteria for a Recommended Standard...Occupational Exposure to Inorganic Lead (Revised Criteria), U.S. Department of Health, Education, and Welfare, Publ. (NIOSH) 78-158 (1978).

[2] Documentation of the NIOSH Validation Tests, U.S. Department of Health, Education, and Welfare, Publ. (NIOSH) 77-185 (1977).

[3] Heavy Metal Aerosols: Collection and Dissolution Efficiencies, Final Report of NIOSH Contract 210-79-0058, W. F. Gutknecht, M. H. Ranade, P. M. Grohse, A. Damle, and D. O'Neal, Research Triangle Institute; available as Order No. PB 83-106740 from NTIS, Springfield, VA 22161 (1981).

[4] NIOSH Manual of Analytical Methods, 2nd. ed., V. 1, P&CAM 102, U.S. Department of Health, Education, and Welfare, Publ. (NIOSH) 77-157-A (1977).

[5] Ibid, P&CAM 191.

[6] Ibid, P&CAM 214.

[7] Ibid., V. 3, S341, U.S. Department of Health, Education, and Welfare, Publ. (NIOSH) 77-157-C (1977).

[8] Ibid, V. 5, P&CAM 173, U.S. Department of Health, Education, and Welfare, Publ. (NIOSH) 77-157-A (1979).

[9] Ibid, V. 7, S341 (revised 3/25/81), U.S. Department of Health and Human Services, Publ. (NIOSH) 82-100 (1982).

[10] Analytical Methods for Atomic Absorption Spectrophotometry, Perkin-Elmer (1976).

METHOD REVISED BY: Mark Millson and R. DeLon Hull, NIOSH/DPSE; S341 originally validated under NIOSH Contract CDC-94-74-45; additional studies under NIOSH Contract 210-79-0058.

Excerpt from:

Fartel, M. 1987. Doctoral thesis. Evaluation of Health and Environmental Effects of Two Methods of Residential Lead Paint Removal, Johns Hopkins University School of Hygiene and Public Health.

METHOD OF DUST SAMPLE COLLECTION

Wipe samples of dust from uncarpeted floor, window sill, and window well surfaces were collected using WET ONES alcohol towelettes (5 3/4 X 8 in) impregnated with 20% denatured alcohol and benzalkonium chloride 1:750, which were found to be "lead-free". To avoid cross contaminating samples, floor samples were taken first, since they generally had the lowest levels of lead in dust, and window wells were sampled last because they often contained quantities of visible paint chips and particulate matter with very high lead content. Also to control cross contamination, the collector's hands were wiped between samples using clean WET ONES towelettes.

One square foot of floor surface was marked off with a template and wiped using an open flat hand with the fingers together. Floors were wiped twice, both left:right and then up:down, in such a way as to contact the entire one square foot of surface. The towelette was then folded in half with the sample side folded on the inside and the procedure was repeated. The sample was then placed inside a small pre-labelled plastic bag and sealed with tape. Window sill and window well samples were also sealed in bags in this manner.

****

Since window sills were generally too narrow to accommodate a flat hand, wipes were collected by holding the fingers together and flat against the sill. The sampled portion of the sill was wiped back and forth twice in this manner. The towelette was then folded with the sample side inside and the procedure was repeated. The sample was handled in such a way as to keep loose chips of paint and visible dust contained in the folded towelette.

Since samples could not be collected from the window wells with an open hand or with the fingers together, the samples were collected by applying pressure to the towelette using fingertips. Otherwise, the sample collection procedure was the same as for window sills. When there was a large quantity of loose paint chips and particulate material in the window well, the material was collected and folded into the towelette. In this case, the second series of passes over the window well could not be done.

3.6.2. Surface dust sampling

Surface dust sampling is the primary method to determine the levels of lead dust that are present after cleanup. Surface dust sampling should be done a minimum of 24 hours after final cleanup is completed.

The inspector should be aware of all abated surfaces in the dwelling. If there is a visible accumulation of dust, surface dust sampling should be deferred until a thorough cleanup has been completed. Surface dust samples should be taken from the floor (near the edge of the room, not the center of the room), a window well, and a window sill in each room.

The following are protocols are to be followed for wipe sampling.

a. Materials needed

- Wipes consisting of commercial wipes moistened with a non-alcohol wetting agent.
- Plastic template (1 foot by 1 foot)
- Measuring tape
- Marking pen
- 50 ml. polypropylene tube
- Rack to carry tubes
- Sample sheet (see Appendix 3-4)
- Disposable gloves

b. Sample size

The 1 square foot plastic template should be used when samples are taken from the floor. When window sills and wells are sampled, the length and width of the area is measured in inches. One square foot is sampled according to the formula:

$$\frac{\text{Length x Width}}{144} = \text{Square foot}$$

c. Sample collection

Identify and document all areas to be sampled, beginning in one room. Documentation should include:

- Location of sample
- Surface type (floor, sill, well)
- Surface material (wood, metal)
- Surface area measurements
- Abatement status (abated, not abated)
- Abatement method if known.

Put on disposable gloves (to prevent sample contamination by lead on the hands).

Place the first wipe in a tube to submit to the laboratory as a blank.

Place a wipe flat on the surface to be sampled. Rub the wipe over the entire measured area. Fold the wipe in half and rub the surface again. Fold the wipe and place it in a tube.

Mark the tube with the sample number, location, and surface (sill, well, floor).

Change gloves after sampling window wells, since these tend to have high dust levels.

Use the same sampling technique for every sample. For example, use the same amount of pressure when wiping the surface at each sample location. Changing the technique may change the results.

Submit the samples to the laboratory for analysis. Levels greater than 200 ug/sq. ft. (floors), 500 ug/sq. ft. (sills) and 800 ug/sq. ft. (wells) indicate that dust levels are too high and the dwelling should be recleaned.

3.6.3 Quality control measures

Laboratory quality control measures for wipe and soil sample analysis can be found in Appendix 3-3. Quality control in the field is discussed below.

The final inspection includes a visual inspection, collection of soil and wipe samples, and on-site screening for lead with a portable XRF analyzer. In order to monitor overall inspection thoroughness and accuracy, independent spot checks should be conducted. However, the conditions in which a final visual inspection and testing take place change rapidly. Therefore, the "checker" must go with the inspector and as the inspector conducts the inspection, the checker should verify the results.

For soil samples and wipe samples, blanks must be collected in the field and submitted to the lab with the other samples for analysis. The collection of the blank samples is described in the respective sampling protocol sections. When analyzed, the sample blanks will be split in two; the field blank represents contamination added in the field and the sample blank represents contamination added in the field and during storage and sample preparation. Laboratory quality control measures, needed to ensure that the laboratory is reproducible and accurately measuring the concentration, are given in the appendix.

3.6.4. Post-abatement soil sampling

After the abatement of exterior lead-paint, the soil within six feet of the building should be sampled. Samples should be collected from the top 1/2" inch or so with a clean metal scoop, trowel, or other object capable of penetrating the soil. One sample of soil should be collected for each 200

Tracor Technology Resources

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March 14, 1989

Mr. Chip Harris
Dewberry and Davis
8401 Arlington Blvd
Fairfax, VA 22031

Subject: Request for Sampling Information for LBP Demonstration

Dear Mr. Harris:

As you requested, the estimated sampling numbers are listed below. In order to estimate sample numbers defined parameters were used and specific protocol were listed. There are some optional testing areas that would provide useful research data but the information is an added expense. The decision must ultimately be made by HUD on what information they deem as necessary. The only caution is that once the job is completed the opportunity for collecting the data is lost. A suggestion may be to implement all data collection protocols for the first 10 "trial" abatements then taper off to less thorough sampling if the data turns out to be of little value in Tony Blackburn's algorithm. In that way you are covered statistically and can document to the research community why you did not use certain procedures.

These sample numbers are based on an abatement job with the following parameters:

1 Abatement = 5 Days of Active Abatement

5 Person Crew

2 Methods of Abatement

4 Substrates Being Abated

10 Rooms

3 Floors

2 Sides of the Building

1 Type of Hazardous Waste Generated

Type of Sample	Pre-Abatement	During	Interim (After Initial Cleaning)	Post-Abatement
Personals	Initial Monitoring	1/Person/Method/Day	N/A	N/A
NIBS 3.4.4.2.	1/Person/Method (Once established in each city - no longer needed)	(Do if Levels High or for Research Data Only)		
# Samples	2	10	0	0
Field Blk	2 2-10/Batch	1/day or 2-10/Batch 5 or 2		
Total	4	15 12	0	0
Area	Background Samples* 5/floor 1/room	1 inside work area 1 outside /Day	N/A	N/A
# Samples	15 or 10	10	0	0
Field Blanks	2 2-10/Batch	1/day or 2-10/Batch 5 or 2 2-10/Batch		
Total	17 or 12	15 or 12	0	0
Wipes	Background	*	1/Method/ Substrate	1/Method/ Substrate
Suggested by TTR	1/Method/Substrate *	1/Method/Substrate/ Day	(May vary w/job)	
# Samples	8	40	8 Add'l. Samples for research data only	8
Field Blk 1/BAtch	1 1/batch	1/day or 1/batch 5 or 1	1 1/Batch	1
Totals	9	45 41	9	9
HUD/Maryland Protocol	4/Room 1/floor 1/Window Well 1/Window Sill 1/Hall	1/Room/Day*	Not Specified 1/(abated Surface) Substrate	4/Room 1/Floor 1/Window Sill 1/Window Well 1/Hall

Type of Sample	Pre-Abatement	During	Interim (After Initial Cleaning)	Post-Abatement
# Samples	40	50	4	40
Field Blk	1/Batch	1/Day or 1/Batch		1/batch
	1	5 or 51	1	4
Total	41	55 or 51	5	44
Soil	Background			
Exterior Abatements N.IB.S 3.4.3.d	2/Side*	1/Day/Side*	N/A	2/Side
# Samples	4	10	N/A	4
Field Blk	1/Day	1/Batch or 1/Day		1/Day
		1 or 5		
Total	5	11 or 15		5
EPTOX[a]	N/A	N/A	N/A	1/Type of Hazardous Waste
Total	0	0	0	1

Other Samples:

Paint Chips	10/survey (could use 10% of total samples surveyed)	Stationary XRF*
a.a sent to TTR by KTA as QC		Random Selection 1 per every 2 abatements
# Samples	10	
Field Blk	N/A	N/A
Total	4,000	100

*Not Required, For Research Data Only
[a]Landfill May Require their own test in addition. Additionally 10% of Area, Personal, Wipe and Soil Samples will be recounted for QC program

These totals may be applied to the current total number of abatements x the cost information already submitted to you.

BLANKS

Personals - NIOSH 7082 - Requires 2-10 Field Blanks/Batch

Area - NIOSH 7082 - Requires 2-10 Field Blanks/Batch

Wipes - a.a. Spec. Need 1 Field blank per Lab Run, 1/Batch

Soil - NIBS (Draft) 1 Blank per Work Day

I hope that this information is useful to you. If you have any questions or require additional information, please call me at (301) 984-2730.

Sincerely,

Rene M. Filipowski
Industrial Hygienist

RF:na

cc: L. Apple
D. Chute
Project File: 123-111

LEAD IN AIR SAMPLE SHEET

Project No. 123-111-11

Page _____ of _____
City ________________
Unit ________________
Date ________________

Sample #	Pump ID	Flow Calibration		Mean (1/min.)	Time (Military)		Total (min)	Volume	Results (ug/m^3)
		Pre	Post		On	Off			

Field Technician: ______________________

Employer: ______________________

Date Sample Shipped: ______________________

Date Results Received: ______________________

›sults Received From: ______________________

Mean Flow Calculation: $\frac{\text{Pre + Post}}{2}$

LEAD DUST WIPE SAMPLE FORM

Project Number: 123-111-11

SAMPLE #	TYPE	LOCATION/DESCRIPTION	TEMPLATE	DATE / TIME	RESULT ug/ft^2

Field Technician: ____________________

Employer: ____________________

Date Sample Shipped: ____________________

Date Results Received: ____________________

Results Received From: ____________________

Conversion Factor: $mg/cm^2 = (.0000011 \frac{mg/ft^2}{ug/cm^2})\ ug/ft^2$

<u>LEAD ABATEMENT EQUIPMENT CHECKLIST</u>

_____ Low Volume Pump (minimum of 6 or per job specification)

_____ Low Volume Charger

_____ High Volume Pump (2)

_____ Rotometer (Low, High)calibrated against 1^{o} std.

_____ 37 mm Cassettes MCEF Type

_____ Pre-Labeled Tape

_____ Pens, Pencil

_____ Baby Wipes "6 x 8"

_____ 50 ml Polypropylene Tube

_____ Plastic Template 1 Square Foot

_____ Tape/Labels

_____ Marking Pen

_____ Disposable Gloves

_____ Tube Rack

_____ Compass

_____ Metal Scoop

_____ Large Ziplock Baggies

_____ Flashlight

_____ Tape Recorder

_____ Clean Quartz Sand

_____ Paint Scraper

_____ Scalpel or other Sharp Implement

_____ Small Ziplock Baggies

_____ Respirator 1/2 Face and/or PAPR

_____ HEPA Cartridges

_____ PAPR Charger

PAPERWORK

_____ General Air Sample Sheets

_____ Pre-, Daily, Final, Checklists

_____ Log Notebook

_____ Time and Motion Sheets

_____ Chain of Custody Forms

_____ Federal Express Envelopes

TRACOR TECHNOLOGY RESOURCES, INC.

Air/Wipe ________ City ______________________

Unit __________ No. of Samples __________

Date Samples Collected _______________________

Team Leader __________________________________

Date Submitted to TTR ________________________

TRACOR TECHNOLOGY RESOURCES, INC.

________	__________	______	__________
Air/Wipe	City	Unit	Sample No.

________________________	___________
Field Technician	Employee No.
____________________	123-111-11
Date	Project No.

LEAD PRE-ABATEMENT CHECKLIST

Building________________________________ Date__________

Address____

Project Number/Description______________________________

____

Company Performing Abatement____________________________

____

Abatement Company Supervisor on Job____________________ Title__________

Building Occupied_____Yes _____No

	Yes	No	Not Applicable
Work-Site Preparation			
A. General			
1. Area non-accessible to general public	___	___	___
2. Sufficient fire/emergency exits	___	___	___
a. Fire/Emergency evacuation plan developed and reviewed with all abatement workers			
3. Safety hazards reduced	___	___	___
a. Other safety aspects addressed:			
1. height	___	___	___
2. confined spaces			
3. electrical	___	___	___
4. heat	___	___	___
5. cold	___	___	___
6. other	___	___	___

4. Work-Zone area

Sq. Ft._______ Cu. Ft._______ Number of Rooms_______

5. Pre-cleaning (Hepa/Wet Wipe)

Revised 5/88

	Yes	No	Not Applicable
a. Moveable objects	___	___	___
b. Fixed objects	___	___	___
6. Temporary Waste Storage Area	___	___	___
7. Emergency Plan/Phone Numbers	___	___	___

Comments:

___

___

B. Signage

1. Proper warning signs at entrances and exits	___	___	___
2. Dumpster Labeled	___	___	___

Comments:

___

___

	Yes	No	Not Applicable
C. Airlock-Decontamination Area			
1. Clean Room - 1st Stage			
a. Hangers/lockers, clothing storage provided	___	___	___
b. Double plastic flaps at entrance and exit	___	___	___
c. Bag for towel/cartridge disposal	___	___	___
2. Shower Area - 2nd Stage			
a. Showers operating	___	___	___
1. Hot Water Available	___	___	___

	Yes	No	Not Applicable
2. Cold Water Available	___	___	___
b. Shower waste water properly filtered	___	___	___
c. Double plastic flaps at entrance and exit	___	___	___
d. Clean, disposable towels available	___	___	___
e. Opaque Poly at exit/entrance	___	___	___
f. Soap, shampoo available	___	___	___
g. Disinfectant available	___	___	___
3. Equipment Room - 3rd Stage			
a. Double plastic flaps at entrance and exit	___	___	___
b. Bag for disposal of used suits	___	___	___

Comments:

____

____

D. Perimeter Barrier Preparation

	Yes	No	Not Applicable
1. 6 ml plastic used	___	___	___
2. Floor plastic (2 layers)	___	___	___
3. Wall plastic	___	___	___
4. Proper sealing of:			
a. Doors	___	___	___
b. Windows	___	___	___
c. Ventilation Systems	___	___	___
1. Vents	___	___	___
2. Ducts	___	___	___
3. Grilles	___	___	___
4. System turned off	___	___	___
d. Pipes and conduit	___	___	___
e. Light Fixtures	___	___	___
f. Sprinkler heads	___	___	___

LEAD PRE-ABATEMENT CHECKLIST

	Yes	No	Not Applicable
g. Any other openings into work area	___	___	___
h. Other misc. fixtures/gauges, etc.	___	___	___
i. Penetrations through ceiling into work area	___	___	___
5. Test Methods			
a. Smoke tubes	___	___	___
b. Visual	___	___	___

Comments:

____

____

E. Removal Equipment

1. H.E.P.A. Filtered Vacuums
   a. Number of units ______________________
   b. Type ______________________
   c. H.E.P.A. filters present ______________________
   d. Machine working hours ______________________
   e. Most recent date of H.E.P.A. filter change ___________

2. H.E.P.A. Ventilation Units
   a. Number of units ______________________
   b. Type ______________________
   c. Operating ___ Yes ___ No
   d. H.E.P.A. filters present ___ Yes ___ No
   e. Exhausted out of work area ___ Yes ___ No
   f. Machine working hours ______________________
   g. Most recent date of H.E.P.A. filter change ___________
   h. Negative pressure inside work area:

Measurements	Inches H20	Location
1	___	___
2	___	___
3	___	___

3. Water hoses present ___ Yes ___ No

4. Airless sprayers present ___ Yes ___ No

LEAD PRE-ABATEMENT CHECKLIST

	Yes	No	Not Applicable
5. Type of encapsulant to be used	________		
6. Any other equipment to be used	________		

Comments:

____

____

F. Worker Protection

1. Respiratory Protection
   a. Type of respirators to be used ________
   b. Are respirators NIOSH/MSHA approved? ___ Yes ___ No

2. Employee training within past 12 months? ___ Yes ___ No

3. Medical Exam within past 12 months? ___ Yes ___ No

4. Blood test within past 12 months? ___ Yes ___ No

5. If jurisdiction requires licensing, do all workers have proper identification ___ Yes ___ No

6. Disposable Protective Clothing
   - ___ Full body coveralls
   - ___ Head covers
   - ___ Foot covers
   - ___ Ear protection
   - ___ Rubber boots
   - ___ Hard hats
   - ___ Eye protection
   - ___ Gloves
   - ___ Knee protection

7. First aid kit on site? ___ Yes ___ No

8. Adequate lighting? ___ Yes ___ No

LEAD PRE-ABATEMENT CHECKLIST

	Yes	No	Not Applicable

Comments:

____

____

G. Verification of Waste Disposal Site ___ Yes ___ No

Name and Location______________________________

H. Authorization to Proceed:

Date______________________ Time____________

Inspector____________________ Signature____________

Title____________________________________

Authorization given to__________________________

Witness(es)________________________________

DAILY LEAD ABATEMENT CHECKLIST

Building ______________________________ Date ______________

Address ____

Project Number/Description ______________________________

____

Company Performing Abatement ______________________________

____

Abatement Company Supervisor on Job ______________ Title ______________

Work-Site Preparation	Yes	No	Not Applicable
A. Airlock - Decontamination area	___	___	___
1. Clean Room - 1st stage			
a. Floors clean	___	___	___
b. Bag for disposal of towels and cartridges	___	___	___
c. Street clothes properly stored	___	___	___
d. Daily sign-in/sign-out sheet posted	___	___	___
2. Shower area - 2nd stage			
a. Shower operating	___	___	___
1. Hot water available	___	___	___
2. Cold water available	___	___	___
b. Shower waste water properly filtered	___	___	___
c. Opaque Poly at exit and entrance	___	___	___
d. Soap and shampoo available	___	___	___
e. Sanitized	___	___	___
3. Equipment area - 3rd stage			
a. No excess lead debris present	___	___	___
b. Contaminated suits and material placed in lead bag	___	___	___
4. Airlock perimeter plastic flaps intact	___	___	___

Revised 5/88

DAILY LEAD ABATEMENT CHECKLIST

	Yes	No	Not Applicable
5. Proper signage at entrance	___	___	___

Comments:

___

___

B. Perimeter Barriers

	Yes	No	Not Applicable
1. Perimeter plastic intact	___	___	___
2. Windows and doors sealed	___	___	___
3. Ducts, ventilation systems, pipes sealed	___	___	___
4. All other vertical and horizontal openings into area sealed	___	___	___

Comments:

___

___

C. Work Area Practices

	Yes	No	Not Applicable
1. No hammers, saws or brooms	___	___	___
2. Material kept wet	___	___	___
3. Material bagged properly	___	___	___
4. Workers protective equipment:			
a. Full body disposable clothing intact	___	___	___
b. Proper foot protection	___	___	___
c. Proper NIOSH/MSHA approved respirators	___	___	___
Type: ___			

DAILY LEAD ABATEMENT CHECKLIST

	Yes	No	Not Applicable
d. Hard hats	___	___	___
e. Eye protection	___	___	___
f. Gloves	___	___	___
g. Ear protection	___	___	___
h. Knee Protection/Elbow Protection	___	___	___
i. Rubber boots	___	___	___
5. Adequate lighting	___	___	___
6. Protective equipment for inspectors available	___	___	___
7. Emergency/fire exits marked and unobstructed.	___	___	___

Comments:

____

____

D. Worker Decontamination and Work Habits

	Yes	No	Not Applicable
1. Workers shower upon leaving work area	___	___	___
2. Contaminated full body suits bagged in dirty room	___	___	___
3. Disposable suits used once	___	___	___
4. No smoking in regulated area	___	___	___
5. No eating or drinking in regulated area	___	___	___

Comments:

____

____

DAILY LEAD ABATEMENT CHECKLIST

	Yes	No	Not Applicable
E. H.E.P.A. Ventilation Units			
1. Number in use ______			
2. Pre-filters changed periodically	___	___	______
3. Negative Pressure Inside Work Area:	___	___	______
a. Measured with:			
1. Magnahelic gauge ___			
2. Transducer ___			
b. Location(s) and Negative Pressure Reading:			

	Location	Inches H2O
#1	______	______
#2	______	______
#3	______	______

	Yes	No	Not Applicable
4. Is microtrap exhaust properly vented?	___	___	______
5. Is microtrap exhaust hose intact?	___	___	______
F. End of Work Day Procedures			
1. Material on floors bagged before leaving area	___	___	______
2. Bags of lead waste sealed and labeled	___	___	______
3. If bags are removed			
a. Properly decontaminated	___	___	______
b. Tightly sealed	___	___	______
c. Placed in drums	___	___	______
4. Are microtraps left running overnight/ continuously through job end	___	___	______

	Yes	No	Not Applicable
5. Work area properly sealed off	___	___	___
6. Persons loading/unloading lead waste are properly protected with disposable clothing and respirators	___	___	___

Comments:

____

____

G. Samples Taken

	Area	Personal
1. Number of Air Samples taken	___	___
2. Number of Air Samples taken by Contractor	___	___
3. Number of Bulk Samples taken	___	___

4. Personal Sampling Results

Sample Number	Worker Task	Results (f/cc)
___	___	___
___	___	___
___	___	___
___	___	___

H. What is the daily job progress?
(Include amount of lead which was removed/encapsulated)

____

____

____

____

FINAL INSPECTION OF LEAD REMOVAL

LOCATION: ______________________________ DATE: __________

PROJECT DESCRIPTION: ______________________________

ABATEMENT FOREMAN ON-SITE: ______________________________

TTR INDUSTRIAL HYGIENIST: ______________________________

	Yes	No	Not Applicable
1. All lead based paint has been removed from containment, verified by XRF operator.	____	____	____

Signature of XRF Operator: ______________________________

	Yes	No	Not Applicable
2. All lead waste has been placed in sealed 6 mil poly bags and removed from premises.	____	____	____
3. All surfaces in the work area have been vacuum cleaned with a HEPA vacuum.	____	____	____
Woodwork	____	____	____
Walls	____	____	____
Windows	____	____	____
Window Wells	____	____	____
Ceilings	____	____	____
Floors	____	____	____

COMMENTS: ______________________________

____

____

	Yes	No	Not Applicable
4. All surfaces in the work area have been washed with a high phosphate solution.	____	____	____
Woodwork	____	____	____
Walls	____	____	____
Windows	____	____	____
Window Wells	____	____	____
Ceilings	____	____	____
Floors	____	____	____

COMMENTS: ______________________________

____

____

	Yes	No	Not Applicable
5. All surfaces in work area are dry and have been HEPA vacuumed after washing.	____	____	________
Visible residue remaining.	____	____	________

COMMENTS: ____

____

____

	Yes	No	Not Applicable
6. Maryland Department of the Environment notified that preliminary cleaning is complete.	____	____	________

DATE DEPARTMENT NOTIFIED: ______________________________

	Yes	No	Not Applicable
Inspection to be performed by MDE.	____	____	________

DATE OF INSPECTION: ______________________________

	Yes	No	Not Applicable
7. All treated surfaces have been repainted, recoated and/or encapsulated	____	____	________
Woodwork	____	____	________
Walls	____	____	________
Windows	____	____	________
Window Wells	____	____	________
Ceilings	____	____	________
Floors	____	____	________

COMMENTS: ____

____

____

CLEANING - FOLLOWING REPAINTING, RECOATING AND/OR ENCAPSULATION

	Yes	No	Not Applicable
8. All surfaces in the work area have been vacuum cleaned with HEPA vacuum.	____	____	________
Woodwork	____	____	________
Walls	____	____	________
Windows	____	____	________
Window Wells	____	____	________
Ceilings	____	____	________
Floors	____	____	________

COMMENTS: ____

____

____

	Yes	No	Not Applicable
9. All surfaces in the work area have been washed with a high phosphate detergent.	____	____	________
Woodwork	____	____	________
Walls	____	____	________
Windows	____	____	________
Window Wells	____	____	________
Ceilings	____	____	________
Floors	____	____	________

COMMENTS: ____

____

____

	Yes	No	Not Applicable
10. All treated surfaces are dry and have been vacuum cleaned with a HEPA vacuum.	____	____	________
Woodwork	____	____	________
Walls	____	____	________
Windows	____	____	________
Window Wells	____	____	________
Ceilings	____	____	________
Floors	____	____	________

COMMENTS: ____

____

____

	Yes	No	Not Applicable
11. All floors have been sealed with:			
Polyurethane	____	____	________
Gloss Deck Enamel	____	____	________
Tight Fitting Vinyl Floor Covering	____	____	________
Other	____	____	________
12. Maryland Department of the Environment has been notified of abatement completion.	____	____	________

DATE DEPARTMENT NOTIFIED: ______________________________

COMMENTS: ____

____

____

	Yes	No	Not Applicable
Inspection by Department Scheduled?	____	____	________

DATE OF INSPECTION: ______________________________

FINAL INSPECTION WIPE SAMPLE RESULTS

LOCATION: ______________________________ DATE: __________

SURFACE WIPE SAMPLES COLLECTED BY: ______________, ______________
Name Title

SAMPLES SENT TO: Name: ______________________________

Address: ______________________________

SAMPLE LOCATIONS	Pb LEVEL DETECTED (ug/m^3)
______________________	________
______________________	________
______________________	________
______________________	________
______________________	________
______________________	________
______________________	________
______________________	________
______________________	________
______________________	________
______________________	________
______________________	________
______________________	________

UNIT LAB RESULTS ACCEPTABLE? Yes _____ No ____

ACCEPTANCE BY AUTHORIZED PERSONNEL

I have reviewed the attached Final Inspection Checklist and have found this abatement inspection to be satisfactory and complete in accordance with project specifications.

Signature Title

TTR: ______________________________/______________

Marcor: ______________________________/______________

Dewberry & Davis: ______________________________/______________

COMMENTS: ______________________________

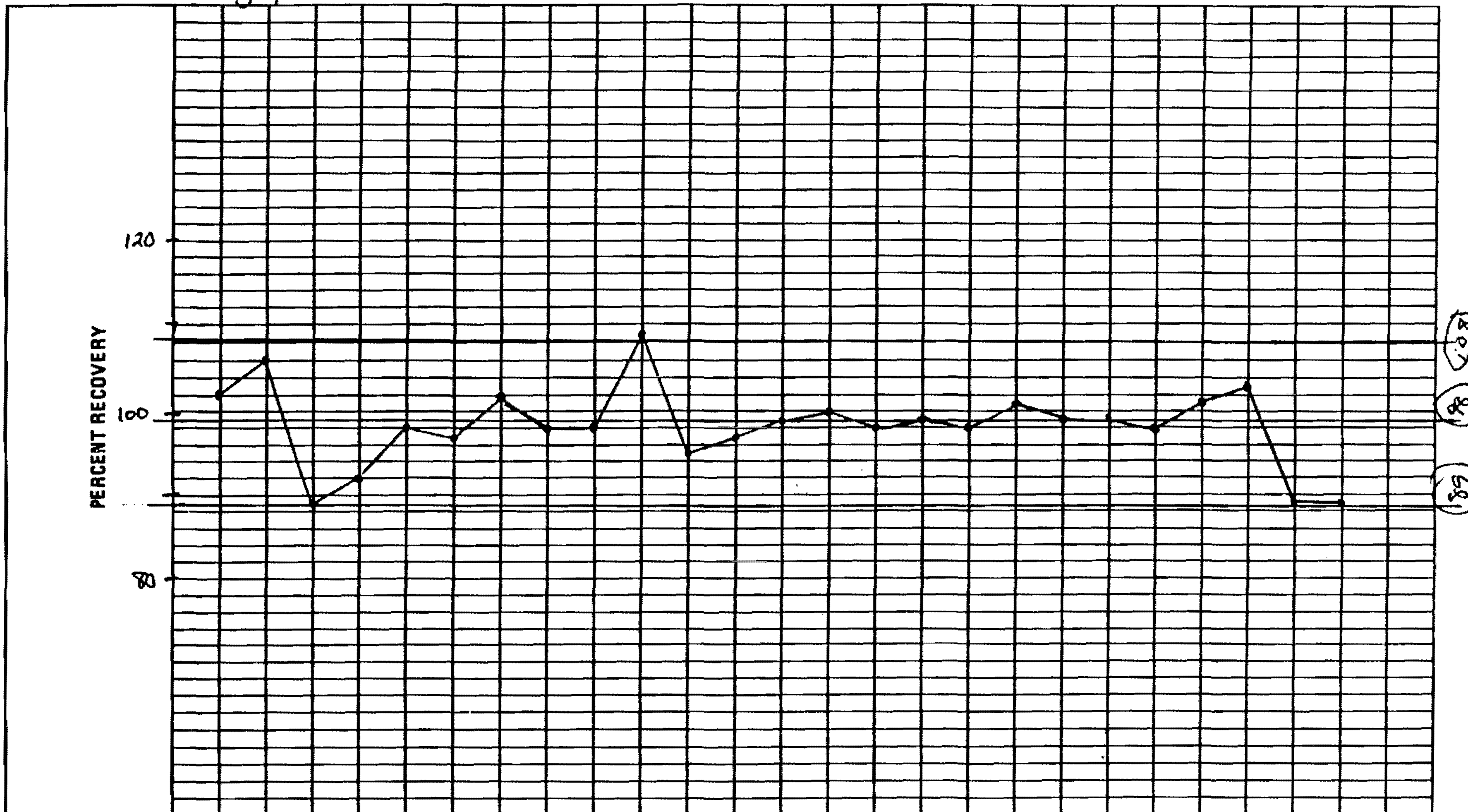
____

____

SAMPLE LOCATIONS	Pb LEVEL DETECTED (ug/m^3)

PARAMETER *Lead*
PAGE *19* METHOD *graphite furnace*

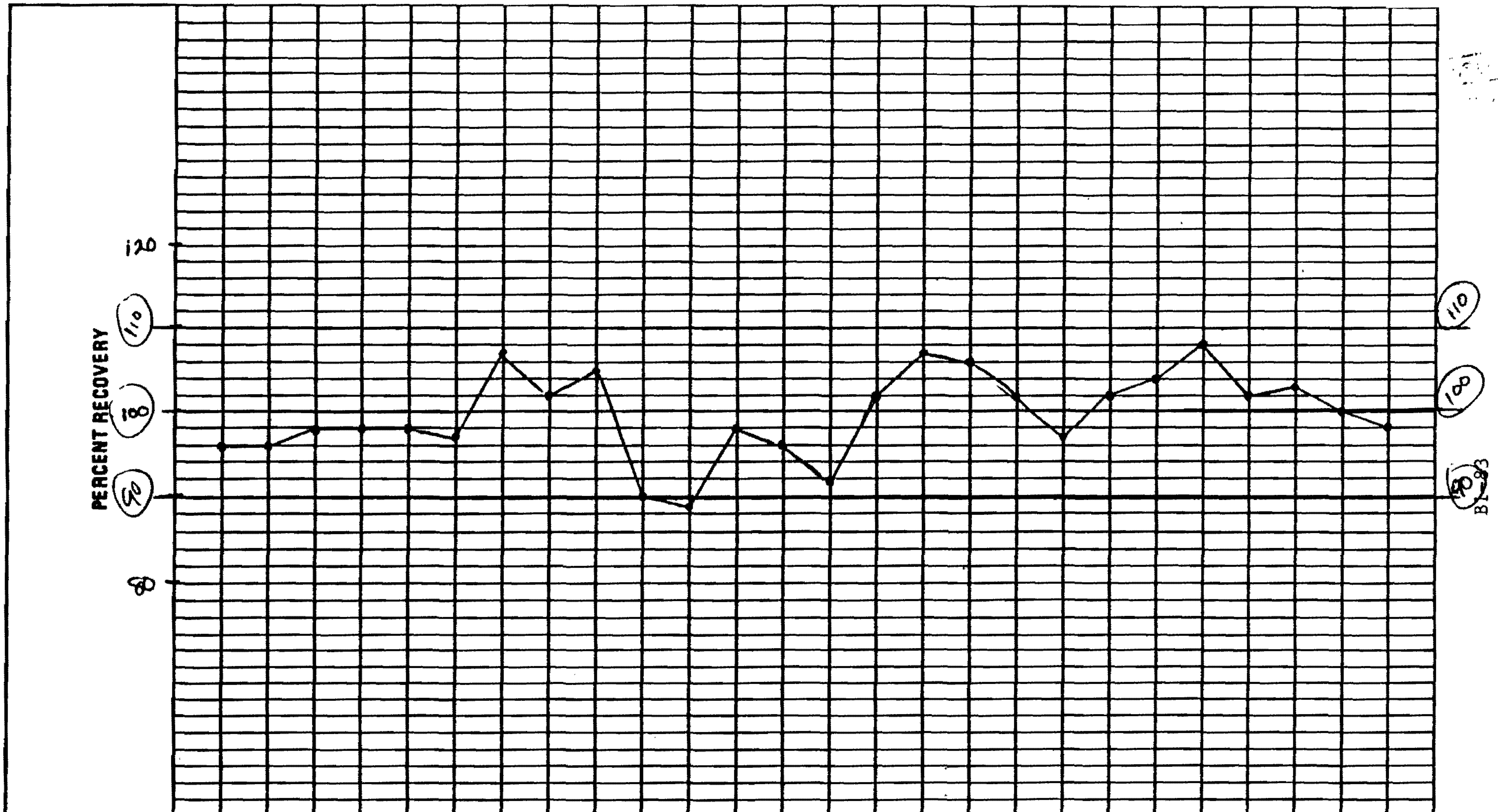
1. ENTER SAMPLE I.D. IN SPACE PROVIDED.
2. RECORD % RECOVERY IN SPACE BELOW CHART.
3. PLOT % RECOVERY ON CHART.



SAMPLE I.D.	2/3/89	→	2/10/89	→	2/17/89	2/21/89	→	2/23/89	2/28/89	→	3/20/89	4/3/89	4/4/89	→	4/6/89	4/14/89	4/25/89	→	4/28/89	5/8/89	→			5/18/89	→	
PERCENT RECOVERY	102	106	89	92	98	97	102	98	98	109	95	97	99	100	98	99	98	101	99	99	98	101	103	89	89	

PARAMETER Lead
PAGE 4 METHOD Flame AAS

1. ENTER SAMPLE I.D. IN SPACE PROVIDED.
2. RECORD % RECOVERY IN SPACE BELOW CHART.
3. PLOT % RECOVERY ON CHART.



SAMPLE I.D.	1/16/89 →				1/17/89	1/20/89 →		2/12/89	3/6/89	3/9/89 →				3/10/89	3/13/89 →		3/21/89	3/24/89 →		3/28/89 →			4/5/89		4/7/89
PERCENT RECOVERY	96	96	98	98	98	97	107	102	105	90	89	98	96	92	102	107	106	102	97	102	104	108	102	103	100	98

Tracor Technology Resources

PAGE____OF____

QA INSPECTION REPORT

INSPECTION DATE ______________________ AUDITOR ______________________

STUDY TITLE OR CLIENT ______________________

PHASE OR TEST INSPECTED ______________________

DATE REPORTED ______________________ CIRCULATE TO: ______________________

____

____

QA FINDINGS/COMMENTS	ACTION TAKEN

INITIAL AFTER REVIEW ________ ________ ________

Units Abated in the
Lead-Based Paint Abatement Demonstration

Listing by Metropolitan Area

SEATTLE/TACOMA, WASHINGTON

Group	Unit Address
A	6504 28th Avenue, S., Seattle
A	10405 Renton Avenue, S., Seattle
A	10600 12th Avenue, SW, Seattle
A	2244 East Harrison Street, Tacoma
A	1522 S. 47th Street, Tacoma
A	1040 E. 47th Street, Tacoma
B	7919 Beacon Avenue S., Seattle
B	11630 24th Avenue, Seattle
B	553 S. Donovan Street, Seattle
B	1924 South "M" Street, Tacoma
B	4515 Pacific, Tacoma
C	1945 South Hosmer, Tacoma
C	1020 South Ferry, Tacoma
C	5634 South Warner, Tacoma
C	7725 East "E" Street, Tacoma
C	547 27th Avenue, Seattle
D	1422 East 34th Street, Tacoma
D	6202 South Warner, Tacoma
D	617 South 35th Street,Tacoma
D	2516 North 8th Street, Tacoma
D	1418 East Wright Avenue, Tacoma
E	5518 North 45th Street, Tacoma
E	407 South 30th Street, Tacoma
E	906 NW 62nd Avenue, Seattle
E	2356 20th Avenue S., Seattle
E	4217 S. Spencer Street, Seattle

Units Abated in the
Lead-Based Paint Abatement Demonstration

Listing by Metropolitan Area

DENVER, COLORADO

Group	Unit Address
A	467 South Lowell
A	1245 Emporia Street
A	1624 Chester Street
A	5019 West 38th Street
A	4033 Vallejo Street
B	3394 West Center Avenue
B	268 Meade Street
B	175 South Dale Court
B	3763 Osceola
B	2921 Curtis Street
C	2215 South Bannock
C	4324 Lincoln
C	4519 Columbine
C	4420 Pennsylvania
C	4320 Zuni
D2	4920 Zuni
D2	4316 Zuni
D3	3454 York
D3	6801 Irving
D3	4423 Pennsylvania
E	10 South Hazel Court
E	3504 York
E	4454 Josephine
E	228 South Logan
E	1860 W. Berkeley
F	525 South Lowell Blvd.
F	3246 Elizabeth
F	2871 West College Avenue
F	4840 Chase
F	7080 Kearney
G	1321 East 27th Street
G	4895 Vallejo
G	2714 Dowing Street
G	4775 Decatur

Units Abated in the
Lead-Based Paint Abatement Demonstration

Listing by Metropolitan Area

WASHINGTON, D.C.

Group	Unit Address
A	818 51st Street
A	1012 17th Place
A	5901 14th Place
A	2801 Quay Avenue
A	1608 18th Street #4
B	1510 Pacific Avenue
B	905 Drum
B	8637 Leslie Avenue
B	5716 Sheridan
C	6113 Bellwood Street

Units Abated in the
Lead-Based Paint Abatement Demonstration

Listing by Metropolitan Area

BALTIMORE, MARYLAND

Group	Unit Address
A	6155 Parkway Drive
A	5834 Jonquil
A	3810 Belle Avenue
A	1727 Pulaski
A	420 Bouldin
B	3141 Clifmont
B	4101 Hayward
B	2739 Mura Street
B	110 North Decker
C	1304 Walters Avenue
C	2931 Riggs
C	3135 Elmora
C	4408 St. Thomas Apt. #1
D	413 Bradford
D	1720 North Milton Avenue
E	5312 Midwood Avenue
E	1715 Poplar Grove Street
F	3201 Lyndale
F	703 N. Luzerne
G	4907 Midwood
G	1606 Ashburton
G	3714 Elerslie

Units Abated in the
Lead-Based Paint Abatement Demonstration

Listing by Metropolitan Area

BIRMINGHAM, ALABAMA

Group	Unit Address
A	3425 38th Place N.
A	1624 Dennison Avenue
A	1778 Jefferson
A	4101 Main Street
A	6620 1st Avenue S.
B1	5940 Avenue O
B1	616 49th Street
B2	4205 N. 40th Court
B2	4924 9th Court N.
C1	1415 30th Street
C1	918 80th Street S.
C1	1388 Fulton Avenue
C2	5905 Avenue M
C2	1609 29th Street
D	4340 Greenwood
D	4120 41st Avenue
D	112 Midfield Avenue
D	1892 St. Charles Ct.
E	1313 19th Place, S.W.
E	8641 9th Ct. Circle S.
E	5005 8th Terrace South
F	2313 W. 20th Street
F	8410 10th Avenue S.

Units Abated in the
Lead-Based Paint Abatement Demonstration

Listing by Metropolitan Area

DENVER, COLORADO

Group	Unit Address
H	3629 Josephine
H	3311 West Walsh Place
H	2447 Emerson Street
H	4951 Fillmore
H	877 South Sherman
H	7142 East 74th Street
I	3565 Kramoria
I	1910 Chester Street
I	1908 Lansing
I	1665 Macon
I	1934 Ironton
I	3745 Eudora
J	4438 West Kentucky
J	4818 W. 36th Avenue
J	125 S. Decatur
J	3291 W. Custer
J	3920 Vrain
J	350 South Meade
K	617 Elk
K	4430 Columbine
K	4613 Lincoln
K	3317 W. 63rd Avenue
K	4719 Gaylord

Units Abated in the
Lead-Based Paint Abatement Demonstration

Listing by Metropolitan Area

INDIANAPOLIS, INDIANA

Group	Unit Address
A	3924 East 30th Street
A	1308 Wallace
A	5120 Walnut
A	528 Grand
A	371 Emerson (1LV)
B	3449 Kinnear
B	5230 16th Street
B	338 Chester
B	636 Temple
B	1649 Temple
C	3884 Downey
C	1504 Martin
C	1533 Spruce Street
C	802 Raymond
C	6135 Cooper
D	1318 Markwood
D	922 East 42nd Street
D	3456 Carrollton
D	2508 Indianapolis
D	920 Minnesota
E	4249 Carrollton
E	2310 40th Street
E	615 Udel
E	802 Iowa
E	1917 Rivera
F	2214 Arlington
F	1838 Orleans
F	3443 12th Street
F	112 Harris
G	3421 North Gale
G	3814 N. Arlington
G	3058 Stuart
H	17 Tacoma
H	317½ Emerson

RELEASE OF HOUSING UNIT FROM THE LEAD-BASED PAINT ABATEMENT DEMONSTRATION

The housing unit known as: 2921 Curtis Street (Denver)
HUD Case #051-353009-203

had lead-based paint hazard abatement activities undertaken on it as part of the Lead-Based Paint Abatement Demonstration undertaken by the U.S. Department of Housing and Urban Development during the calendar years 1989 and 1990.

Dewberry & Davis, the prime contractor for the Lead-Base Paint Abatement Demonstration, subcontracted the abatement construction firm listed below.

Environet, Inc.
7351 Washington Avenue,South
Minneapolis, MN 55439-2407
ATTN: Steve Gilbertson, Project Manager
612-944-9775

Actual abatement work was undertaken during the period:

10/17/89-1/30/90

Workmanship and materials for this effort were guaranteed by the construction firm for one year from acceptance by Dewberry & Davis, which was on

January 30, 1990

RELEASE PART C

2921 Curtis Street, Denver

Item	Spec.	Qty.	Description
LIVING ROOM			
1C	D	1	Window 2-5x5-9
2C	D	1	Window 2-5x5-8
3C	D	1	Window 5-6x6-4
4C	D	15 l.f.	Window sill
5C	D	78 l.f.	Window trim
6C	D	1	Cabinet 3-2x6-8
KITCHEN			
7C	D	1	Window 2-3x2-9
8C	D	3-7 l.f.	Window sill
9C	D	12 l.f.	Window trim
10C	D	1	Door 2-8x6-7
11C	D	23 l.f.	Door frame/trim (both sides)
12C	D	9 l.f.	Baseboards
BATHROOM 1			
13C	G-1	64 s.f.	Ceiling
14C	G-1	51 s.f.	Wall 1
15C	G-1	51 s.f.	Wall 3
16C	D	49 l.f.	Door frame/trim (both sides)
17C	D	13 l.f.	Baseboard
BEDROOM 1			
18C	J	60 s.f.	Wall 1
19C	J	30 s.f.	Wall 3
20C	J	75 s.f.	Wall 4
21C	D	1	Window 2-5x5-1
22C	D	3-8 l.f.	Window sill
23C	D	18 l.f.	Window trim
24C	D	1	Door 2-6x6-5
25C	D	78 l.f.	Door frame/trim (both sides)
26C	D	42 l.f.	Baseboard
27C	J	70 s.f.	Interior closet wall
BEDROOM 2			
28C	D	2	Windows 2-5x5-1
29C	D	7 l.f.	Window sill
30C	D	34 l.f.	Window trim
31C	D	1	Door 2-6x6-5
32C	D	42 l.f.	Door frame/trim (both sides)
33C	D	33 l.f.	Baseboard

2921 Curtis Street, Denver (continued)

Item	Spec.	Qty.	Description
BEDROOM 3			
34C	A	84 s.f.	Wall 1
35C	D	1	Window 2-0x3-10

BATHROOM 2

Item	Spec.	Qty.	Description
36C	G	30 s.f.	Ceiling
37C	F or G	35 s.f.	Wall 3
38C	F or G	48 s.f.	Wall 4
39C	D	1	Window 2-0x3-4
40C	D	3 l.f.	Window sill
41C	D	14 l.f.	Window trim
42C	D	1	Door 2-5x6-4
43C	D	20 l.f.	Baseboard (Walls 1 & 2)
44C	I	8 l.f.	Baseboard (Walls 3 & 4)
45C	D	4	Cabinet 2-4x2-6
46C	I	12 l.f.	Chair rail (Walls 3 & 4)
47C	B	2 l.f.	(Wall 1)
HALL 1 (2ND LEVEL)			
48C	D	1	Door 2-7x6-4
49C	D	30 l.f.	Baseboard
50C	D	17 l.f.	Door frame/trim
HALL 2 (1ST LEVEL)			
51C	F or G	81 s.f.	Closet wall
52C	I	8 l.f.	Baseboard
LAUNDRY			
53C	G	50 s.f.	Ceiling
54C	F or G	30	Wall 1
55C	F or G	81	Wall 2
56C	F or G	38	Wall 3
57C	F or G	81	Wall 4
58C	D	1	Window 2-0x3-9
59C	D	3-4 l.f.	Window sill
60C	D	11 l.f.	Window trim
61C	I	20 l.f.	Baseboard (Wall 1)
62C	Remove	9 l.f.	Chair rail (Wall 1)

2921 Curtis Street, Denver (continued)

Item	Spec.	Qty.	Description
EXTERIOR			
63C	A	268 s.f.	Side 1
64C	A	1,024 s.f.	Side 2
65C	A	286 s.f.	Side 3
66C	A	28 s.f.	Front porch siding
67C	D	24 l.f.	3 Columns 6"x6"
68C	A	18 s.f.	Back porch siding
69C	D	1	Back door 2-8x6-7
70C	D	194 l.f.	Window trim
71C	A	24 l.f.	Columns 4"x4"
72C	A	30 s.f.	Balcony ceiling
73C	I	51 s.f.	Shingles, ft. porch
74C	Remove	All	Wood Screens

NOTES TO PART C

2921 Curtis Street, Denver (continued)

Items #10C, 24C, 31C, 42C, and 65C-70C were not sanded because of the inordinate amount of time necessary to properly abate a substrate. The sanding unit is basically a "finish" type of unit and not a "gross" type of removal unit.

Items #34C, 62C, 63C, and 64C were not vacuum blasted because the vacuum blasting procedure was damaging the substrate too much.

Items #44C and 46C were removed/replaced as opposed to just removed in an effort to make the bathroom look better.

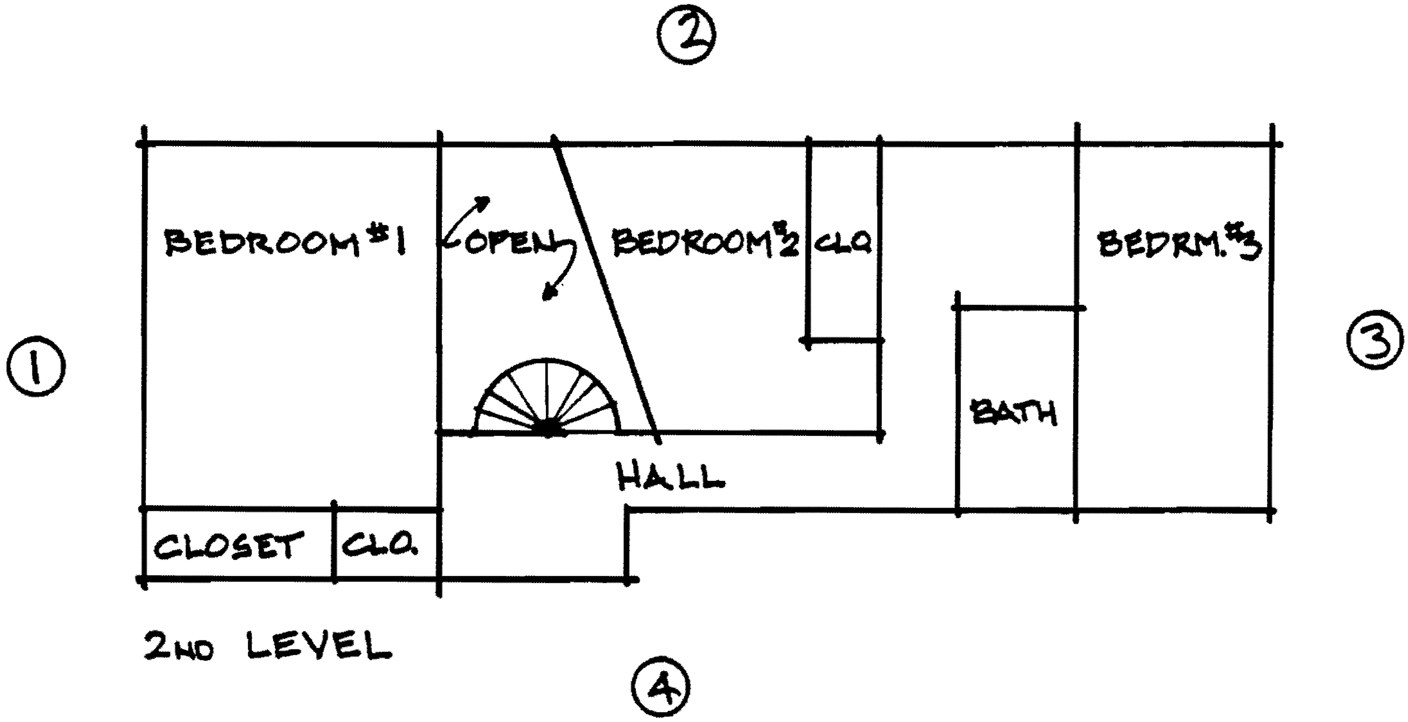
Original Item #48C was deleted because it was already abated in Item 43C.

Item #60C was changed from remove only to remove/replace to serve two purposes: 1) protect the new dry wall at the floor, and 2) make the room look better.

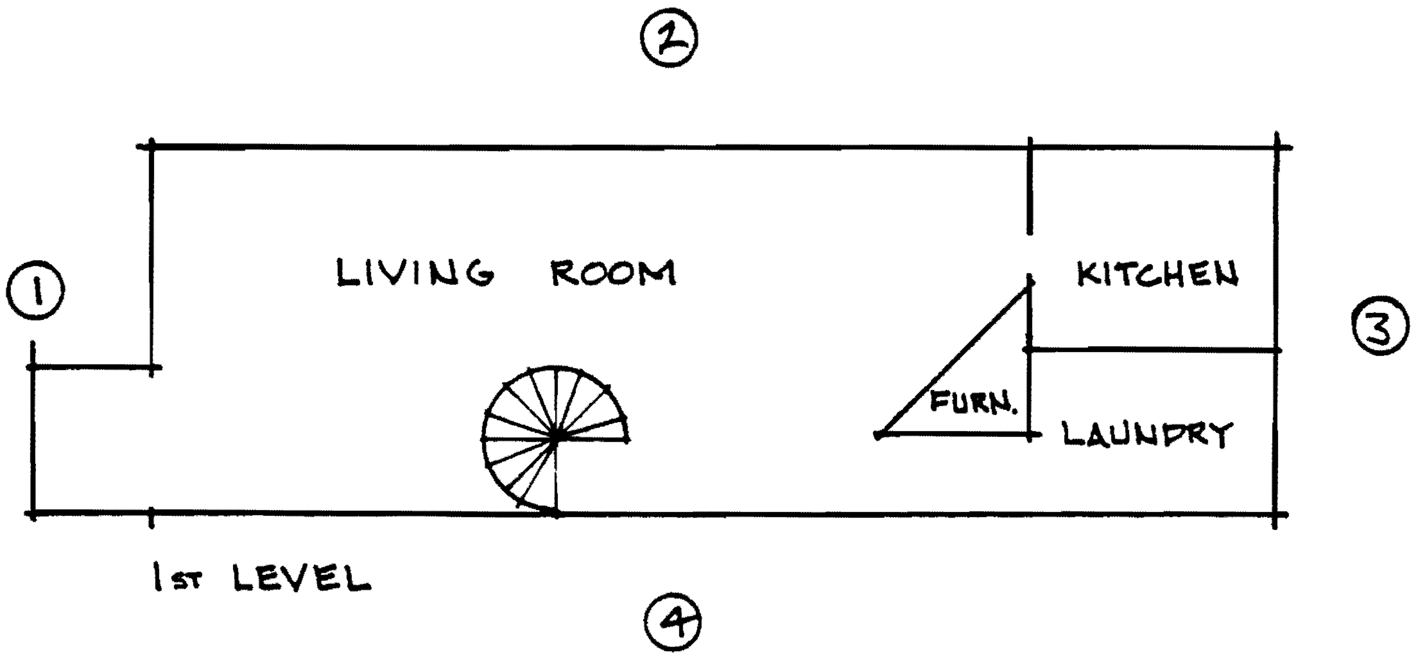
All other items were abated according to original abatement specifications.

Approximately 1 barrel of hazardous waste was generated at this site.

About 1 barrel of hazardous waste was removed from this site by the hazardous waste disposal firm.



2ND LEVEL



1ST LEVEL

2921 CURTIS ST.
DENVER, CO

DESCRIPTIONS OF PART C SPECIFICATIONS FOR ABATEMENT METHODOLOGIES

SPECIFICATION	DESCRIPTION
A	Encapsulation - This specification included the coating of Lead-Based Paint (LBP) surfaces with elastic acrylic coatings that were heavy-bodied and compatible with the substrate to which they were applied. Note that friction surfaces such as door jams and window sashes and tracks were chemically stripped of paint prior to encapsulation of the substrates.
B	Abrasive Removal - Substrates were sanded, ground, or blasted by equipment such as sanders equipped with HEPA attachments. The substrates were then painted with a primer/sealer.
C	Heat Gun - A hot air stream from heat blowers was used to blister and soften LBP for removal by scraping and/or brushing. Substrates that were abated by use of a heat gun were treated with a primer/sealer.
D	Chemical - Chemical removers that were compatible with and not harmful to the substrates were used to abate LBP identified surfaces. Substrates that were abated by chemical removal were treated with a primer/sealer.
E	Vacuum Blasting - Vacuum blasting was of the full containment type and was generally only used on masonry surfaces.
F	Enclosure (Paneling) - Panel enclosure included the sealing and attachment of paneling to the surface requiring abatement. Prior to the enclosure, 3"x5" warning labels stating that the surface contains LBP were posted on 4 foot centers.

G

Enclosure (Gypsum Board) - Gypsum wallboard was used to enclose walls and ceilings identified to have LBP coatings. The gypsum boards were glued and screwed after 3"x5" warning labels were posted.

G-1

Enclosure (Exterior) - Composite enclosure systems of aluminum, vinyl, or wood were installed to the substrate in a continuous system as to completely enclose the LBP substrate. The enclosure was installed after the 3"x5" warning labels were posted.

H

Off Site Chemical - Off site chemical stripping entailed the removal of a substrate from the unit to be chemically stripped at a remote location. Once the substrate was abated, it was reinstalled and coated with a primer/sealer.

I

Remove/Replace - This strategy utilized the physical removal of a substrate and subsequent replacement with like or better quality replacement substrate.

J

Encapsulation (Flexible Wall Covering) - Flexible wall coverings of the reinforced fiber were used to form a secure bond with the substrate and be resistant to peeling. The wall covering system formed a seal over the substrate to which the cover was applied, such that the passage of dust into the living area was not possible.

K

Other - Occasionally a contractor used an alternative method as approved by the engineer. For these occasions, a brief description of the abatement process is described.

Part C Definitions

Window System - Consists of 3 parts including the window, window sill, and window trim.

Window - that part of the window system including the frame, movable sashes, channel guides, mullions and panes of glass.

Window Sill - the lower portion of a window system on which the window sash rests.

Window Trim - that part of the window system that covers the working components and underlying frame.

Door System - Consists of 2 main parts, the door and the door frame/trim.

Door - solid or hollow core portion of the door system that is movable and includes 2 sides and 4 edges as well as related hardware.

Door Frame/Trim - the frame of a doorway including the jamb, lintel, stop, and associated trim.

Baseboard - the board that forms the foot of an interior wall where wall and floor meet (sometimes called the skirt or mopboard).

Chair Rail - a molding on an interior wall approximately waist height.

Ceiling Moldings - molding found where the wall and ceiling meet, sometimes referred to as crown molding.

Stair Systems - Consists of several parts including the tread, riser, handrail, and balustrades. Each item is noted separately except when an entire system required abatement.

Mechanical - A mechanical item may be a radiator, air vent, electrical box, or other random item. Clarification will be made under the description column of the Part C.

Soffit/Facia - A facia board and soffit may or may not be specified individually. In general if a unit contains both soffit and facia, both will be treated in a like manner. The soffit is generally a roof overhang, whereas the facia board is the trim board at the uppermost part of an exterior wall just below the roofing materials.