NBSIR 75-974

# The Demonstration of Experimental Lead Paint Hazard Abatement Methods in Atlanta, Georgia

Thomas H. Boone
Harvey W. Berger
A. Philip Cramp
Herbert A. Jackson

Institute for Applied Technology
National Bureau of Standards
Washington, D. C. 20234

December 1975

Final

Prepared for
**Office of Policy Development and Research**
**Department of Housing and Urban Development**
**Washington, D. C. 20410**

NBSIR 75-974

# THE DEMONSTRATION OF EXPERIMENTAL LEAD PAINT HAZARD ABATEMENT METHODS IN ATLANTA, GEORGIA

Thomas H. Boone
Harvey W. Berger
A. Philip Cramp
Herbert A. Jackson

Institute for Applied Technology
National Bureau of Standards
Washington, D. C. 20234

December 1975

Final

Prepared for
Office of Policy Development
Department of Housing and Urban Development
Washington, D. C. 20410


**U.S. DEPARTMENT OF COMMERCE**, Rogers C.B. Morton, *Secretary*
James A. Baker, III, *Under Secretary*
Dr. Betsy Ancker-Johnson, *Assistant Secretary for Science and Technology*

**NATIONAL BUREAU OF STANDARDS**, Ernest Ambler, *Acting Director*

Table of Contents

Tables of Contents (con't.)

Table of Contents (con't.)

List of Tables

List of Figures

## SI Conversion Units

The conversion factors and units contained in this report are in accordance with the International System of Units (abbreviated SI for Systeme International d'Unites). The SI was defined and given official status by the 11th General Conference on Weights and Measures which met in Paris in October 1960. For assistance in converting U.S. customary units to SI units, see ASTM E 380, ASTM Standard Metric Practice Guide, available from the American Society for Testing and Materials, 1916 Race Street, Philadelphia, PA. 19103. The conversion factors for the units found in this Standard are as follows:

Length

1 in = 0.0254* meter

1 ft = 0.3048* meter

1 mil = 0.001* in

Area

1 $in^2$ = 6.4516* x $10^{-4}$ $meter^2$

1 $ft^2$ = 0.9290* $meter^2$

Volume

1 $in^3$ = 1.638 x $10^{-5}$ $meter^3$

1 liter = 1.000* x $10^{-3}$ $meter^3$

Mass

1 grain = 6.479 x $10^{-5}$ kilogram

1 ounce-mass (avoirdupois) = 2.834 x $10^{-2}$ kilogram

1 pound-mass (avoirdupois) = 0.4535 kilogram

Pressure or Stress (Force/Area)

1 inch of mercury (60°F) = 3376 $newton/meter^2$

1 pound-force/inch (psi) = 6894 $newton/meter^2$

---

*Exactly

Energy

1 inch-pound-force (in-lbf) = 0.1130 joule

Plane Angle

1 degree (angle) = $1.745 \times 10^{-2}$ radian

Power

1 watt = $1.000^{*} \times 10^{7}$ erg/second

Temperature

°C = 5/9 (Temperature °F - 32)

---

*Exactly

The Demonstration of Experimental Lead Paint Hazard Abatement Methods in Atlanta, Georgia

Abstract

This report describes the second phase of an experimental lead paint hazard abatement program carried out in 80 dwelling units in Atlanta, Georgia. The first phase was conducted in Washington, D.C. The entire program will ultimately involve the abatement of lead paint hazards in a total of approximately 250 dwelling units distributed over three or more cities.

The procedures demonstrated in this field testing program were: paint removal using chemical sovlents; paint removal using three heat producing devices; the replacement of components such as windows, doors, and wood trim and the installation of flexible sheet materials, rigid boards, plaster products and aggregate filled coatings, over existing lead paint on walls. Also evaluated was the covering of deteriorated, lead paint coated floors with plywood.

The report includes procedures for inspecting and selecting dwellings for lead paint hazard abatement, evaluations of the suitability and implementation characteristics of the abatement methods, and recommendations for their use.

Subsequent reports will present the results of comparable programs in additional cities and a final report will compare the cost-effectiveness of the alternative abatement methods.

Key Words: Abatement; barrier materials; building materials; children; housing; lead-based paint; lead poisoning; paint removal.

## 1. INTRODUCTION

Lead poisoning is recognized as a serious national health problem which affects hundreds of thousands of children annually. A major contributor to this desease is lead based paint which exists as a hazard in most housing built before 1940. Children who suffer from pica, an abnormal desire to eat non-food items, will develop lead poisoning if they have access to loose or peeling lead paint on walls or on other surfaces such as window sills, railings and door edges which are within their reach.

The Lead Based Paint Poisoning Prevention Act of 1971 [1]* was enacted to attack the problem of lead paint poisoning of children. As one of many responsibilities under that law, The Department of Housing and Urban Development (HUD) was directed to carry out a research and demonstration program on technological means for the elimination of lead paint hazards from housing. In order to meet that obligation, HUD developed an Experimental Hazard Abatement Program (EHAP) in which approximately twenty lead paint hazard abatement methods would be demonstrated in 250 dwellings, distributed in a number of major cities across the country.

The Center for Building Technology at the National Bureau of Standards (NBS) is a primary source of technical assistance to HUD in the areas of housing research and building technology. In addition to participating in several other research activities pertaining to the lead poisoning problem, NBS is providing technical assistance to HUD on

*Numbers in brackets indicate the literature reference at the end of this paper.

the EHAP. NBS is responsible for assisting in the design of the program and for the evaluation of the performance and characteristics of the abatement methods and the determination of their relative cost effectiveness. The Boeing Aerospace Company is providing field management services for the EHAP under a contract with HUD.

This report is the second in a series of reports on the EHAP. The first report [2] described the abatement of lead paint hazards in 30 dwellings in Washington, D.C. This report describes the abatement of lead paint in 80 dwellings in Atlanta, Georgia and represents the completion of the first phase of the EHAP. It is anticipated that a total of 140 dwellings will be abated in one or possibly two additional cities in the second phase of the EHAP. That work will be the subject of subsequent reports. A final report will be prepared at the conclusion of the EHAP which will be a summary of the technical observations and recommendations, a presentation of cost data obtained throughout the program and an analysis of the cost effectiveness of the abatement methods which were demonstrated.

This report is intended to provide technical guidance in the selection of abatement methods to housing and code officials and to others who are immediately concerned with the elimination of lead paint hazards from housing and/or the control of lead paint poisoning in children.

The reader is urged to review the first report [2] of this series which provides additional introductory information on the roles and responsebilities of the various participants in the EHAP and some of the operational procedures.

## 1.1 SELECTION OF ATLANTA, GEORGIA FOR THE EHAP

The dwellings used for the demonstration of lead paint hazard abatement in the EHAP are public housing units or properties that are in HUD's temporary inventory because of defaults, by previous owners, of HUD/FHA insured mortgages. Atlanta was selected as one of the cities to be included in the EHAP because of the availability of a large stock of dwellings from which appropriate units could be selected and because the type of construction and materials usage appeared to be representative of housing in the south-eastern region of the country.

# 2. DWELLING UNIT SELECTIONS

## 2.1 HOUSING SELECTION CRITERIA AND SAMPLING PLAN

A series of criteria were developed to control the selection of the housing sample in order to assure an appropriate number of housing units with a variety of construction types, ages and extremes in the conditions which are believed to contribute to lead paint poisoning. In addition, it was especially desirable to have units, in which abatement would be carried out in wet areas* such as kitchens and bathrooms, as well as in dry areas such as bedrooms, living rooms, dining rooms and hallways.

A criterion was established for the minimum amount of painted surface area to be abated in each dwelling unit. This criterion was intended to assure that a sufficient quantity of work was performed on each abatement system to determine its feasibility and to provide reliable cost data for a later final report as noted in the introduction. The factors considered in this report are basically procedural and technical.

*Areas frequently exposed to high humidity and splashing water.

The criteria listed below were intended to assure that the dwelling units selected for lead paint abatement in Atlanta were representative of housing that is believed to contribute to lead paint poisoning and were, in fact, hazardous by virtue of their lead paint content and deteriorated condition.

CRITERION 1: Lead Content

The interior painted surfaces shall contain at least 2.0 milligrams of lead per square centimeter of surface area. The surface shall be measured as described in Section 2.2 below with a portable X-ray fluorescent (XRF) lead detector. (The characteristics and use of such detectors are described elsewhere [3]).

CRITERION 2: Physical Conditions

The paint on wall surfaces shall be cracked, scaling, peeling or chipping and/or if the painted trim, such as windows, window sills, doors, door frames and molding, although tight, is within four feet of the floor.

CRITERION 3: Surface Dimensions

One or more of the following requirements must be satisfied:

(a) At least 500 square feet of interior wall surface will require abatement.

(b) At least 500 linear feet of interior trim will require abatement.

(c) Four interior doors will require abatement.

(d) Four windows will require abatement.

In addition to meeting the CRITERIA listed above, the units in Atlanta were selected to fulfill to the extent possible, a housing sample selection

plan (See Table 1) which specified the types and ages of dwellings units to be used in the Program.

2.2 SCREENING AND SELECTION PROCESS

In the process of screening housing for inclusion in the Program and in accordance with CRITERION 1, only those walls whose painted surfaces were in a deteriorated condition were measured to determine their lead content. If after a quick walk-through of the dwelling unit, none of the walls were found to be in such condition, the inspectors proceeded directly to the measurement of lead on doors, windows, and trim in each interior room.

If the XRF measurements of lead content were below 1.0 mg/cm$^2$ on all surfaces, the dwelling was eliminated as a potential condidate for the Program. If on the other hand, certain surfaces rendered single XRF readings greater than 1.0 mg/cm$^2$, more detailed XRF inspections were made according to the following procedure:

| Value of "Initial" XRF Reading mg/cm$^2$ | Number of "Additional Readings at a Single Point" |
|---|---|
| less than 1.0 | None |
| 1.0 to 3.4 | 2 |
| more than 3.4 | None |

For each surface which indicated an average lead paint content of 2.0 mg/cm$^2$ or above (or a single reading of 3.4 mg/cm$^2$ or more) additional information was recorded on its total area in square feet or length in linear feet.

All of this information was recorded on an "Interior Surfaces" form (Figure 1) as well as data on the types and conditions of the substrates

Table 1

Housing Sample Selection Plan for 80 Dwelling Units

| | Year of Construction | | | |
|---|---|---|---|---|
| | Pre 1920 | 1921-1940 | 1941-1950 | 1951-1960 |
| MFHR[1] | 0 | 2 | 6 | 2 |
| MFLR[2] | 0 | 2 | 10 | 3 |
| SFA[3] | 5 | 25 | 5 | 5 |
| SFD[4] | 2 | 8 | 4 | 1 |

[1]MFHR - Multifamily High Rise - A multiple dwelling exceeding three stories in height.

[2]MFLR - Multifamily Low Rise - A multiple dwelling not exceeding three stories in height.

[3]SFA - Single Family Attached - A dwelling, one or more stories in height, of which the walls on one or more sides are party or lot line walls.

[4]SFD - Single Family Detached - A dwelling, one or more stories in height, which is completely surrounded by permanent open spaces.

Figure 1

Recording Form for Interior Surfaces

FORMAT I

# INTERIOR SURFACES Room or Location _____ Assigned No _____

| ITEMS | | XRF MEASUREMENT (Lead in mg/cm²) 1 | 2 | 3 | AVG. | DIMENSIONS SQ. FT. | LIN. FT. | SURFACE TYPE (P) (V) (W) | SURFACE CONDITION T | C | B | P | SUBSTRATE TYPE (PL) (G) (M) (W) (ML) | SUBSTRATE CONDITION S | C | R | B | H | F |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| WALLS | N | | | | | | | | | | | | | | | | | | |
| | E | | | | | | | | | | | | | | | | | | |
| | S | | | | | | | | | | | | | | | | | | |
| | W | | | | | | | | | | | | | | | | | | |
| BASE BOARD | N | | | | | | | | | | | | | | | | | | |
| | E | | | | | | | | | | | | | | | | | | |
| | S | | | | | | | | | | | | | | | | | | |
| | W | | | | | | | | | | | | | | | | | | |
| CEILING | | | | | | | | | | | | | | | | | | | |
| DOOR | | | | | | | | | | | | | | | | | | | |
| | FRAME | | | | | | | | | | | | | | | | | | |
| DOOR | | | | | | | | | | | | | | | | | | | |
| | FRAME | | | | | | | | | | | | | | | | | | |
| DOOR | | | | | | | | | | | | | | | | | | | |
| | FRAME | | | | | | | | | | | | | | | | | | |
| DOOR | | | | | | | | | | | | | | | | | | | |
| | FRAME | | | | | | | | | | | | | | | | | | |
| WINDOW | | | | | | | | | | | | | | | | | | | |
| | FRAME | | | | | | | | | | | | | | | | | | |
| WINDOW | | | | | | | | | | | | | | | | | | | |
| | FRAME | | | | | | | | | | | | | | | | | | |
| WINDOW | | | | | | | | | | | | | | | | | | | |
| | FRAME | | | | | | | | | | | | | | | | | | |
| CABINET | | | | | | | | | | | | | | | | | | | |
| | | | | | | | | | | | | | | | | | | | |
| | | | | | | | | | | | | | | | | | | | |

**SURFACE**

TYPE (P) PAINT
(V) VARNISH
(W) WALLPAPER

CONDITION T TIGHT
C CRACKED
B BLISTERING
P PEELING

**SUBSTRATE**

TYPE (PL) PLASTER
(G) GYPSUM BOARD
(M) MASONRY
(W) WOOD
(ML) METAL

CONDITION S SOUND
C CRACKED
R REPAIRED
B BUCKLED
H HOLES
F FALLING

**BASIC ROOM DIMENSIONS**

WIDTH _____
LENGTH _____
HEIGHT _____

No. of Doors _____
No. of Windows _____

and surfaces in each room. In addition, other potentially important information was noted on the general conditions of each dwelling unit including, major structural defects, roof and plumbing leaks, and the nature and condition of electrical wiring, heating and plumbing systems.

## 2.3 DWELLING UNIT SAMPLE CHARACTERISTICS AND CONDITIONS

The Public Housing Authority of the City of Atlanta maintains responsibility for approximately 10,800 public housing units. The files on this housing stock were reviewed briefly in order to select specific properties for preliminary inspections and ultimate selection for the EHAP in accordance with the Housing Sample Selection Plan (Table 1).

Of the approximately 80 public housing units that were inspected by Housing Authority teams, 48 were finally selected for the EHAP from the public housing stock. All of the units, which had been built between 1936 and 1940, were occupied and were located at three sites in the inner part of the city: Techwood Homes, University Homes, and John Hope Homes.

All of the units were of masonry construction with brick exterior facing. The two story buildings, at University Homes and John Hope Homes, had private entrances for each dwelling unit and balconies with wrought iron railings on the second floors. The three story buildings, at Techwood Homes, had public or common entrances but did not have balconies.

In spite of their age, the conditions of the exteriors and interiors were surprisingly good. The exterior brick, concrete stoops and steps, railings and entrance doors were in sound condition. There were no major repairs required for walls or ceilings and there were no weak or unsafe floors. In fact, with the exception of minor gouges and small puncture holes, the interior plaster walls were sound.

However, peeling paint was prevalent and about one-third of the original steel casement windows were inoperative because of corrosion and wear.

During the time of the housing selection process (October through November 1975) the Atlanta HUD Area Office was in possession of an inventory of about 600 housing units acquired by default of HUD insured mortgages. Thirty-two of these acquired properties were finally selected for inclusion in the EHAP.

All of these properties were unoccupied single family detached houses. Their styles ranged from Cape Cod or bungalow type to two-story colonials with front and rear porches. The majority were of frame construction with wood clapboard exterior siding. Four of these houses were built before 1920, twenty-three were built between 1920 and 1940 and five were built between 1940 and 1950.

All of the 32 acquired properties had plaster interior walls and wood double-hung windows that were sound and in working condition. The majority had four or six panel colonial interior doors with ornate wood trim. Several of the units had walls and ceilings with falling plaster and some of the wood porch decks were weak and unsafe. However, none of these conditions of deterioration were found in areas where lead paint was present and therefore no prior repair work was required for the implementation of the lead hazard abatement methods.

A brief summary of the characteristics of the 80 dwelling units used in Atlanta is given in Table 2. A comparison of the types and ages of the dwellings with the original sampling plan, shown in Table 1, indicates differences between the planned and actual samples. These differences

Table 2

Summary of Characteristics of Dwellings Used in Atlanta EHAP

| | Acquired Properties | Public Housing |
|---|---|---|
| Type of Unit | SFA | MFLR |
| Total number of units | 32 | 48 |
| Year of Construction: | | |
| before 1920 | 4 | 0 |
| 1920-40 | 23 | 40 |
| 1940-50 | 5 | 8 |
| Construction Type | Frame | Masonry |
| Materials Used: | | |
| Walls | Plaster | Plaster |
| Windows | Wood Double Hung | Steel Casement |
| Doors | Wood 4 - 6 panel | Wood - Flush |
| Trim | Wood - ornate | Metal - Plain |

in the mixture of ages and types of dwellings were simply due to the absence of many of the desired categories of housing in the Atlanta public housing and acquired properties inventory. All of the types of housing identified in Table 1 exist in the City of Atlanta but they are not represented in the publicly owned property stock.

The unavailability of several housing types and the consistently sound condition of the surfaces, which were abated, constituted some limitation with regard to the program objectives. A number of the abatement methods which were to be applied to surfaces with major damages could not be implemented under those circumstances. The nature and costs of preparation and repair work could not be determined because of the generally sound condition of the 80 units.

### 2.3.1 LEAD PAINT LOCATIONS AND LEVELS

The locations of lead paint in the dwelling units and the measured quantity of lead at or above 2.0 $mg/cm^2$, for each location, are presented in Tables 3 and 4. Only five of the 47 multi-family dwelling unit listed in Table 3 contained interior walls in dry areas, which were above 2.0$mg/cm^2$. These were all located in the stairwells. With the exceptions of units 268, 269, and 271, the doors; door frames; windows; window frames and baseboards all had measured lead levels above 2.0 $mg/cm^2$.

In Atlanta, areas which were considered to be accessible to children (such as front and rear porches or stoops) and having painted surfaces measuring 2.0 $mg/cm^2$ or above, as shown in Table 4, were abated.

The average lead levels found in the dwelling units are shown in Table 5. As in Washington, D.C., the hazardous areas were primarily found within the dwelling units, on the walls in wet areas (kitchens and bathrooms), on windows and doors and on most trim (door and window frames

Table 3

LEAD PAINT LOCATIONS & LEVELS

(MULTI-FAMILY LOW RISE DWELLING UNITS)

Lead Content $mg/cm^2$ before abatement

| DWELLING UNIT NO. | WALLS | | | DOORS | DOOR FRAMES | WINDOWS | WINDOW FRAMES | BASEBOARDS |
|---|---|---|---|---|---|---|---|---|
| | Kitchens | Bathrooms | Staircase | | | | | |
| 203 | 7.0 | | 5.0 | 3.5 | 3.5 | | 4.0 | |
| 204 | 7.0 | 8.0 | | 6.0 | 6.0 | | 5.0 | |
| 205 | 4.0 | 5.5 | | 7.0 | 3.0 | | 3.0 | 3.5 |
| 206 | 5.0 | 4.0 | | 5.0 | 4.5 | | 3.0 | 4.0 |
| 207 | | | | 4.0 | 3.5 | 5.0 | 3.0 | |
| 208 | | | | 5.0 | 7.5 | 5.3 | 3.5 | |
| 209 | 13.5 | 16.0 | 20.5 | 3.5 | 3.0 | | | |
| 210 | 16.5 | 12.0 | | 6.0 | 6.0 | | | 5.5 |
| 211 | 11.0 | 11.0 | | | | | | 5.5 |
| 212 | 15.0 | 10.0 | | 6.0 | 9.0 | | | 4.5 |
| 213 | 7.0 | 9.0 | | 4.5 | 5.0 | | | |
| 217 | | | | 8.0 | 7.0 | | 2.4 | |
| 222 | | | | 3.5 | 3.0 | | | |
| 223 | | | | 3.5 | 6.0 | | | |
| 227 | | | | 4.0 | 6.0 | | | |
| 231 | | | | 5.5 | 8.0 | | | |
| 232 | | | | 3.5 | 5.5 | | | |
| 233 | | | | 5.5 | 8.5 | | | |
| 238 | | | | 2.5 | | | | |
| 240 | 7.0 | 6.0 | | 2.5 | 2.5 | | 3.0 | |
| 242 | 5.5 | 7.0 | | 4.0 | 5.0 | | 4.0 | |
| 243 | 5.5 | 7.0 | | 5.0 | 3.0 | | 4.0 | |
| 244 | 3.0 | 5.5 | | 3.5 | 3.0 | | 3.5 | |
| 246 | 7.0 | 4.0 | | 3.0 | 3.0 | | 3.0 | |
| 247 | 6.0 | 4.0 | | 3.0 | 2.5 | | 3.0 | |
| 248 | 3.5 | 4.0 | | 8.0 | 7.0 | | 3.0 | |
| 249 | 19.0 | 14.0 | | 9.0 | 11.0 | | 3.0 | |
| 250 | 15.0 | 18.0 | | 8.0 | 8.0 | | 3.0 | |
| 251 | 10.0 | 10.0 | | 8.0 | 7.0 | | | |
| 252 | 13.0 | 19.0 | | 8.0 | 4.5 | | | |
| 253 | 8.5 | 11.0 | | 8.0 | 6.0 | | | |
| 254 | 19.0 | 14.0 | | 7.5 | 7.0 | | | |
| 255 | 10.5 | 12.5 | | 5.3 | 11.0 | | | |
| 256 | 3.0 | 7.0 | | 5.0 | 3.0 | | | |
| 257 | 12.0 | 8.0 | | 6.0 | 4.0 | | | |
| 258 | 9.0 | 9.0 | | 4.0 | 5.0 | | | |
| 263 | 12.0 | 8.0 | | 3.0 | 8.0 | | | |
| 264 | 13.0 | 17.0 | | 6.0 | 7.0 | | | |
| 265 | 11.0 | 12.0 | | 3.0 | 4.0 | | | |
| 266 | 10.0 | 9.0 | | 4.0 | | | | |
| 267 | 8.0 | 14.0 | | 5.0 | 5.0 | 4.5 | | |
| 268 | 9.0 | 13.0 | | | | | | |
| 269 | 9.0 | 13.0 | 6.0 | | | | | |
| 270 | 9.0 | 12.5 | | 6.2 | 6.3 | | | |
| 271 | 12.0 | 14.0 | | | | | | |
| 273 | 15.5 | 11.5 | 6.0 | 6.5 | | | | |
| 274 | 13.5 | 17.0 | 4.5 | | 6.1 | | | |
| | | | | | | | | |

Table 4

# LEAD PAINT LOCATIONS & LEVELS

(SINGLE FAMILY DETACHED DWELLING UNITS)

Lead Content $mg/cm^2$ before abatement

| | INTERIOR | | | | | | | | EXTERIOR | | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | WALLS | | | | | | | | WALLS | | DOORS | | DOOR FRAMES | | WINDOWS | | WINDOW FRAMES | | PORCH | | | | | | | |
| Dwelling Unit Number | Kitchen | Bathroom | Doors | Door Frames | Windows | Window Frames | Baseboards | Cabinets | Front | Rear | Front | Rear | Front | Rear | Front | Rear | Front | Rear | Railings (Front) | Railings (Rear) | Columns (Front) | Columns (Rear) | Deck (Front) | Deck (Rear) | | |
| 301 | | | 5.5 | 5.6 | | | | | | | 2.0 | | 12.0 | | 12.0 | | 12.0 | | 12.0 | | | | 2.6 | | | |
| 302 | 5.0 | 7.5 | 5.0 | 5.0 | 7.0 | 6.0 | 8.0 | | | | | | | | | | | | | | | | | | | |
| 303 | 5.0 | | 5.0 | 5.0 | 4.0 | 4.0 | | | | | 9.0 | 13.0 | 9.0 | 13.0 | | | | | | | | | | | | |
| 305 | 12.0 | 13.0 | | | | | | 7.0 | 5.5 | 15.0 | 5.0 | | 3.0 | | 5.0 | | 6.0 | | | | | | | | | |
| 306 | | | 7.0 | 7.0 | 3.5 | | 7.0 | 6.0 | | | 7.0 | 15.0 | 11.0 | 15.0 | | | | | | | | | | | | 5.0 |
| 307 | | | 13.0 | 11.0 | 13.0 | 13.0 | 13.0 | 10.0 | | | 18.0 | 20.0 | 21.0 | 21.0 | 16.0 | 16.0 | 21.0 | 16.0 | 11.0 | | | | | | | |
| 308 | | | 4.0 | 5.0 | 4.0 | 4.0 | | | 14.0 | | 13.0 | | | | 12.5 | | | | | | | | | | | |
| 310 | 7.5 | 10.0 | 15.0 | | 15.0 | 14.0 | 2.0 | | 14.0 | 12.5 | 3.0 | 14.0 | 3.0 | | 18.0 | | 18.0 | | | | | | | | | |
| 312 | | | 6.0 | 3.0 | 3.0 | 3.0 | | | | 18.0 | | 9.0 | 14.0 | 9.0 | 9.0 | 14.0 | 16.0 | 14.0 | 19.0 | | 20.0 | | 6.0 | | | |
| 314 | | 8.5 | 8.7 | 9.0 | 7.5 | 8.5 | 9.0 | | | | 9.5 | | 10.0 | | 9.0 | | | | | | 14.2 | | | | | |
| 316 | | | 6.0 | 4.0 | | | 5.0 | | 17.0 | 13.0 | | | | | | | | | | | | | | | | |
| 320 | | | | | | | | | 4.4 | | 10.0 | | 18.0 | | 18.0 | | 18.0 | | 26.0 | | 17.0 | | 2.5 | | | |
| 321 | | | | | | | | | 5.9 | | 12.1 | | 16.5 | | | | | | | | 17.8 | | | | | |
| 322 | | | | | | | | | 8.6 | | 4.0 | | 10.0 | | 9.0 | | 9.0 | | 11.0 | | 8.0 | | | | | |
| 325 | | | | | | | | | 19.0 | 16.5 | | | 7.0 | 15.0 | | | | | 15.0 | | 15.0 | | | | | 11.0 |
| 326 | | | | | | | | | 10.2 | 9.7 | | 9.0 | 7.0 | 9.0 | 6.5 | 4.0 | 6.5 | 7.0 | | | 7.0 | | | | | |
| 327 | | | | | | | | | 5.6 | | | | 3.5 | | 4.0 | | 4.0 | | | | | | | | | |
| 328 | | | | | | | | | 6.0 | 5.0 | | 5.0 | 4.0 | | | | | | | | | | 7.0 | | | |
| 329 | | | | | | | | | 10.0 | | 2.5 | | 15.0 | | 13.0 | | 13.0 | | | | 12.0 | | 7.0 | | | |
| 330 | | | | | | | | | 10.0 | | 8.0 | | 10.0 | | 11.0 | | 11.0 | | | | 16.0 | | | | | |
| 331 | | | | | | | | | 27.0 | | 18.0 | | 22.0 | | 29.0 | | | | | | | | | | | |
| 332 | | | | | | | | | 10.0 | | 9.5 | | 12.0 | | 9.5 | | 9.5 | | | | | | | | | |
| 334 | | | | | | | | | 11.0 | 11.0 | 11.0 | 6.0 | 10.0 | 10.0 | | 12.0 | 9.0 | | | | | 10.0 | | | | |
| 335 | | | | | | | | | 6.0 | | 6.0 | | 24.0 | | 27.0 | | 27.0 | | | | 24.0 | | 3.0 | | | |
| 336 | | | | | | | | | 15.0 | | 2.5 | | 7.5 | | 15.0 | | 15.0 | | | | 13.0 | 13.0 | | | | |
| 337 | | | | | | | | | 2.6 | | 2.0 | | 2.0 | | | | | | 4.0 | | 3.0 | | | | | |
| 338 | | | | | | | | | 6.0 | | 5.0 | | 3.5 | | | | | | | | 3.5 | | | | | |
| 339 | | | | | | | | | 8.0 | | 8.0 | | 9.0 | | 9.0 | | | | | 10.5 | | | | | | |
| 341 | | | | | | | | | 22.5 | | | | 26.0 | | 25.0 | | | | | | 17.5 | | | | | |
| 342 | | | | | | | | | 28.0 | | 5.0 | | 19.0 | | 19.0 | | 19.0 | | | | 23.0 | | | | | |
| 343 | | | | | | | | | 2.5 | | 16.0 | | 24.5 | | 24.0 | | 27.0 | | 32.0 | | 24.0 | | | | | |
| 347 | | | | | | | | | 27.0 | | | | 15.0 | | | | 13.0 | | | | | | | | | |
| 348 | | | | | | | | | | | | | 14.0 | | 18.0 | | 18.0 | | | | 26.0 | | | | | |

Table 5

AVERAGE LEAD LEVELS FOUND ON SURFACES SELECTED FOR ABATEMENT IN ATLANTA, GEORGIA

| Hazardous Areas | Average Lead Content Levels ($mg/cm^2$) SFD | MFLR |
|---|---|---|
| Wall (Kitchen) | 7.0 | 10.0 |
| Wall (Bathroom) | 10.0 | 14.0 |
| Wall (Stairway) | -- | 8.0 |
| Doors | 9.0 | 5.0 |
| Door Frames | 6.0 | 6.0 |
| Windows | 7.0 | 6.0 |
| Window Frames | 5.0 | 3.0 |
| Baseboards | 7.0 | 4.5 |
| Cabinets | 8.0 | -- |
| **Exterior Surfaces** | | |
| Wall (front) | 12.0 | |
| Wall (rear) | 11.0 | |
| Doors (front) | 8.0 | |
| Doors (rear) | 11.0 | |
| Door Frames (front) | 11.0 | |
| Door Frames (rear) | 13.0 | |
| Windows (front) | 14.5 | |
| Window Frames (front) | 14.0 | |
| Window Frames (rear) | 12.0 | |
| Porch Railings (front) | 17.0 | |
| Porch Railings (rear) | 13.5 | |
| Porch Columns (front) | 15.0 | |
| Porch Columns (rear) | 14.0 | |
| Porch Decks (front) | 7.0 | |
| Porch Decks (rear) | 8.0 | |

and base moldings). The average lead levels found on the exterior surfaces are also shown in Table 5.

## 3. LEAD PAINT HAZARD ABATEMENT PROCESSES

The materials and techniques which were selected for demonstration in Atlanta, were chosen in part on the basis of the results of an extensive laboratory testing program carried out by NBS in which the performance and properties of seventeen potential lead paint hazard abatement methods were determined. The results of that work were reported in NBS Technical Note 808 entitled Potential Systems for Lead Hazard Elimination: Evaluations and Recommendations for Use [4].

The procedures and materials used in Atlanta are described below and include: six techniques for removing paint; the process of removing and replacing interior components such as doors, windows and trim; and nine barrier materials for application to walls or planar surfaces. Detailed material and installation specifications of the processes used in Atlanta are presented in Appendix 1.

Eight of the 16 lead paint hazard abatement methods demonstrated in Atlanta were previously demonstrated in the Washington, D.C. phase of the EHAP. A number of the 16 methods will be demonstrated again in the subsequent stages of the Program. The reason for this repetition is the need for determining variations in costs, quality of workmanship and applicability resulting from variations in housing conditions and types, local labor availability, different contractors for the work, labor rates and other unpredictable factors.

The descriptions of the repeated abatement processes (in both Sections 3 and 5) are included in this report for completeness. Differences in observations, conclusions or recommendations between the Washington and

Atlanta stages of the Program are noted where appropriate.

## 3.1 PAINT REMOVAL METHODS

The safety of workmen and dwelling occupants was a primary consideration in the implementation of paint removal methods. The general intention was to avoid any procedures which might result in lead poisoning due to the inhalation or absorption of lead fumes or dust. In addition there was concern for the potential fire hazard associated with the use of open flame paint removal techniques.

### 3.1.1 SOLVENT-BASED PAINT REMOVERS

A number of "industrial grade" paint removers were used to remove lead paint from windows, doors and other wood trim and components. The normally viscous liquids were applied to both horizontal and vertical surfaces by brush, allowed to react with the lead paint coatings and then removed along with the softened paint using various metal scrapers.

Paint removers are extremely variable in their ability to penetrate and react with multiple layers of dried paint. The effectiveness of the remover depends not only on its own composition but also on the nature of the multi-layered coating to which it is applied. Most removers will react with only 2 to 4 layers of paint at a time. In such cases, where more than that number of layers of paint is present, the remover-paint agglomeration must be removed and fresh remover applied as often as necessary to achieve complete removal. Of the nine commercial paint removers used in Atlanta, only one satisfactorily removed more than a few layers of dried paint in a single application. The composition and characteristics of that product are being investigated.

Generally, the reaction time for paint removers is about one-half hour. The remover-paint waste, which is scraped from the treated surfaces, is

collected on polyethylene drop cloths and discarded. Prior to light sanding and repainting, the surface was wiped with a water-saturated rag in order to remove any residue of remover-paint mixture.

Proper precautions regarding open flames, adequate ventilation and avoidance of contact with skin is necessary to assure the safe use of this class of products.

3.1.2 DIP TANK METHOD

Commercial furniture stripping plants have facilities for removing old paint and varnish by totally immersing the object of interest in large tanks containing heated alkaline solvents in an aqueous medium.

Doors which were stripped by this process required two and three hours of treatment during which time they were alternately soaked and scrubbed with heavy bristle brushes. The total stripping time is dependent on the type of paint, the number of paint layers and the temperature and strength of the solvent bath. Doors can be stripped with hinges and other hardware still attached . After the paint is completely removed the doors are washed with water, allowed to air dry and then returned to the dwelling from which they were taken where they are reinstalled and repainted.

3.1.3 HAND SCRAPING

Simple hand tools such as paint scrapers and putty knives were used to remove loose and flaking paint. In the experiment at Atlanta, these tools were used for removing the paint on exterior walls, wood porch railings and columns, exterior wood doors and windows and their frames, and interior wood doors and windows and their frames.

Electrical sanders were used to achieve the complete removal of

paint that was too tighty adhered to those surfaces for hand scraping.

### 3.1.4 ELECTRICAL HEAT GUN

When paint is heated sufficiently, it softens, swells and usually blisters so that it can be removed easily from its substrate with metal scrapers. Several techniques are available for removing paint from doors, windows and other wood surfaces, by means of heat generation.

One such technique, a portable flameless electric hot air blowing device was selected for this Program because of its effectiveness in removing paint from wood substrates as demonstrated in laboratory tests and its apparent low risk of fire and injury to the operator and by-standers.

This commercially manufactured device consists essentially of an air blower attached to a reinforced flexible plastic hose, with a cylindrical electric heater at the outlet. The heater is heavily insulated, so that it can be hand held while in operation. This apparatus (shown in Figure 2) is mounted on a stand which is quite mobile. It is capable of producing a strong stream of hot air at temperatures of between 175° and 540°C (350° and 1000°F). The working end of the device is very light in weight and a single workman can perform the continous operations of heating the paint to its softening point and scraping it off with metal tools. Electrical circuits or portable generators supplying 20 ampere currents at 110-120 volts are required for operation of the hot air blower.

In Atlanta, this device was used exclusively for the removal of lead paint from doors and other wood components and trim. It was not used on walls or other large planar surfaces.

Figure 2 - Scraping lead paint softened by
Electrical Heat Gun

### 3.1.5 INFRA-RED HEAT DEVICE

The infra-red heat device used in Atlanta consists of a propane torch whose flame is recessed in a metal reflector covered with a metal grid. When the flame is lit, the grid is heated. The device is held near the surface that is to be stripped and the heat radiating from the grid softens the paint so that it can be scraped off with metal tools.

This device (shown in Figure 3) is somewhat less hazardous than a propane torch because the open flame is recessed. It is completely portable, uses one pound disposable propane cylinders or a 25 pound refillable propane tank and the process of heating and scraping can be carried out by a single workman. Two reflector sizes are available: one with a 3-inch (7.5 cm) diameter opening is intended for use on wood trim, windows, and frames; the other with an 8-inch (20 cm) square opening is available for walls and large planar surfaces. Only wood components were stripped using this device in the Atlanta EHAP.

### 3.1.6 PROPANE TORCH

The open flame produced by a propane torch can be used to directly heat paint to the softening point so that it can be scraped off with metal tools. The process is easily carries out by a single workman using a one pound propane bottle.

Until recently, the use of propane torches has been quite widespread for this purpose but, they are falling into disfavor because of the extreme fire hazard of an open flame (especially in occupied and furnished dwellings) and the danger of over-heating paints to the point of vaporization of the lead pigments. As a safety precaution its use in the Atlanta EHAP was restricted to the stripping of exterior wood trim surfaces.

Figure 3

INFRA-RED HEAT
DEVICE

## 3.2 REPLACEMENT OF COMPONENTS

Removal of doors, windows, trim, and other lead painted components and replacement with new materials is an accepted technique of lead paint hazard abatement. It is an especially logical choice of techniques when the subject components are deteriorated beyond the point of functionality and the cost of abatement by other means is unjustifiable in light of their poor condition.

In Atlanta, windows and doors were replaced if they were found to be deteriorated or damaged to the extent that they could no longer function. Interior doors were replaced with new plywood veneer hollow core type doors which were reinstalled on existing frames. Carpentry skills were necessary for rehanging, fitting and remounting hardware. Custom carpentry was required for replacing wooden sash windows and frames in single family units.

## 3.3 BARRIER MATERIALS

The complete stripping of lead paint from surfaces or the removal and replacement of building components which are coated with lead paint can unequivocally be defined as hazard elimination methods. The effectiveness of such methods is essentially total. However, the application of those methods to large wall surfaces appear to be both impractical and prohibitively expensive. The application of materials, which are intended to act as barriers is, in most cases, the only reasonable approach to lead paint hazard abatement of wall surfaces. The effectiveness of these barrier materials is a function of the degree to which they prevent access to the existing lead paint which they cover. The material's strength, durability and permanence are the primary characteris-

tics that establish its effectiveness in lead paint hazard abatement.

The nine barrier materials, which were demonstrated in Atlanta, are representative of only a small fraction of the commercially manufactured products which could be applicable to this purpose. Nevertheless, they do represent a wide range of physical properties and include rigid board-like panels, flexible sheet goods and semi-liquid applied coatings. Their characteristics are discussed below.

### 3.3.1 GYPSUM IMPREGNATED JUTE FABRIC

This wall covering product consists of jute fabric which is impregnated with uncrystallized gypsum (hydrated calcium sulfate). It is applied to walls, in the same manner as wallpaper, with a water base adhesive which is recommended by the manufacturer of the fabric. As the gypsum absorbs moisture from the air, it hydrates, hardens and becomes a fairly rigid and penetration-resistant material.

There are no safety hazards associated with application of the material and it can be used in occupied and unoccupied dwellings if adequate space is available in which to lay it out, cut it to length and apply the adhesive.

A clean substrate, in good repair, is necessary for adequate adhesion. The covering will, however, bridge minor voids and mask minor substrate imperfections.

The product is supplied in 120 cm (48 inches) wide rolls wrapped in polyethylene bags to prevent premature hydration of the gypsum. The product is available in several pastel colors and may also be painted. A protective coating can be applied if the material is to be used in wet areas.

### 3.3.2 GYPSUM WALLBOARD

Gypsum wallboard is a product which is comprised of a thick layer of gypsum to which paper or other materials are bonded to provide a finished or finishable surface. It is intended for use on walls, ceilings, or partitions and can be applied directly to existing surfaces or to wood or metal furring strips.

Gypsum wallboard has been used extensively as a barrier material for lead paint hazard abatement in cities throughout the country. Its advantages are: low materials cost; familiarity of the product among contractors; and particularly, its low flammability. The product used in Atlanta was regular, tapered edge, 3/8-inch thick (9.5 mm) available in 4 by 8 feet (1.2 x 2.4 m) sheets. It was applied directly to existing walls with adhesives and nails. The installed wallboard was prepared for painting by finishing the joints between the sheets with joint tape and compound. Nail heads were also covered with compound and both areas were sanded to a smooth finish.

### 3.3.3 MELAMINE COATED HARDBOARD

This product is a 1/4-inch (6.4 mm) thick tempered hardboard to which a 1-1/2 mil (.038 mm) thick melamine film has been laminated to provide a serviceable, decorative finish. The material is supplied in 4 x 8 feet panels (1.2 x 2.4 m) and is applied to existing walls with an adhesive. Pre-formed strips are used to cover verticle butted seams and as a molding at the ceiling line. Baseboards are applied over the paneling along the floor line.

### 3.3.4 GYPSUM VENEER PLASTER

The gypsum plaster used in the Program was a one-component pre-

packaged material which becomes plastic when mixed with water so that it can be trowel applied to form a highly polished finish or can be worked to achieve a textured finish. It was applied to solid plaster walls which were first treated with a vinyl polymer bonding compound to improve adhesion to the existing painted surfaces. The finished thickness of the plaster was approximately 1/8-inch (3.2 mm) thick. Skilled workmen are required for the satisfactory application of this product.

3.3.5 GYPSUM PLASTER WITH METAL LATH

Gypsum plaster is applied to a metal lath which serves as a support for the plaster and a means of adhesion to the surface being treated. The lath is a netting of 20 gauge galvanized steel which is fastened to a surface with nails, staples or screws. The lath and plaster is readily obtainable in building supply outlets. The metal lath used in Atlanta came in sheets of 27 x 96 inches (65 x 250 cm). Pre-mixed plaster, needing only water, came in 80 lbs (36 kg) bags and unmixed plaster, needing sand and water, came in 100 lbs (45 kg) bags. Both plasters can be mixed by hand but a better product, of more uniform consistency, is obtained by machine mixing.

The plaster is usually applied in two stages resulting in a final thickness of 1/2-inch (1.3 cm). In the first application, wood fiber is added to the gypsum plaster to improve its working characteristics by making it easier to apply and to increase its adhesion to the metal lath. This first coat is applied by trowel to a uniform thickness of about 3/8-inch (1 cm). The plaster sets up (hardens) rapidly and must be applied quickly. Highly calcined gypsum plaster is used for the second

or top-coat. This plaster contains a retarder which delays hardening so that the desired finish (smooth or textured) can be achieved. The final coat is about 1/8-inch (0.3 cm) thick. The finished dried surface is usually painted.

The application of plaster to lath should be done by skilled workmen. The temperature of the work area and surface should be above 50°F and adequate ventilation (for proper drying of the plaster) should be provided.

3.3.6 AGGREGATE FILLED PAINT

This coating, also known as "filled paint", is a latex based product which contains sand or other mineral aggregate which provides a thick finish comparable in texture to sand finished plaster.

The generic product is manufactured by many firms. It is usually available only in white but may be tinted to any pastel color and can be purchased in one or five gallon (3.8 or 19 liter) cans and in 30 or 55 gallon (114 or 209 liter) drums from paint stores or building materials supply outlets respectively.

Filled paint is viscous. The product used was formulated for application by airless spray equipment but it, and most other formulations, can be applied using a brush or roller. It requires no mixing or thinning and it can be applied to any surface which is free of dirt, oil or grease. Primers are not required for use on previously painted surfaces and thicknesses as high as 20 mils (0.02 inch or 0.05 cm) can be obtained with one coat. The finish texture, ranging from smooth to coarse, depends upon the aggregate quantity and particle size.

### 3.3.7 VINYL COATED FABRIC

Vinyl coated fabric is basically similar to wallpaper or vinyl clad paper. Its strength and durability exceeds that of the other two materials because of its combination of vinyl surface and textile fabric backing.

Vinyl-coated fabrics vary in size and weight depending upon the thickness of the vinyl used and are manufactured in light, medium, and heavy weights. The light weight, which was used in Atlanta, has an average weight of 9 oz. per square yard (315 g. per $m^2$). It has all the advantages of the medium and heavy weight vinyl wallcovering with the exception of its somewhat greater vulnerability to abrasion and abuse. It is available in rolls 27-inch wide (68 cm) x 5 to 6 yards (4.5 to 5.5 m) long.

Vinyl-coated fabric may be installed on any wall surface that is free of dirt, grease, oil and moisture. The method used for hanging vinyl-coated fabric is the same as used for hanging wallpaper. The adhesive used depends upon the weight of the vinyl-coated fabric. These fabrics normally resist soiling and staining even by objects such as crayon, lipstick, ink, etc. A mild detergent and a sponge usually will remove most soils and stains. They conform to the bends and contours of most surfaces and are installed readily by workmen who are familiar with wallpaper installation using ordinary hand tools and equipment.

### 3.3.8 PLYWOOD ON FLOORS

Plywood is used to cover-up lead painted exterior wood decks on porches. Warped and rotted boards are replaced with new or sound ones

and a 15 lb. (6.8 kg) roofing felt is put down as an underlayment before installing the plywood.

The felt is available at most building supply outlets and comes in rolls 3 ft. (0.9 m) wide with 432 square feet (39 m ) per roll. It is easily cut with a linoleum knife and is stapled in place over the entire porch deck.

Four by 8 foot (1.2 x 2.4 m) sheets of 3/8-inch (9.5 mm) A-B grade, exterior or marine plywood is used. All edges are treated with wood preservative and the sheets are nailed or screwed to the existing deck with its A grade surface up. All exposed edges are covered with wood trim and the new surface is painted with one coat of primer and two coats of exterior paint.

Skilled workmen are required to install plywood on existing porch decks with satisfactory workmanship. Although the job can be done with hand tools it can be accomplished much more easily with ordinary power tools such as electric drills and saws.

3.3.9 CEMENTITIOUS COATING

The cementitious coating consists of portland cement, sand, and acrylic resin to which water is added to make a slurry. It can be tinted to desire colors by the addition of pigments recommended by the manufacturer.

The cementitious coating is viscous and it has a rough texture. It can be applied by brush or roller or any other equipment designed to apply viscous filled coatings. It can be obtained in 5 gallon (19 liter) containers.

The surface to be coated must be clean and free from loose particles.

Glossy surfaces must be roughened with an abrasive and chaulky surfaces sealed with a sealer as recommended by the manufacturer to ensure good adhesion. The applied coating has a final thickness of 1/16-inch (about 2.1 mm).

### 3.4 PACKAGE PLANS

The abatement methods being demonstrated in this Program were grouped in a manner to assure that specific combinations of techniques would be carried out in assigned dwelling units. The groupings or "package plans" shown in Tables 6, 7, 8, 9, 10, and 11 indicate which abatement techniques were carried out after selection of the dwelling units according to the housing selection criteria previously discussed in Section 2. This approach simplified decision making concerning the manner in which the hazard in each unit was to be abated, and ensured that each method was tested in a variety of housing units.

A few substitutions were made, for various abatement methods specified in the individual package plans, in order to adjust to specific dwelling unit and job conditions.

## 4. ABATEMENT METHOD ASSIGNMENTS

Of the 80 housing units to be abated in the Atlanta Program, 25 were intended for use in demonstrating Package Plan Series I and II, on interior surfaces, as shown in Table 6 and 7. The remaining 55 were to be used for demonstrating Package Plan Series III, IV, and V, on interior and exterior surfaces, as shown in Tables 8, 9, and 10.

Only 33 units meeting the criterion for exterior abatement (Package Plan Series III, IV, and V) could be found during the time alloted for housing selection and, therefore, the 25 units under Package Plan Series I

Table 6

Series I Package Plans for Dwelling Units
Requiring Abatement of Interior Walls and Trim

| Package Plan | Walls | | Trim | | Doors | Windows |
|---|---|---|---|---|---|---|
| | Dry Area | Wet Area | Dry Area | Wet Area | | |
| I-A | Gypsum Board, Paint | Gypsum Board, Paint | Replace with Wood | Replace with Wood | Replace | Replace |
| I-B | Veneer Plaster, Paint | Veneer Plaster, Paint | Replace with Wood | Replace with Wood | Replace | Replace |
| I-C | Plaster/ Lath, Paint | Plaster/ Lath, Paint | Solvent Strip Repaint | Solvent Strip Repaint | Solvent Strip Repaint | Solvent Strip Repaint |
| I-D | Gypsum-Jute | Gypsum-Jute | Solvent Strip Repaint | Solvent Strip Repaint | Replace | Replace |
| I-E | Filled Paint | Filled Paint | Solvent Strip Repaint | Solvent Strip Repaint | Solvent Strip Repaint | Solvent Strip Repaint |
| I-F | Cement Paint | Melamine Panel | Solvent Strip Repaint | Solvent Strip Repaint | Solvent Strip Repaint | Solvent Strip Repaint |
| I-I | Gypsum-Jute | Vinyl Covering | Scrape Repaint | Scrape Repaint | Scrape Repaint | Scrape Repaint |

Table 7

Series II Package Plans for Dwelling Units
Requiring Abatement of Interior Trim only

| Package Plan | Windows | Doors | Baseboards | All other Trim |
|---|---|---|---|---|
| II-A | Replace | Replace | Replace | Replace |
| II-B | Replace | Replace | Replace | Replace |
| II-C | Solvent Strip<br>Repaint | Solvent Strip<br>Repaint | Solvent Strip<br>Repaint | Solvent Strip<br>Repaint |
| II-D | Solvent Strip<br>Repaint | Solvent Strip<br>Repaint | Solvent Strip<br>Repaint | Solvent Strip<br>Repaint |
| II-E | Heat Gun<br>Repaint | Heat Gun<br>Repaint | Heat Gun<br>Repaint | Heat Gun<br>Repaint |
| II-F | Heat Gun<br>Repaint | Heat Gun<br>Repaint | Heat Gun<br>Repaint | Heat Gun<br>Repaint |
| II-G | Solvent Strip<br>Repaint | Dip Tank<br>Repaint | Solvent Strip<br>Repaint | Solvent Strip<br>Repaint |

Table 8

Series III Package Plans for Dwelling Units Requiring Abatement of Exteriors Only

| Package Plan | Windows | Doors | Railings Posts | Steps Floors | Wall 4 Feet |
|---|---|---|---|---|---|
| III-A | Scrape<br>Repaint | Scrape<br>Repaint | Scrape<br>Repaint | Scrape<br>Repaint | Scrape<br>Repaint |
| III-B | Solvent Strip<br>Repaint | Solvent Strip<br>Repaint | Solvent Strip<br>Repaint | Solvent Strip<br>Repaint | Solvent Strip<br>Repaint |
| III-C | * Torch Removal<br>Repaint | Torch Removal<br>Repaint | Torch Removal<br>Repaint | Torch Removal<br>Repaint | Torch Removal<br>Repaint |
| III-D | Heat Gun<br>Repaint | Heat Gun<br>Repaint | Heat Gun<br>Repaint | Heat Gun<br>Repaint | Heat Gun<br>Repaint |
| III-E | Solvent Strip<br>Repaint | Dip Tank<br>Repaint | Solvent Strip<br>Repaint | Solvent Strip<br>Repaint | Solvent Strip<br>Repaint |
| III-F | Replace | Replace | Replace | Scrape<br>Repaint | Scrape<br>Repaint |
| III-G | Scrape<br>Repaint | Plywood | Scrape<br>Paint | Plywood<br>Paint | Plywood<br>Paint |

*Propane Torch (Open Flame)

Table 9

Series IV Package Plans for Dwelling Units Requiring Abatement of Interior Walls and Trim and Exteriors

| Package Plan | | Combination of |
|---|---|---|
| IV-A | = | I-A + III-F |
| IV-B | = | I-B + III-F |
| IV-C | = | I-D + III-F |
| IV-E | = | I-C + III-B |
| IV-F | = | I-E + III-A |
| IV-G | = | I-F + III-C |

Table 10

Series V Package Plans for Dwelling Units

Requiring Abatement of Interior Trim and Exteriors Only

| Package Plan | | Combination of |
|---|---|---|
| V-A | = | II-A + III-F |
| V-B | = | II-B + III-F |
| V-C | = | II-C + III-B |
| V-D | = | II-D + III-G |
| V-E | = | II-E + III-C |
| V-F | = | II-F + III-D |
| V-G | = | II-G + III-E |

Table 11

Abatement Method Assignments

| Package Plans | No. of Units Planned | Actual | Package Plan | No. of Units Planned | Actual |
|---|---|---|---|---|---|
| I-A | 4 | 9 | III-B | 1 | 6 |
| I-B | 4 | 8 | III-F | - | 10 |
| I-C | 4 | 6 | III-G | 1 | 6 |
| I-D | - | 4 | | | |
| I-E | 1 | 5 | IV-A | 5 | - |
| I-F | - | 3 | IV-B | 4 | - |
| I-H | 1 | 1 | IV-C | 4 | - |
| I-I | 1 | 1 | IV-E | 4 | 2 |
| | | | IV-F | 4 | - |
| | | | IV-G | 4 | 1 |
| II-B | 3 | 3 | V-A | 5 | - |
| II-C | 3 | 3 | V-B | 5 | - |
| II-E | 3 | 3 | V-C | 5 | - |
| II-F | 1 | 1 | V-D | 5 | - |
| | | | V-E | 5 | 5 |
| | | | V-F | 1 | 1 |
| | | | V-G | 2 | 2 |
| TOTAL | 25 | 47 | | 55 | 33 |

and II was increased to 47 so that the total units abated in Atlanta would total 80. The number of units finally assigned to each package plan are shown in Table 11.

## 4.1 SPECIFICATIONS

The materials and installation specifications for all of the abatement methods (as presented in the Appendix) include the following:

| Specification Title | Specification No. |
|---|---|
| General Requirements | 0101[1,2,3] |
| Gypsum Wallboard | 0901[2] |
| Melamine Coated Hardboard | 0905[2] |
| Gypsum Impregnated Jute Fabric | 0906[2] |
| Vinyl Coated Fabric | 0908[2] |
| Gypsum Veneer Plaster with Bonding Agent | 0912[2] |
| Gypsum Plaster with Lath | 0913[2] |
| Filled Paint | 0914[2] |
| Cementitious Coating | 0915[2] |
| Plywood | 0918[3] |
| Scrape | 0921[2,3] |
| Solvent Based Paint Remover | 0922[2,3] |
| Electric Head Gun | 0923[2,3] |
| Propane Torch | 0924[3] |
| Dip Tank Stripping of Doors | 0925[2,3] |
| Infra-Red Device | 0926[2,3] |

Ten contract packages, each containing work scopes and specifications for one to sixteen dwelling units, were prepared (by Boeing) for the 80 dwellings. The completed documents were reviewed by HUD and NBS before the abatement contracts were advertised for competitive bids. The contract packages were awarded to eight contractors: two contractors abating 16 units each, two contractors abating 22 units each (the low bidders on two contract packages containing 11 units each) and four

1. Window, door, and trim replacement are covered in part five of this specifications
2. Used for abatement on the interior surfaces of the dwelling units.
3. Used for abatement on the exterior surfaces of the dwelling units.

contractors with one unit each.

## 5. EVALUATION OF THE ABATEMENT PROCESSES.

This section of the report is a critique and commentary on the effectiveness of the materials and systems used for lead paint hazard abatement in the Atlanta Program. It contains discussions of the implementation characteristics and effectiveness of the lead paint abatement techniques.

### 5.1 IMPLEMENTATION CHARACTERISTICS

One of the major objectives of the field demonstration of lead paint hazard abatement methods is the evaluation of the technical feasibility and operational characteristics associated with the implementation of each method.

Implementation characteristics pertain to the working aspects of lead paint hazard abatement. The field engineer or evaluator is primarily concerned with functions such as: materials availability; the transporation of materials and equipment to the work-site; the process of preparing and of applying materials or techniques to surfaces which require abatement; waste disposal; safety; finished appearance and other issues.

Implementation data and information were obtained for each abatement method demonstrated in the Atlanta Program by on-the-job observations both during and after the completion of the work in each dwelling unit. The final ratings were based on the observations and conclusions of NBS and HUD technical personnel, and also on information and opinions acquired as a result of debriefings of the contractor's workmen, their supervisors and representatives of the Atlanta housing authorities and HUD area offices.

### 5.1.1 IMPLEMENTATION CHARACTERISTICS RATING PROCEDURES

A rating procedure was developed, based on the Matrix Priority Rating System described by Dunford [5], in order to evaluate the performance of field demonstrated lead paint hazard abatement methods. The basic attributes by which the characteristics of a lead paint hazard abatement method can be defined are: safety; cost; appearance; physical properties and the effectiveness of abatement. Of these attributes only the first three (safety, cost and appearance) relate specifically to the work aspects or implementation of the abatement.

The implementation factors shown in Figures 4A, 4B, and 4C are derived from the three broad attribute categories of safety, cost and appearance. For example, preparation work, material supply, and ease of installation will clearly impact the cost of hazard abatement. The factors for safety and appearance are self evident.

A numerical value called a "criterion weight" is assigned to each implementation factor. These values were based on engineering judgement of the relative importance of each criterion in obtaining a total rating for each system. Ranking answers were assigned to each implementation factor and numerical "ranking rates" to each rank.

The total point value, for the criteria, is 1000. The distribution of points is as follows:

Safety - 200
Cost - 700 (labor-450, materials-150, and equipment-100)
Appearance - 100

The allocation of these criteria weights was, of necessity, based on engineering judgement and an intuitive feeling for those factors which are more significant in evaluating and judging alternative and

Figure 4A

## IMPLEMENTATION CHARACTERISTICS RATING SHEET

Subcontractor _____ Technique, System or Material Evaluated _____ Address _____

Contract No. _____ Evaluator _____ Date _____ City _____

| IMPLEMENTATION FACTORS | (A) Criteria Weight | Ranking Rates (B) 5 | 5 | 4 | 3 | 2 | 1 | Score A x B | Remarks |
|---|---|---|---|---|---|---|---|---|---|
| **A. Preparation** | | | | | | | | | |
| 1. Surface preparation needed | 15 | N/A | none | small | med. | large | V. large | | |
| 2. Substrate preparation needed | 15 | N/A | none | small | med. | large | V. large | | |
| 3. Relocation or modification of fixtures utilities or heat outlets | 10 | N/A | none | small | med. | large | V. large | | |
| | | | | | | | Total | | |
| **B. Materials Supply** | | | | | | | | | |
| 4. Adequate supply | 15 | N/A | yes | | | | no | | |
| 5. Local or non-local supply | 5 | N/A | local | | | | non-local | | |
| | | | | | | | Total | | |
| **C. Materials and Equipment Handling & Transport.** | | | | | | | | | |
| 6. Ease of transportation of materials to the job site | 2 | N/A | very easy | easy | fairly easy | diff. | very diff. | | |
| 7. Materials damage resistance during trans. | 2 | N/A | very high | high | fairly high | low | very low | | |
| 8. Ease of handling and moving of materials or equipment on the job. | 2 | N/A | very easy | easy | fairly easy | diff. | very diff. | | |
| 9. Materials or equipment damage resistance on the job. | 3 | N/A | very high | high | fairly high | low | very low | | |
| 10. Ease of transportation of equipment to the job site. | 1 | N/A | very easy | easy | fairly easy | diff. | very diff. | | |

CIRCLE RANKING WORD

Total _____

Figure 4B

| Implementation Factors | (A) Criteria Weights | Ranking Rates (B) 5 | 5 | 4 | 3 | 2 | 1 | score A x B | Remarks |
|---|---|---|---|---|---|---|---|---|---|
| D. Relative Ease of Installation | | | | | | | | | |
| 11. Ease of cutting or shaping materials | 5 | N/A | very easy | fairly easy | fairly diff. | diff. | very diff. | | |
| 12. Ease of application of process generally | 8 | N/A | very easy | fairly easy | fairly diff. | diff. | very diff. | | |
| 13. Ease of application of process to contoured surfaces | 8 | N/A | very easy | fairly easy | fairly diff. | diff. | very diff. | | |
| 14. Impairment or destruction of areas adjacent to those being deleaded | 5 | N/A | none | slight | medium | heavy dam. | destruction | | |
| 15. Amount finishing work required | 8 | N/A | none | small | medium | large | very large | | |
| 16. Need for non-standard fabrication | 3 | N/A | none | | Needed for part of job | | essential for all of the job | | |
| 17. Familiarity with, or adaptability to, deleading system | 3 | N/A | compl. fam. or very adap. | | some-what fam. or adap. | | not fam. or not adap-tible | | |
| E. Special Equipment Requirement | | | | | | | | TOTAL | |
| 18. Need for ordinary power tools | 5 | N/A | no | very little | moder. | consider-able | essen-tial | | |
| 19. Need for special tools or equipment | 15 | N/A | no | very little | moder. | consider-able | essen-tial | | |
| F. Finished Appearance | | | | | | | | TOTAL | |
| 20. General quality and appearance of finished job | 20 | N/A | ex-cell. | very good | accep-table | poor | very poor | | |
| | | | | | | | | TOTAL | |

Figure 4C

| Implementation Factors | (A) Criteria Weights | 5 | 5 | 4 | Ranking Rates (B) 3 | 2 | 1 | Scores A x B | Remarks |
|---|---|---|---|---|---|---|---|---|---|
| G. Waste Disposal and Cleanup | | | | | | | | | |
| 21. Amount of Waste | 5 | N/A | none | very little | medium | large | very large | | |
| 22. Ease of waste removal and disposal | 3 | N/A | no waste | very easy | fairly easy | diff. | very diff. | | |
| 23. Ease of cleanup after job completion | 2 | N/A | very easy | easy | fairly easy | diff. | very diff. | | |
| | | | | | | | TOTAL | | |
| H. Safety | | | | | | | | | |
| 24. Potential danger of materials | 10 | N/A | none | small | moderate | high | very high | | |
| 25. Potential danger of equipment | 10 | N/A | none | small | moderate | high | very high | | |
| 26. Need for safety equipment at job site | 4 | N/A | none | small | moderate | con-sid. | essen. for all the job | | |
| 27. Need (if any) for special handling of toxic waste disposal | 8 | N/A | none | small | moderate | con-sid. | essen. for all waste disposal | | |
| 28. Discomfort of workmen caused by materials or equipment | 8 | N/A | none | small | moderate | great | very great | | |
| | | | | | | | TOTAL | | |

GRAND TOTAL _____

varied abatement methods. The evaluation system for implementation characteristics is flexible and criteria weights can be changed as experience demands.

The implementation characteristics are grouped into eight categories (A through H as defined below).

A. Preparation of substrate prior to application - Includes surface and substrate pre-treatment, and relocation or modification of fixtures, utilities or heat outlets (if necessary) prior to application of the abatement technique, system or material. Barrier and replacement systems and paint removal techniques generally require relocation or modification of fixtures, utilities or heat outlets.

B. Materials Supply - Deals with the relative availablility of the materials in the quantities required and the sources of supply (local or not).

C. Materials and Equipment handling and transportation - Refers to the ease of transportation of materials and equipment to the job sites and the relative resistance of materials to damage, during transportation to, and handling at, the job site.

D. Relative ease of installation - Covers such characteristics as: ease of cutting or shaping materials; ease of application of materials generally; ease of application to contoured surfaces; impairment or destruction of areas adjacent to those being abated; amount of finishing work required; need for non-standard fabrication of parts or components and familiarity (of the contractor) with, or adaptability to, the deleading system being evaluated.

E. Special equipment requirement - Considers the need for both ordinary

and special power tools and equipment. The scores for this category grade from a maximum for those systems requiring no power tools of any kind to a minimum for those which require special power tools or power sources for installation.

F. Finished appearance - For brevity, the lead paint hazard removal techniques or systems being evaluated in this project are named to describe only the hazard removal part of the procedures (e.g., paint removal: solvent method; replacement of doors, windows, etc.) with no reference to any finishing procedures necessary to complete the task. However, for most systems, finishing work is required. Consequently the term "finished appearance" means the appearance of the completed job after the finishing work, such as painting, has been done.

G. Waste Disposal and Clean-up - Consists of the following factors: amount of waste; ease of waste removal; and disposal; ease of cleanup after job completion. This category is particularly important insofar as it affects labor costs and the possible need for special containers for handling the waste accumlated from an abatement methods.

H. Safety - This important category includes consideration of the following factors: potential danger of materials and equipment used for the job; need for safety equipment at the job site; need for special handling of toxic waste disposal; discomfort of workmen caused by materials or equipment. A potential danger of injury, from the use of hazardous equipment or materials required for implementation of a lead paint hazard abatement method is a major consideration in obtaining an overall rating for the method. The safety of not only the workmen but also the tenants (especially children) is extremely important. The

need for a great deal of caution on the job, including special safety equipment, and special handling of waste, can cause very expensive job delays.

In using the rating sheet to evaluate a system, a ranking rate is first decided upon for each implementation factor. A score is obtained by multiplying the criterion weight by the value of the ranking rate. The scores for each implementation factor are totalled for each of the eight categories in the form, (i.e., Preparation, Materials, Supply, Etc.), and these, in turn are added together to obtain the total ranking for the system. The higher the score obtained, the better are its implementation characteristics. A space is given on the right hand side of the form for pertinent remarks, if any, which might assist in increasing the accuracy of the appraisal of a system.

Some abatement methods require no cutting or shaping (paint removal is an obvious example). For these methods the maximum available score is given for this characteristic. Where ease of application of materials to contoured surfaces does not apply for a system ( for example, in replacement of doors, windows and trim) the maximum score possible is also given.

5.1.2 DISCUSSION OF IMPLEMENTATION CHARACTERISITCS OF ABATEMENT METHODS

The summary ratings of the sixteen lead paint hazard abatement methods in each of eight implementation characteristics categories are presented in Table 12.

The first nine items in the table are barrier materials. The next item is replacement (of doors, windows, and trim) and the remaining six are paint removal techniques. Of the paint removal methods, solvent

Table 12

SUMMARY RATINGS OF IMPLEMENTATION CHARACTERISTICS

ABATEMENT SYSTEMS

Maximum Possible Score (1000)

| | ABATEMENT METHODS | Preparation (200) | Material Supply (100) | Materials & Equip. Handling & Transportation (50) | Relative Ease of Installation (200) | Special Equipment Required (100) | Finished Appearance (100) | Waste Disposal & Clean-up (50) | Safety (200) | Total 1000 |
|---|---|---|---|---|---|---|---|---|---|---|
| Barrier Materials | Gypsum Impregnated Jute Fabric | 155 | 80 | 45 | 186 | 100 | 80 | 42 | 200 | 888 |
| | Melamine Coated Hardboard | 170 | 100 | 35 | 117 | 80 | 100 | 35 | 186 | 823 |
| | Gypsum Wallboard | 170 | 100 | 21 | 109 | 100 | 80 | 30 | 192 | 802 |
| | Gypsum Veneer Plaster with Bonding Agent | 110 | 100 | 31 | 103 | 80 | 60 | 18 | 200 | 692 |
| | Plaster with Lath | 170 | 100 | 29 | 93 | 70 | 60 | 15 | 190 | 727 |
| | Vinyl Coated Fabric | 155 | 100 | 45 | 186 | 100 | 100 | 42 | 200 | 928 |
| | Plywood on Floors | 125 | 100 | 34 | 136 | 85 | 60 | 35 | 186 | 761 |
| | Filled Paint | 155 | 100 | 46 | 195 | 100 | 90 | 38 | 200 | 924 |
| | Cementitious Coating | 155 | 80 | 41 | 141 | 70 | 80 | 33 | 180 | 780 |
| Replacement | Trim, Door & Window Frames | 170 | 100 | 43 | 161 | 90 | 80 | 32 | 168 | 844 |
| | Door | 160 | 100 | 41 | 165 | 90 | 80 | 32 | 168 | 836 |
| | Window | 140 | 100 | 34 | 141 | 90 | 80 | 32 | 138 | 755 |
| Removal Methods | Scraping | 200 | 100 | 50 | 97 | 85 | 20 | 20 | 88 | 660 |
| | Solvent (a) Interior | 200 | 100 | 50 | 111 | 100 | 60 | 10 | 70 | 701 |
| | (b) Exterior | 200 | 100 | 50 | 111 | 100 | 60 | 12 | 97 | 725 |
| | Propane Torch | 200 | 100 | 45 | 152 | 40 | 40 | 30 | 68 | 675 |
| | Infra-Red Heater | 200 | 100 | 44 | 155 | 40 | 60 | 30 | 78 | 707 |
| | Electric Heat Blower | 200 | 80 | 44 | 173 | 40 | 60 | 30 | 135 | 763 |
| | Dip Tank | 170 | 100 | 37 | 179 | 40 | 60 | 42 | 82 | 710 |

removal and the infra-red heater were the only methods applied to both interior and exterior paint removal. Scraping and the propane torch were used for exterior paint stripping only. The electrical heat blower was used only on interior doors, windows and trim. The dip tank removal method was applied to interior doors only.

The abatement methods are ranked in their categories as shown in Table 13.

Eight of the sixteen abatement methods evaluated in Atlanta had also been evaluated in the Washington demonstration [2]. These methods were: gypsum impregnated jute fabric, melamine coated hardboard, gypsum wallboard, gypsum veneer plaster with bonding agent, replacement of doors, windows and trim, solvent stripping (interior surfaces), the electric heat blower, and the dip tank. The total point values for those methods obtained as a result of the Washington Phase of the experiment are also listed in Table 13.

The higher total implementation characteristics value for melamine coated hardboard, in Atlanta, resulted from a higher value in the "finished appearance" category only. In this category the applications received an "excellent" rating compared with only "very good" in Washington. The proper level of skilled carpentry employed in Atlanta for the installation of this product was the sole cause of this difference.

The higher total implementation characteristics value for gypsum wallboard in Atlanta was due to higher values in the "finished appearance" and "waste disposal and clean-up" categories. Again, superior workmanship in Atlanta was responsible for these differences.

The higher total implementation characteristics values for the dip

Table 13

RANKING OF IMPLEMENTATION CHARACTERISTICS ON ABATEMENT PROCESSES DEMONSTRATED IN ATLANTA, GA. AND WASHINGTON, D.C.

| | Atlanta[1/] | Washington[2/] |
|---|---|---|
| **Barrier Materials** | | |
| 1. Vinyl Coated Fabric | 928 | *[3/] |
| 2. Filled Paint | 924 | * |
| 3. Gypsum Jute Fabric | 888 | 888 |
| 4. Melamine Coated Hardboard | 823 | 803 |
| 5. Gypsum Wallboard | 802 | 780 |
| 6. Cementitious Coating | 780 | * |
| 7. Plywood on Floors | 761 | * |
| 8. Gypsum Plaster with Lath | 727 | * |
| 9. Gypsum Veneer Plaster | 692 | 692 |
| **Replacement** | | |
| 1. Trim, Door & Window Frames | 844 | 844 |
| 2. Doors | 836 | 836 |
| 3. Windows | 755 | 670 |
| **Paint Removal** | | |
| 1. Electric Heat Blower | 763 | 763 |
| 2. Solvent, Exterior | 725 | * |
| 3. Dip Tank | 710 | 674 |
| 4. Infra-red Device | 707 | * |
| 5. Solvent, Interior | 701 | 701 |
| 6. Propane Torch, Exterior | 675 | * |
| 7. Scraping/Sanding | 660 | * |

1/ Total scores from Table 12 of this report.
2/ Total scores from Washington Report, see reference [2].
3/ *Processes not demonstrated in Washington, D.C.

tank method in Atlanta than in Washington was caused by higher values in the "materials supply" (more appropriately, time required for treatment and return) and "relative ease of application" (reinstallation of the stripped doors) categories. In Atlanta the time required to remove, treat doors, and deliver them back to the unit was about 24 hours, whereas in Washington this required about one week. Also, in Washington the dipping operation frequently warped the doors making reinstallation difficult and time consuming. The warping was believed to be caused by the much longer dip period.

Window replacement in Atlanta had a much higher total implementation characteristic value than in Washington because of higher categorical values for "materials supply", waste disposal" and clean-up". In Washington the supply of windows (steel frame) was inadequate and non-local, requiring an excessive delivery time. In Atlanta this type of window was easily obatined from a local supplier. Again, the workmanship in Washington resulted in more trash (especially broken glass) than in Atlanta.

The following is a general discussion of the implementation characteristics of the abatement methods evaluated in Atlanta and the significance of particular ratings.

5.1.2.1 SOLVENT BASED PAINT REMOVERS

Viscous paint removers are applied to vertical and horizontal painted wood surfaces with a brush. After about one-half hour the softened paint is scraped with a variety of metal tools and the solvent-paint mixture is collected on polyethylene drop cloths.

ADVANTAGES - Paint removal using solvent based strippers is a commonly

used procedure which is very familiar to redecoration and renovation workers. It is easily done by a single unskilled laborer and no special tools or equipment are required. Solvents are readily available at local wholesale and retail building materials supply outlets.

DISADVANTAGES - Solvent based strippers used in the Washington, D.C. Phase of EHAP were not capable of removing multiple layers of paint at a single application. The general experience was that the cycle (of solvent application, reaction time and scraping) had to be repeated 3 to 4 times on typical multi-layer painted surfaces. This was not totally the case in the Atlanta Phase. One solvent based stripper (a heavy strength marine industrial type) did remove multiple layers of paint at a single application.

The solvent-paint combination is gummy and somewhat difficult to handle and dispose of. The waste accumulated on the drop cloth does not dry hard and tends to be tracked throughout the dwelling unit unless extra care is exercised.

Significant safety precautions must be followed in order to control the hazards inherent in the use of solvents. Adequate ventilation is necessary, smoking and the use of open flames must be avoided as well as direct skin contact with either the solvent or solvent paint combination.

In general, extensive stripping of paint surfaces with solvents was a cause of discomfort and displeasure to the workmen. This lack of acceptance by the workmen could have been the cause of poorer workmanship and less efficiency as compared with the use of the heat gun techniques.

5.1.2.2 DIP TANK METHOD

Selected doors were removed from their locations and taken to a local

furniture stripping firm where they were immersed in large solvent filled tanks in order to remove the lead paint. Door knobs were taken off but hinges were allowed to remain on the doors. The stripped doors were dried, returned to the dwelling units, and rehung in their original locations.

ADVANTAGES - Except for the fact that the removal and disposal of lead paint occurs at a location away from the dwelling unit, no significant advantage was gained from the use of the off-site commercial paint stripping procedure in Atlanta. However, it should be noted that the dip tank technique removed lead paint from the entire door while other stripping techniques were applied only to door stiles four feet above the floor. The turn-around time, from removal to replacement, was as short as one day, whereas in the Washington Phase it ran as long as one week.

DISADVANTAGES - Although the dip tank method is extremely effective in stripping paint, doors must be removed, transported to the stripping firm, returned to the job site and re-installed; all of which add to the time and cost for accomplishing the process.

5.1.2.3 HAND SCRAPING

In the Atlanta EHAP, handscraping was investigated as a method for removing lead paint. Tools such as scrapers and putty knives were used for this purpose, and paint was removed from both interior and exterior areas of the houses. Interior substrates from which paint was scraped included wood door stiles and door frames, window, and window frames; all to a level of four feet above the floor. Exterior wood doors, windows and frames and wood porch railings and columns were also scraped.

ADVANTAGES - Hand scraping does not require skilled labor and does not present a fire hazard. Paint can be hand scraped from areas which are

inaccessible to heat removal systems. Clean-up and waste removal is fairly easy.

DISADVANTAGES - Scraping tends to mar and gouge substrates, especially wood. Hand scraping is hard, tedious and very time consuming. The large physical effort required, for hand scraping, and the paint chips and dust which result causes considerable discomfort to the workmen. The paint chips and dust are also a health hazard and, in fact, workmen were advised to wear goggles and face masks in Atlanta. It is essential that cooking and eating utensils near the scraping operations be covered while the work is in progress, and that occupants, especially children, be restricted from the work area.

5.1.2.4 ELECTRIC HEAT GUN

The electric heat gun delivers forced hot air at temperatures which are high enough to soften paint so that it can be scraped and removed from wood substrates with a variety of metal tools.

ADVANTAGES - Very thick layers of paint, consisting of multiple coats, can be stripped from wood surfaces at a single pass. In fact, it was generally observed that the ease of stripping increased with increasing paint thickness, probably because of the greater absorption and retention of heat and the greater entrapment of solvents in the old coatings.

The device is portable and is easily operated by a single unskilled laborer. The nozzle from which the heated air emanates is held in one hand, and the other hand is used for scraping the paint immediately after it is softened.

Aside from the danger of being injured by misdirected hot air the entire procedure is relatively free of hazards. The paint scrap-

ings are hazards by virtue of their lead content but they are dry and hard almost immediately after removal from the substrate and they are easily collected and disposed of. There is no significant fire hazard.

In general the device is easily controlled, there are minimum discomforts to the operators, and target areas can be stripped quickly and neatly without damage to the substrate or adjacent areas.

DISADVANTAGES - In addition to the overall disadvantages inherent in all paint removal methods (need for refinishing, waste disposal, etc.) the use of the heat gun requires auxillary electrical power. The device requires a 20 ampere circuit, at 110-120 volts, which most of the older dwellings that require lead paint hazard abatement do not have. Portable generators and sufficient electrical cable is required to reach rooms in multiple story buildings.

5.1.2.5 INFRA-RED HEAT DEVICE

This hand held device is similar to the propane torch, except that the flame is recessed and the heat radiates from a wire grill. There is no direct flame on the painted surfaces. The softened paint is scraped and removed from the substrate with a variety of hand tools.

ADVANTAGES - The infra-red heat device can be used on interior as well as exterior surfaces. Multiple layers of paint can be softened and scraped from the substrate in one operation. The paint scrapings are dry and therefore easily collected from the floor. The device may be used near glass windows without breakage.

DISADVANTAGES - In addition to the overall disadvantages inherent in all paint removal methods (need for refinishing, waste disposal, etc.) the use of the infra-red heat device requires propane fuel and the effective release of this propane gas from the tanks is greatly dependent on

temperature. With the presently available reflector bonnets the device cannot be used in tight places and is not effective on ornate trim. Although the flame is recessed, it is open.

5.1.2.6 PROPANE TORCH

Direct heating and scraping of old paint using hand held propane torches was limited in this Program to exterior surfaces only.

ADVANTAGES - Equipment and propane fuel tanks are readily available.

DISADVANTAGES - Because of the high temperatures generated at the painted surfaces by the direct open flame there is high risk of fire and toxic smoke. Unless extreme care is taken the substrate may be damaged by scorching. Glass window panes are easily broken when the propane torch is used to remove paint from window frames.

5.1.2.7 REPLACEMENT OF COMPONENTS

Selected windows, wood doors and miscellaneous wood trim were removed and replaced with components which were chosen or constructed to resemble the original items as closely as possible.

ADVANTAGES - Wood trim and wood doors were removed and replaced easily and quickly by skilled carpenters. Plain trim and doors were readily available at local wholesale and retail building materials suppliers.

The replacement of inoperative or heavily damaged windows with a new component enhances the safety (in terms of emergency egress) and comfort control of a dwelling.

DISADVANTAGES - Ornate trim in older housing is very difficult to replace with similar or comparable trim. Such replacements are often unaesthetic and unacceptable to the dwelling occupants or owners.

Replacement doors are usually hollow core types which are not as

sturdy and secure as the solid hardwood doors usually found in older dwellings.

Wood double hung windows are replaced by first ripping or prying away the trim molding around them. The process usually entails considerable damage to the plaster walls around the window. Broken glass is both an inconvenience and a hazard.

The storage of replacement trim, doors and windows is a problem in occupied dwellings. There is usually insufficient work space for custom carpentry. In cases where standard or commonly available replacement windows are not acceptable, the procurement of special order items can cause prolonged delays and added costs.

5.1.2.8 GYPSUM IMPREGNATED JUTE FABRIC

This wallcovering product is used to cover existing wall surfaces. It is applied to walls in the same manner as wallpaper.

ADVANTAGES - The product is available in several pastel colors and can be applied to most types of walls including concrete block. It can bridge and hide minor cracks, patches, mortar joints, and other irregularities in normal surface construction. No special skills or techniques are required for installation, and it can be installed easily in occupied dwellings.

This product is easy to cut and shape, and ordinary scissors may be used for this purpose. It can be easily fitted around both flat and single curvature surfaces.

DISADVANTAGES - Surfaces must be adequately prepared prior to installation in order to assure proper adhesion. Loose or cracked paint must be scraped and large damaged areas have to be repaired, sealed or primed.

Dirty or grease laden surfaces require cleaning. This wall covering product is vulnerable to moisture and it should not be installed in wet areas such as the kitchen and bathroom unless a special finish coating is applied. Such a coating is available through the manufacturer of the gypsum impregnated jute fabric. It is a transparent solution which will not detract from the texture or appearance of the substrate.

5.1.2.9 GYPSUM WALLBOARD

In the Atlanta experiment, 1/2 inch (12.7 mm) thick gypsum wallboard was used for covering some of the wall surfaces. The 1/2-inch product is commonly used in the building industry and it is readily available at building supply outlets. The other thicknesses (3/8-inch and 5/8-inch 9.5 mm and 15.9 mm) are generally available but accessories such as "J" molding which is used to cover the exposed edges of the product is readily available only for the 1/2-inch board. "J" molding for other thicknesses, may have to be specially ordered.

ADVANTAGES - Gypsum wallboard can be installed on most wall surfaces, even surfaces with large cracks and holes, without any preparation, provided that the existing framing is sound. In most cases, if the installed wallboard becomes damaged due to abrasion or impact, it can easily be repaired. Even during installation most damaged and miscut wallboards can be repaired. No special skills, technique, or tools are required for installation. It may be installed in wet and dry areas.

Gypsum wallboard is practically non-combustible and there are no toxic hazards involved in its use.

DISADVANTAGES - Gypsum wallboard is heavy, bulky, awkward to manipulate, and rather easily damaged. Consequently, hand carrying the wallboard

long distances or up stairs is difficult, tiring and time consuming.

Numerous operations are necessary to install and properly finish gypsum wallboard. Baseboard trim must be removed prior to wallboard installation and then replaced. Electrical switch-plates, outlet plates and heat registers must be reset outward to accommodate the thickness of the wallboard. After the wallboard is fastened to the substrate (by nailing or with adhesives), nail holes, depressions and joints have to be spackled, high or rough areas must be sanded and the entire surface finally painted. Some debris and considerable dust results from gypsum wallboard installation.

The large area required for the work and the long time period for installation (up to one week) can cause considerable discomfort and annoyance for occupants.

5.1.2.10 MELAMINE COATED HARDBOARD

This rigid board product was applied to flat wall surfaces with adhesive. Trim molding was nailed to the hardboard and through to the walls at the ceilings, floor and wall corners and edges.

ADVANTAGES - As in the case of similar rigid board products, with high impact resistance, this material can be applied directly over seriously deteriorated walls, with large voids, without prior repair. The melamine finish surface is factory applied to a hardboard backing and offers an attractive, durable finish. The product is non-toxic and presents no significant hazard to workmen or occupants during the installation. It is readily available at local retail and wholesale building supply outlets.

DISADVANTAGES - Melamine coated hardboard must be installed with an adhesive because the use of nails or other metal fasteners detracts from

its appearance. The use of adhesives necessitates a moderate amount of surface cleaning and other preparation (scraping loose paint) to assure proper adhesion. The product should be installed by skilled workmen because errors in measurement and cutting, and damage to the melamine surface, cannot be compensated for or repaired easily, as in the case of gypsum wallboard.

Power tools are required to cut the hardboard. A properly finished job includes the installation of trim molding at the floor and ceiling and at all corners and edges.

There are difficulties in manipulating, cutting and placing large rigid boards in the confined working space of occupied dwellings.

5.1.2.11 GYPSUM VENEER PLASTER

This product is trowel-applied to walls, to a thickness of 1/8-inch (3.2 mm) following the application of a bonding agent which is used to improve the adhesion between the old painted surfaces and the plaster.

ADVANTAGES - Veneer plaster can be applied to curved as well as planar wall surfaces. It can be used to fill cracks and other minor voids in otherwise sound substrates. It can be applied rapidly and provides an excellent surface for final finishes.

Because it is essentially a thin coating it can be feather-edged into trim and other molding and there is no necessity for resetting cover plates for electrical fixtures or heat registers. It can be applied easily in confined work areas and around cabinets and other fixtures in kitchens and bathrooms.

DISADVANTAGES - In addition to the application of a bonding agent, other

preparatory work, including scraping loose paint and repairing major wall damage, is required prior to troweling on the plaster. A fairly large work area is needed to set up a work table for mixing and preparing the plaster and the work must be done by skilled workmen.

After drying, at least two coats of paint must be applied to the plaster and the elapsed time between these operations is generally an incovenience to occupants. A substantial amount of plaster dust and waste results in a difficult clean-up problem.

5.1.2.12 GYPSUM PLASTER WITH LATH

Metal lath is attached to the existing wall surface and gypsum plaster is applied to the lath.

ADVANTAGES - Plaster and lath is readily available at local building supply outlets. It can be used to cover existing walls which have large holes, cracks, patches, and other imperfections. Holes, cracks, and gouges in walls can be filled with the plaster compound. It is suitable for use in both wet and dry areas. This system can be used to essentially rebuild walls which are otherwise beyond repair.

DISADVANTAGES - The installation of plaster with lath, like wallboard, requires outward relocation of electrical switch plates, outlet plates and heat registers to bring them in line with the new plaster surfaces. Considerable space is needed for the work, and the amounts of waste and dust are considerable and difficult to clean up. Good ventilation and a room temperature of at least 60°F (15.5°C) is required for curing and drying, which generally requires about 7 days under those conditions. Plaster with lath requires finishing, which can be done either by painting or by covering with wallpaper. Finishing cannot be done until the plaster is air-dry.

5.1.2.13 AGGREGATE FILLED PAINT

Aggregate filled paint, known also as "filled paint," provides a thick finish comparable in texture to sand finished plaster.

ADVANTAGES - Aggregate filled paint is a ready-mixed product, which requires no mixing or thinning. It hides minor cracks, small holes, and joints. It is a one coat operation that requires no special skills for application. It can be applied quickly to most interior surfaces by brush, roller, or airless spray equipment, and if brush or rollers are used, it can be applied in occupied dwelling units.

DISADVANTAGES - Preparation is required prior to the application of the product. The surface to be painted must be free of grease, dirt, peeling paint and large holes and cracks.

This product should not be applied in occupied dwelling units with airless spray equipment.

5.1.2.14 VINYL COATED FABRIC

Vinyl coated fabric is basically similar to wallpaper or vinyl clad paper.

ADVANTAGES - This product is readily available at local wallpaper, paint, and department stores. It is easy to cut and shape, and can be installed quickly and easily in the same manner as wallpaper. No special tools or skills are required for installation, and it presents no hazards to occupants or workmen.

Vinyl coated fabric may be used in the wet and dry areas because it is washable and it resists moisture and stains. This material is not as vulnerable to damage by abrasion and impact as wallpaper and it will cover minor cracks and imperfections.

DISADVANTAGES - Some preparation is required prior to installation. Holes and large cracks must be repaired, and the surface must be free of grease, dirt, and peeling paint.

5.1.2.15 PLYWOOD ON FLOORS

Plywood was used to cover a wood porch deck coated with leaded paint.

ADVANTAGES - Plywood can be used to cover porch floors which are in need of major surface refinishing or when paint removal by other methods would be difficult or more costly.

DISADVANTAGES - Skilled workmen (carpenters) are required for the installation. Badly rotted and warped boards or boards with holes must be replaced prior to the installation of the plywood. The increased floor thickness brought about by plywood covering could necessitate re-work of doors to insure proper opening and closing.

5.1.2.16 CEMENTITIOUS COATING

The cementitious coating which provides a thick coat with a rough texture was applied to some wall surfaces.

ADVANTAGES - Small cracks and other imperfections can be hidden by just painting over those imperfections. This product can be applied in occupied dwellings if spray equipment is not used. It can be applied by painters using brush, rollers, or spray equipment.

DISADVANTAGES - Most holes and large cracks must be repaired. Loose and flaking paint must be removed, glossy painted surfaces must be roughened with an abrasive and chalky surfaces sealed with a sealer prior to application of the cementitious coating.

## 5.2 HAZARD ABATEMENT EFFECTIVENESS

The effectiveness of a hazard abatement method is a function of the extent to which lead is removed from the child's environment or of the strength and durability of a barrier system installed to prevent his access to lead paint.

In addition to durability and permanance, a barrier product must adhere to the hazardous substrate for which protection is intended. The results of physical property tests conducted in the laboratory can be indicative of the performance of a product in acutal use. However, the only sure way of testing the initial and long term effectiveness of any type of hazard abatement method is to study its performance in occupied dwellings. In such environments, human usage most likely will present conditions and forces which are unpredictable or not reproducible in the laboratory. Such conditions and forces may be the cause of ultimate failure of the system.

The HUD research objectives for the Atlanta demonstration program include long-term evaluation of all lead abatement systems being tested. Laboratory tests data on only a few of the materials being tested in Atlanta are available, but a general practical knowlege of the physical properties is known for all the materials included in this program.

### 5.2.1 REDUCTIONS OF LEAD PAINT CONTENT BY REMOVAL METHODS

Tables 14 and 15 contain the average measurements of the lead content of paint on specific surfaces before abatement and after paint removal by the methods evaluated at Atlanta, namely: solvent stripping, propane torch, infra-red heater, electric heat blower, solvent dip tank, and hand scraping. Areas which were coated with barrier materials were

Table 14

EFFECTIVENESS OF LEAD (Pb) PAINT REMOVAL, MFLR

(Before and After XRF Readings $mg/cm^2$ of Lead)

| Dwelling Unit No. | Doors | Door Frames | Windows | Window Frames | Baseboards | Dwelling Unit No. | Doors | Door Frames | Windows | Window Frames |
|---|---|---|---|---|---|---|---|---|---|---|
| 203 | 3.5* 0.4 | 3.5 0.0 | | 4.0 0.4 | | 247 | 3.0 0.4 | 2.5 0.4 | | 3.0 0.3 |
| 204 | 6.0 0.5 | 6.0 0.3 | | 4.0 0.3 | | 248 | 8.0 0.5 | 7.0 0.2 | | 3.0 0.6 |
| 205 | 7.0 0.1 | 3.0 0.2 | | 3.0 0.1 | | 249 | | 11.0 0.6 | | 3.0 0.3 |
| 206 | 5.0 0.7 | 4.5 0.3 | | 3.0 0.2 | 4.0 0.7 | 250 | | 8.0 0.6 | | 3.0 0.3 |
| 207 | 4.0 0.9 | 3.5 1.3 | | | | 251 | | 7.0 0.9 | | |
| 208 | 5.0 0.7 | | | | | 252 | | 4.5 0.6 | | |
| 209 | | | | | | 253 | | 6.0 0.8 | | |
| 210 | 6.0 0.2 | | | | | 254 | | 7.0 1.2 | | |
| 211 | | | | | | 255 | | 11.0 0.3 | | |
| 212 | | | | | | 256 | | 3.0 1.2 | | |
| 213 | 4.5 0.6 | 5.0 0.2 | | | | 257 | 6.0 0.3 | 4.0 0.9 | | |
| 217 | 8.0 0.2 | 7.0 0.8 | | 2.4 0.4 | | 258 | | 5.8 1.7 | | |
| 222 | | | | | | 263 | 3.0 0.5 | 8.0 0.6 | | |
| 223 | 3.5 0.6 | 6.0 0.8 | | | | 264 | | 7.0 2.6 | | |
| 227 | | | | | | 265 | 3.0 0.0 | | | |
| 231 | | | | | | 266 | 4.0 0.4 | | | |
| 232 | 3.5 0.6 | 5.5 0.8 | | | | 267 | 5.0 0.8 | 5.0 0.9 | 4.5 0.3 | |
| 233 | 5.5 0.7 | 8.5 0.5 | | | | 268 | | | | |
| 238 | 2.5 0.8 | | | | | 269 | | | | |
| 240 | 2.5 0.2 | 2.5 0.3 | | 3.0 0.4 | | 270 | | 6.5 1.4 | | |
| 242 | 4.0 0.4 | 5.0 0.4 | | 4.0 0.6 | | 271 | | | | |
| 243 | 5.0 0.5 | 3.0 0.0 | | 4.0 0.2 | | 273 | 6.5 1.0 | 7.0 0.4 | | |
| 244 | 3.5 0.2 | 3.0 0.3 | | 3.5 0.1 | | 274 | | 6.1 1.0 | | |
| 246 | 3.0 0.3 | 3.0 0.1 | | 3.0 0.4 | | | | | | |

*Example:
Lower XRF reading (0.4) indicates after abatement.
Upper XRF reading (3.5) indicates before abatement.

Table 15

EFFECTIVENESS OF LEAD PAINT REMOVAL, SFA

(BEFORE AND AFTER XRF READINGS, $mg/cm^2$ of lead)

| Dwelling Unit Number | INTERIOR | | | | | | EXTERIOR | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | WALLS | | DOORS | | DOOR FRAMES | | WINDOWS | | WINDOW FRAMES | | PORCH | | | | | |
| | Doors | Door Frames | Windows | Window Frames | Baseboards | Cabinets | Front | Rear | Front | Rear | Front | Rear | Front | Rear | Front | Rear | Railings (Front) | Railings (Rear) | Columns (Front) | Columns (Rear) | Deck (Front) | Deck (Rear) |
| 301 | 5.5* 0.1* | 5.5 0.2 | | | | | | | 2.0 0.1 | | 12.0 0.2 | | 12.0 0.8 | | 12.0 1.0 | | | | | | 2.6 0.5 | |
| 302 | 6.0 0.6 | 5.0 0.4 | 7.0 0.4 | 6.0 0.4 | 8.0 0.4 | | | | | | | | | | | | | | | | | |
| 303 | 5.0 .0 | 5.0 0.2 | 4.0 0.3 | 4.0 0.2 | | | | | 9.0 0.0 | 13.0 0.0 | 9.0 0.0 | 13.0 0.0 | | | | | | | | | | |
| 305 | | | | | | | 5.5 0.3 | 15.0 5.6 | 5.0 0.8 | | 3.0 0.1 | | 5.0 0.9 | 15.0 3.4 | 6.0 0.8 | 15.0 7.8 | | | | | | |
| 306 | 7.0 0.9 | 7.0 0.7 | 3.5 0.8 | 4.0 0.6 | 7.0 0.5 | | | | 7.0 1.3 | 15.0 1.4 | 11.0 1.0 | 15.0 1.5 | | | | | | | | | | 5.0 0.1 |
| 307 | 13.0 2.0 | 11.0 0.5 | 13.0 2.3 | 13.0 1.1 | 13.0 2.1 | 10.0 1.3 | | | | 18.0 1.0 | 21.0 0.4 | 21.0 0.4 | 16.0 0.1 | | | | 11.0 0.3 | | | | | |
| 308 | 4.0 0.0 | 5.0 0.5 | 4.0 1.4 | 4.0 1.2 | | | 14.0 3.0 | | 13.0 0.0 | | | | 12.5 2.8 | | | | | | | | | |
| 310 | 15.0 2.1 | | 14.0 3.2 | | 2.0 1.1 | | 14.0 2.7 | 12.5 5.5 | 3.0 2.1 | 14.0 3.1 | 3.0 2.5 | | 18.0 0.0 | | 18.0 0.0 | | | | | | | |
| 312 | 4.0 0.3 | 3.0 0.4 | 3.0 0.4 | 3.0 0.8 | | | | 18.0 0.6 | | 9.0 0.7 | 14.0 0.0 | 9.0 1.4 | 9.0 1.3 | 14.0 2.1 | 16.0 1.6 | 14.0 1.7 | | 19.0 1.1 | | 20.0 2.3 | 6.0 0.3 | |
| 314 | 9.0 0.0 | 9.0 2.1 | | | 9.0 5.3 | | | | 9.5 0.0 | | 10.0 0.0 | | 9.0 2.2 | | | | | | 14.2 3.4 | | | |
| 316 | 6.0 0.0 | 4.0 2.0 | | | 5.0 1.5 | | 17.0 2.6 | 13.0 3.0 | | | | | | | | | | | | | | |
| 320 | | | | | | | | | | | | | | | | | 26.0 1.1 | | 17.0 3.6 | | | |
| 321 | | | | | | | | | 12.1 0.0 | | 16.5 0.7 | | | | | | | | 17.8 1.2 | | | |
| 322 | | | | | | | 8.6 0.0 | — | 4.0 0.7 | | 10.0 0.3 | | 9.0 1.0 | | 9.0 0.7 | | 11.0 0.3 | | 8.0 0.1 | | | |
| 325 | | | | | | | 19.0 3.0 | 16.5 0.8 | | | 7.0 0.1 | 15.0 0.2 | | | | | | 15.0 0.9 | | 15.0 0.9 | | 11.0 0.2 |
| 326 | | | | | | | 10.3 0.8 | 10.0 1.5 | | 9.0 0.0 | 7.0 0.6 | 9.0 0.0 | 6.5 1.0 | 7.0 0.0 | | | | | 7.0 0.0 | | | |
| 327 | | | | | | | 6.0 1.6 | | | | 3.5 0.0 | | 4.0 1.8 | | 4.0 0.9 | | | | | | | |
| 328 | | | | | | | 6.0 0.7 | 5.0 0.6 | | 5.0 1.3 | 4.0 0.8 | | | | | | | | | | | |
| 329 | | | | | | | 10.0 0.1 | | | | | | | | | | | | 12.0 0.4 | | | |
| 330 | | | | | | | 10.0 0.7 | | | | | | | | | | | | 16.0 0.7 | | | |
| 331 | | | | | | | 27.0 0.8 | | 18.0 1.1 | | 22.0 0.9 | | 29.0 0.8 | | | | | | | | | |
| 332 | | | | | | | 10.0 0.6 | | | | | | | | | | | | | | | |
| 334 | | | | | | | 11.0 2.0 | 11.0 2.5 | 11.0 0.0 | 6.0 0.0 | 10.0 1.9 | | | 12.0 0.9 | 9.0 0.5 | | | | 10.0 0.1 | | | |
| 335 | | | | | | | | | | | | | | | | | | | 24.0 0.4 | | | |
| 336 | | | | | | | 15.0 1.7 | | 2.5 0.3 | | 7.5 0.7 | | 15.0 0.5 | | 15.0 0.6 | | | | 13.0 2.4 | 13.0 0.4 | | |
| 337 | | | | | | | 2.6 0.0 | | | | | | | | | | 4.0 0.3 | | 3.0 0.1 | | | |
| 338 | | | | | | | 6.0 0.8 | | | | | | | | | | | | 3.5 1.1 | | | |
| 339 | | | | | | | | | | | | | | | | | | | | | | |
| 341 | | | | | | | 22.5 0.4 | | | | | | | | | | | | 17.5 0.0 | | | |
| 342 | | | | | | | 28.0 2.2 | | | | | | | | | | | | 23.0 2.2 | | | |
| 347 | | | | | | | 27.0 2.3 | | | | | | | | | | | | | | | |
| 348 | | | | | | | | | | | 14.0 0.8 | | 18.0 2.6 | | 18.0 2.2 | | | | 26.0 1.2 | | | |

*Example:
Upper XRF Reading (5.5) indicates before abatement
Lower XRF Reading (0.1) indicates after abatement

not measured for lead after abatement.

The results contained in Tables 14 and 15 show that the paint removal methods were basically very effective, but that lead content was still higher than the maximum permissible level of 2.0 $mg/cm^2$ in scattered areas in 15 of the 57 dwellings in which paint stripping methods of some kind were tested. Of the 15, the paint in unit numbers 305, 307, 310, 312, 325, and 347 was removed by solvents; in numbers 264, 308, 314, and 316 by heat devices; in 320, 334, 336, and 348 by hand scraping.

There appeared to be no real correlation between the paint removal systems and the occurence of high lead levels of areas after abatement. It is noteable, however, that the work on 13 of the above 15 units was done by 2 contractors: 8 by one and 5 by the other.

Because all the areas subjected to paint removal had wood substrates, it was quite likely that most of the high residual lead levels (more than 2.0 $mg/cm^2$) resulted from high penetration of lead paint into the porous wood fibers during application.

Lead pigments or compounds tightly embedded in the subsurface fibers cannot be removed by solvents, heating methods or hand scraping and this low level residue (less than 2.0 $mg/cm^2$) is not likely to present a lead poisoning hazard.

Although most of the high residual lead levels probably resulted from high lead paint penetration into the wood substrates, there were a few instances (such as in unit numbers 305 and 307) where the lead content was sufficiently high after abatement to suspect that at least a considerable amount of the lead paint was not removed from the surface.

In unit 305 the lead level of an exterior wall was reduced from

15.2 mg/cm$^2$ to 5.6 mg/cm$^2$, and a rear window frame from 13.0 mg/cm$^2$ to 10.5 mg/cm$^2$. In unit 307 the lead level of a window frame was reduced from 11.9 to 9.4 mg/cm$^2$, a door frame from 8.6 to 7.7 mg/cm$^2$, and an exterior wall from 22.6 to 5.6 mg/cm$^2$. The abatement system used on both units was solvent stripping, and the work was done by the same contractor.

## 6 RECOMMENDATIONS

The following preliminary recommendations for the use of the abatement methods, covered by this report, are based upon the evaluation of their implementation characteristics as demonstrated in Atlanta and also in Washington, D.C. in those cased where the same method was demonstrated.

A long-term evaluation of the effectivess and durability of the abatement materials and systems demonstrated in the EHAP and the determination of their costs may very well modify these recommendations in the future.

### 6.1 PAINT REMOVAL METHODS

#### 6.1.1 SOLVENT BASED PAINT REMOVERS

Recommended for use -

- on interior or exterior wood and metal doors; windows; frames and trim, in sound condition; of both plain and ornate design; with paint in tight or loose condition.
- in unoccupied dwelling units

Not recommended for use-

- when ambient temperatures are below 50°F (10°C)
- on deteriorated substrates or surfaces
- on inoperable or non-functioning components
- where ventilation is not satisfactory

• in occupied units, (unless extreme care can be taken to protect adjacent surfaces, and waste products can be readily removed.)

6.1.2 DIP TANK (DOORS ONLY)

Recommended for use -

• on exterior and interior wood and metal doors, of ornate or plain design, in sound condition with loose or tight paint.

• in both unoccupied and occupied units (NOTE: Special security measures may be required when used on exterior doors in occupied units)

Not recommended for use -

• on exterior doors during winter unless suitable temporary cover is provided

• if doors are deteriorated or cannot be made operable with new hardware

• for hollow or solid core laminated wood doors where delamination may occur

• if the actual dipping process itself requires approximately two hours time or over

6.1.3 HAND SCRAPING AND SANDING

Recommended for use -

• on plain exterior wood trim and walls in sound condition, with loose and peeling paint

• on plain interior wood trim in sound condition with loose and peeling paint

• in both unoccupied and occupied units

• where unskilled labor is readily available

Not recommended for use-

- on interior and exterior surfaces with tight paint
- on ornate interior or exterior trim
- on balusters or railings

6.1.4 ELECTRIC HEAT GUN

Recommended for use -

- on sound interior or exterior wood trim, of plain or ornate design with tight or loose paint under a wide variety of ambient temperatures
- on wood trim or wood adjacent to glass surfaces
- in both unoccupied and occupied units

Not recommended for use -

- on metal doors and windows
- if 20 amp/110-120 volt electrical power circuits are not available in the dwelling unit or from portable generators

6.1.5 INFRA-RED HEAT DEVICE

Recommended for use -

- on sound interior or exterior wood trim, of plain or ornate design, with tight or loose paint, under wide ambient temperature variations
- on wood trim or wood adjacent to glass surfaces
- in both unoccupied and occupied units

Not recommended for use -

- if ambient temperatures are below 40°F (4.4°C)
- on metal doors and windows

6.1.6 PROPANE TORCH

Not recommended for use under any circumstances

## 6.2 REPLACEMENT OF COMPONENTS

### 6.2.1 DOOR REPLACEMENT

Should be replaced -

- if door is inoperable or in a seriously deteriorated condition

Should not be replaced -

- if door is operable and in sound condition
- if removal of an exterior door endangers the security of the unit and the cost of providing adequate security measures is excessive

### 6.2.2 DOOR TRIM REPLACEMENT

Should be replaced -

- if trim is in a seriously deteriorated condition

Should not be replaced -

- if trim is in sound condition
- if major damage may occur to adjacent areas during removal of old trim

### 6.2.3 WINDOW REPLACEMENT

Should be replaced -

- if window is inoperable or in a seriously deteriorated condition

Should not be replaced -

- if window is operable and in sound condition
- if removal of a window endangers the security of the unit and the cost of providing adequate security measures is excessive

### 6.2.4 WINDOW TRIM REPLACEMENT

Should be replaced -

- if trim is in a seriously deteriorated condition

Should not be replaced -

- if trim is in sound condition
- if major damage may occur to adjacent areas during removal of old trim

6.2.5 BASEBOARD REPLACEMENT

Should be replaced -

- if baseboard is in a seriously deteriorated condition

Should not be replaced -

- if baseboard is in sound condition
- if major damage may occur to adjacent areas during removal of old baseboard

## 6.3 APPLICATION OF BARRIER MATERIALS

### 6.3.1 GYPSUM IMPREGNATED JUTE FABRIC

Recommended for use -

- on sound and clean interior wall surfaces with tight paint, or where loose paint has been removed
- in dry areas or away from direct water contact in wet areas
- over wall surfaces in rooms which contain arches and other curved areas (except double curvature surfaces)
- in both unoccupied and occupied units

Not recommended for use -

- on unsound substrates requiring major repairs
- on deteriorating surfaces
- on exterior surfaces
- on trim other than plain base molding

### 6.3.2 GYPSUM WALLBOARD

Recommended for use -

- directly over unsound or damaged flat substrates where supporting lath or studs are sound
- directly over deteriorating flat wall surfaces with loose paint
- in dry areas, or in wet areas if a water resistant coating is applied for finishing
- in unoccupied units

Not recommended for use -

- in rooms with curved surfaces
- on walls with exposed pipes and exposed electrical conduits

- on exterior surfaces
- on occupied units

6.3.3 MELAMINE COATED HARDBOARD

Recommended for use -

- directly over unsound substrates where the structural supports are sound
- directly over deteriorating wall surfaces with loose paint
- in wet or dry areas
- in both unoccupied and occupied units

Not recommended for use -

- on exterior surfaces
- if skilled carpenters are not available

6.3.4 GYPSUM VENEER PLASTER

Recommended for use -

- on sound interior walls, or those needing only minor repair from which all loose paint, dirt or grease have been removed
- in dry areas, or in wet areas if a water resistant protective finish coating is applied
- in unoccupied units

Not recommended for use

- over deteriorated walls or walls requiring considerable repair
- on exterior surfaces
- if skilled plasterers are not available
- in occupied units

6.3.5 GYPSUM PLASTER WITH METAL LATH

Recommended for use -

- on flat or curved wall surfaces which are in disrepair but which have sound supporting structural members
- in dry areas, or in wet areas if a water resistant protective finish coating is applied
- in unoccupied units

Not recommended for use -

- on exterior surfaces
- if skilled plasterers are not available
- in occupied units

6.3.6 FILLED PAINT

Recommended for use -

- on sound interior walls, or walls needing only minor repair from which all loose paint, dirt or grease have been removed
- in both dry and wet areas
- in unoccupied units

Not recommended for use -

- over deteriorating walls or where considerable patching or repairs are needed
- in occupied units
- on exterior surfaces

6.3.7 'CEMENTITIOUS PAINT

Recommended for use -

- on sound interior walls, or walls needing only minor repairs from which all loose paint, dirt and grease have been removed
- in both dry and wet areas
- in unoccupied units
- on interior surfaces

Not recommended for use -

- over deteriorated walls or where extensive repair is needed

6.3.8 VINYL COATED FABRIC

Recommended for use -

- on sound and clean interior flat wall surfaces with tight paint, or where loose paint has been removed
- in wet and dry areas
- over wall surfaces in rooms which contain arches or other curved surfaces
- in both unoccupied and occupied units

Not recommended for use -

- on dirty surfaces
- on deteriorated substrates requiring major repair or patching
- on exterior surfaces

6.3.9 PLYWOOD ON FLOORS

Recommended for use -

- over exterior painted wood decks where the wood has deteriorated but the structural supports are sound

Not recommended for use -

- over sound wood surfaces or concrete decks (for these remove lead paint by another method and repaint)

## 7. ACKNOWLEGEMENTS

The authors express their sincere appreciation to Messrs. Benjamin Brown, Architect, and William P. Schmieder, Field Engineer, of the Boeing Aerospace Company for their valuable assistance and cooperation in collecting field data related to the lead paint hazard abatement program in Atlanta.

## 8. REFERENCES


[1] "Lead-Based Paint Poisoning Prevention Act", Public Law 91-695, 91st Congress, H.R. 19172, January 13, 1971, Amended November 9, 1973.

[2] Boone, T.H., Berger, H.W., Cramp, A.P., and Jackson, H.A., "The Demonstration of Experimental Lead Paint Hazard Abatement Methods in Washington, D.C.", National Bureau of Standards Report, NBSIR-75-761, (June 1975). (NTIS Access No. Com. 75-11377)

[3] Spurgeon, J.C., "Response Characteristics of a Portable X-Ray Fluroescence Lead Detector: Detection of Lead in Paint," National Bureau of Standards Report NBSIR 73-231, (June 1973).

[4] Waksman, D., Ferguson, J.B., Godette, M., and Reichard, T. "Potential Systems for Lead Hazard Elimination: Evaluations and Recommendations for Use", National Bureau of Standards Technical Note 808, (December 1973).

[5] Dunford, R.R., "Decisions, Decisions," Industrial Research, p. 27, (July 1974).

# 9. Appendix

## Specifications for Abatement Methods Used in Atlanta, Georgia

SECTION 0101

General Requirements

Part 1 General

1.1 Work Included in This Section:

Work included under this section of these specifications include providing all utilities, security, safety services, and waste disposal required to complete work covered in statement of work and not specifically eliminated in this section of these specifications.

1.2 Workmanship:

All work performed under this contract shall be accomplished by qualified craftsman for each task performed and shall be in accordance with good workmanship.

1.3 Codes:

All work shall be accomplished in accordance with all applicable national and local codes.

1.4 Permits:

The contractor shall obtain and pay cost of all required building permits.

1.5 Safety:

The contractor shall take all necessary precautions to assure all work is accomplished in a safe manner and that all materials are used and stored in accordance with the manufacturer's recommendation.

No poisonous or harmful material or dangerous equipment shall be left accessible to tenant of occupied units. All such material and equipment shall be removed from the site at the end of each work day.

The contractor shall provide all required safety equipment for his workmen to assure that the workmen are not exposed to hazards.

Part 2 Utilities

2.1 Public Housing:

In public housing units which are occupied, normal potable water and 120 volt, 15 amp, single phase power (convenience outlets) will be available for use by the contractor at no cost.

In public housing units which are vacant, it shall be the responsibility of the contractor to provide all utilities as required to accomplish work.

2.2 FHA Acquired Properties:

In acquired property units the contractor shall provide all utilities required to accomplish all work covered under this contract at no additional cost.

Part 3 Security

3.1 Public Housing:

In public housing units which are occupied, the contractor shall take every precaution to safeguard property of the occupant during construction. Care must be taken to assure no door or windows are left unsecured when room is not occupied. No window shall be left open at the end of the shift which will expose tenant to danger of falling.

In public housing units which are not occupied, the contractor shall have total responsibility for security during the construction period. It shall be his responsibility to assure the building is secured (locked) at the end of each work day. Boards removed from doors and windows must be replaced at the end of each work shift. The contractor will not be responsible for vandalism which is deemed beyond his control.

3.2 Acquired Properties:

The contractor shall have total responsibility for the security of the dwelling during the construction period. Where units are "boarded up" the contractor shall replace any removed boards at the end of each work shift to prevent any unauthorized entry.

This contractor will not be responsible for any vandalism which is deemed beyond his control.

3.3 Materials and Equipment:

The contractor shall be responsible for the security of all construction equipment and materials stored on site.

Part 4. Dimensions

All dimensions shown in the Technical Scope of Work are approximate; exact dimensions shall be verified by the contractor.

Part 5 Window, Door, and Trim Replacement

All windows, doors, and trim to be replaced shall be replaced with like quality and to match existing, except where specified otherwise in Technical Scope of Work. Where vinyl base is specified, base shall be 4" top set cove base as manufactured by the Burke Co. or equal. The contractor shall submit to construction engineer, for approval, all replacement items not specified herein.

Part 6 Disposal of Waste Material

The contractor shall remove all waste material from the work site and dispose of it in a safe manner.

Material containing lead-based paint shall not be salvaged.

Part 7 Definitions

The following definitions are for clarification and shall apply to all references herein and the Technical Scope of Work.

Window - (wood) - shall include the glass and the wood casing holding the glass in place.

Window Frame - (wood) - shall include the head, jamb, sill, and all associated trim of frame.

Door Frame - (wood) - shall include the jamb and head and all associated trim of the frame.

Door Stiles - shall include the vertical edges of all doors.
- shall include edges and both faces of panel doors.
- shall include edges and minimum of 4" from edges of flush doors.

## SECTION 0901

## Gypsum Wallboard

### Part 1 GENERAL

#### 1.1 Work Covered Under Other Sections:

The scope of work for providing temporary utilities, security, safety, and disposal of waste materials is covered under Section 0101 of these specifications.

#### 1.2 Work Included Under This Section:

Work included under this section includes the furnishing of all labor, materials, and equipment required to install gypsum wallboard complete as called out in these specifications.

### Part 2 PRODUCTS

#### 2.1 Gypsum Wallboard:

Wallboard shall be in accordance with ASTM c36-70 or Federal Specification SS-L-30C, Type III, Grade R, Class 1, and shall be 3/8-inch thick (directly on walls) and 1/2-inch (when furred attachment is used.)

#### 2.2 Molding:

Corner bead shall be U.S. Gypsum No. 101 Dura-bead or equal. Casing bead shall be U.S. Gypsum No. 200A metal trim or equal. Molding shall be installed with formed mitered, tight, smooth corners, and splices.

#### 2.3 Furring:

Furring strips shall be 1" x 2" common 2.a.iii (PS 20-70) grade.

#### 2.4 Adhesive:

Adhesive for bonding paneling to framing or to existing surfaces shall be as recommended by the wallboard manufacturer.

#### 2.5 Nails:

Wallboard fastened directly to furring and framing shall be fastened with smooth shank nails, ASTM C514-70, 1 1/4" long in 3/8" wallboard, and 1 3/8" long in 1/2" wallboard.

Wallboard fastened over existing wall surfaces shall be fastened with smooth shank nails and shall penetrate framing a minimum of 7/8".

2.6 Screws:

Screws shall be self-tapping, bugle head for use with power driven tool.

Type S - 1" long, shall be used to fasten wallboard to sheetmetal.
Type W - 1 1/4" long, shall be used to fasten wallboard to wood.
Type G - 1 1/2" long, shall be used to fasten wallboard to wallboard.
Type G shall be used to fasten wallboard to an existing plaster wall; minimum penetration into framing shall be 5/8".

2.7 Joint Treatment Materials:

Perforated joint tape or tape in accordance with ASTM C475-70 or FS ss-J-570A, Type 11 shall be used.

Joint compound shall be in accordance with ASTM C475 or FS SS-J-570, Type I, or equal.

2.8 Laminating Adhesive:

Laminating adhesive shall be in accordance with wallboard manufacturer's recommendation or ASTM C557-67.

Part 3 EXECUTION

3.1 Surface Preparation:

Remove foreign material, loose plaster, and loose paint.

Where plaster has been removed, install shims (by fastening to framing) of the same thickness as the removed plaster to provide a level surface.

Frame around utility piping obstructing panel installation.

Wallboard shall be conditioned prior to application by storing in the room in which wallboard is to be applied.

Panels shall be stored vertically and separated with furring strips.

3.2 Installation Method:

Direct Adhesive Attachment: (Preferred Method)

This method is to be used when surface level and areas of loose surface materials do not prevent positive bonding of contact adhesive.

Test for soundness of paint bond where condition is questionable:

Apply 3/8" wide x 3" long bead of adhesive to 8" square of gypsum wallboard and press wallboard square onto wall surface. Allow setting time per adhesive manufacturer's instructions. Pull square away from wall. Paint bond is acceptable if paper surface of wallboard sqaure is separated from wallboard square. Repeat procedure whereever wall surface is questionable.

Attachment to Furring: (Alternate Method)

Install furring horizontally over existing wall surface. Space furring 16" on center. Use wooden shims to plumb furring strips.

Furring fasteners shall penetrate at least 3/4" into existing framing members, with two nails at each framing member intersection.

Install 2" x 3" or 2" x 4" vertical studs flat where surface cannot be levelled and plumbed with shims. Studs shall be 16" o.c., and nailed to top and bottom wall plates.

3.3 Wallboard Installation:

General:

Wallboards of maximum lengths shall be used to minimize end joints.

End joints shall be staggered and located as far as possible from center of wall or ceiling.

Secure all ends and edges of wallboards panels.

Direct Adhesive Attachment (Preferred Method)

Each sheet of wallboard shall be fitted before applying adhesive.

The adhesive bead shall be 3/8" diameter and installed 16" o.c. or on all framing.

One bead shall be installed at each abutting edge.

Press wallboard firmly into contact with adhesive. Nail top and bottom edges 8" o.c.

Nail Attachment (Alternate Method)

Nail wallboard directly to studs with 1-3/8" smooth shank nails. Spacing of nailing shall be 8" o.c. top and bottom and 12" o.c. elsewhere along framing.

Wallboard attached to furring shall be with 1 3/8" smooth shank nails. Spacing of nailing shall be 8" o.c. top and bottom and

Wallboard installed over existing wall surface, nails shall be sized to penetrate a minimum of 7/8" into existing framing. Spacing of nails shall be 8" o.c. along edges and 16" o.c. elsewhere along framing.

Screw Attachment (Alternate Method)

Screw spacings shall be as specified above for nailed attachment.

Joint System:

"V" grooves formed by abutting rounded edges of wallboard shall be filled with prefilled joint compound.

Prefill joint compound shall be permitted to harden prior to application of tape.

Compound shall be applied to all joints and angles to be reinforced in a thin uniform layer and reinforcing tape applied immediately.

Skim coat shall be applied immediately following tape embedment.

Dry embedding coat shall be applied prior to application of fill coat.

Fastener depressions shall be raised level with the surface by three separate applications of joint compound.

Two finish fill coats shall be applied and adequate time shall be allowed for drying between coats.

All joint compound surfaces shall be sanded to provide flat surfaces ready for decoration.

SECTION 0905

Melamine Coated Hardboard

Part 1. General

1.1 Work Covered Under Other Sections:

The scope of work for providing temporary utilities, security safety and disposal of waste materials is covered under Section 0101 of these specifications.

1.2 Work Included Under This Section:

Work included under this section includes the furnishing of all labor, materials, and equipment required t install Melamine paneling over existing interior walls as called out in these specifications.

1.3 Samples:
The sub-contractors shall submit to the construction engineer for approval prior to start of work the manufacturer's descriptive literature, a 12" x 12" sample of paneling and a 6" long sample of molding.

Part 2. Products

2.1 Melamine paneling shall be 1/8" thick, tempered hardboard with thermosetting synthetic resin finish of not less than 1 1/2" mils. The paneling shall be "Marlite" as manufactured by the Masonite Corporation or approved equal.

2.2 Finish:

The paneling finish and color shall be selected by the construction engineer. Nails shall be finish type, color to match paneling. Putty stick color shall match paneling.

2.3 Molding:

Molding shall be as recommended by the manufacturer and shall match the approved paneling sample.

2.4 Furring:

Furring strips shall be 1" x 2", common 2.a.iii (PS-20-70) grade

2.5 Adhesive:

Adhesive for bonding paneling to framing or existing surface shall be as recommended by the paneling manufacturer.

2.6 Nails:

Paneling attached directly to furring and framing shall be fastened with 3d finish nails. If one end of the panel must be nailed, do not nail other end. Panels must be free for expansion.

Part 3 Execution

3.1 Surface Preparation:

Remove foreign material, loose plaster and, if Direct Adhesive Attachment is used, loose paint.

Where plaster has been removed, install shims of same thickness as removed plaster to provide a level surface.

Fit paneling around existing utility piping and install escutcheon plates.

Paneling shall be stored in the room to receive paneling application for a period of 24 hours minimum. The paneling shall be stored in a vertical position. Separate each panel with furring strips.

3.2 Installation Methods:

Direct Adhesive Attachment (Preferred Method):

This method is to be used when surface level and areas of loose surface materials do not prevent positive bonding of contact adhesives.

Test for soundness of paint bond where condition is questionable:

Apply a 3/8" wide x 3" long bead of adhesive to a 8" x 8" square of gypsum wallboard, press wallboard square onto wall surface. Allow setting time per adhesive manufacturer's instructions.

Pull square away from wall. Paint bond is acceptable if paper surface of the wallboard square is separated from wallboard square. This procedure shall be repeated wherever wall surface is questionable.

Attachment to Furring (Alternative Method):

Install furring horizontally over existing wall surface. Space furring 16" o.c. Use wooden shims to plumb furring strips.

Furring fasteners shall penetrate at least 3/4" into framing members, attached with two nails at each framing member intersection.

3.3 Panel Installation:

General:

Panel clearance shall be 1/8" top or bottom. Clearance gap shall be covered with molding or base as appropriate.

Panel shall be aligned such that vertical edges are over framing or existing studs.

Direct Adhesive Attachment (preferred Method):

Each panel shall be fitted before apply adhesive. Adhesive application shall be as recommended by the manufacturer.

The adhesive bead shall be 3/8" diameter and installed 16" o.c. or on all furring, where applicable.

One bead shall be installed at each abutting edge but not within 1" of edge.

Press firmly into contact with adhesive.

3.4 Molding:

Molding shall be installed with formed mitered, tight, smooth corners and splices.

SECTION 0906

Gypsum Impregnated Jute Fabric

Part 1. General

1.1 Work Covered Under Other Sections:

The scope of work for providing temporary utilities, security, safety, and disposal of waste materials is covered under Section 0101 of these specifications.

1.2 Work Included Under This Section:

Work inlcuded under this section includes the furnishing of all labor, materials, and equipment required to apply gypsum-jute fabric complete as called out in these specifications.

1.3 Storage and Handling:

Material shall be stored and handled in accordance with manufacturer's specification.

1.4 Environmental Conditioning:

Provide heat to maintain a minimum surface timperature of 40°F for a period of 12 hours before and after application of gypsum-impregnated fabric wall covering.

1.5 Maintenance Instructions:

The owner shall be furnished a copy of the fabric manufacturer's maintenance instructions containing the fabric manufacturer's recommended cleaning materials and application methods including precautions in the use of cleaning materials which may be detrimental to the surface if improperly applied.

Part 2. Products

Materials:

Gypsum-Jute Fabric shall conform to the following:

Color: selected by construction engineer.
Total wall covering weight: 21 oz/sq. yd.
Fabric Backing (count): 9 x 9 1/2
Fabric Backing: Stainless Jute
Fabric Backing Weight: 7.5 oz/sq. yd.
Coating Weight: 13.5 oz/sq. yd.

Fire Hazard Classification: As tested by ASTM E84-61 as applied with manufacturer's approved adhesive in accordance with application instructions provided with the adhesvie.

A. Flame Spread: 15 (Class 1)
B. Fuel Contributed: 0
C. Smoke Development: 0

Adhesive shall be as recommended by wall covering manufacturer.

Gypsum-jute shall be as manufactured by Flexi-Wall Systems Division of Wall and Floor Treatment, Inc., Greenville, S.C.

Adhesive shall be recommended by the wall covering manufacturer.

Part 3. Execution

3.1 Surface Preparation:

Loose paint or scale, and any abnormal surface protrusions and water sensitive materials or pigments that bleed in water or oil shall be removed. Enamel or gloss paint surfaces shall be dulled and rinsed with clear water. Complete all other trade work that penetrates the substrate before beginning fabric installation. Starting work shall indicate acceptance of a suitable substrate surface.

3.2 Installation:

Fabric shall be installed in accordance with the recommendations of the manufacturer.

SECTION 0908

Vinyl Coated Fabric

Part 1. GENERAL

1.1 Work Covered Under Other Sections:

The scope of work for providing temporary utilities, security, safety and disposal of waste materials is covered under Section 0101 of these specifications.

1.2 Work Covered Under This Section:

Work included under this section includes the furnishing of all labor, materials, and equipment required to apply vinyl-coated fabric on existing walls complete as called out in these specifications.

1.3 Environmental Conditioning:

Vinyl coated fabric shall be installed only when normal temperature and humidity conditions approximate the same conditions that will exist when building is occupied. Area to receive fabric covering shall be at a constant temperature averaging 70°F measured at base elevation. Temperature shall be maintained for 48 hours before application, during application and 48 hours after the application. Remove the vinyl-coated fabric from its packaging and allow to acclimatize to the area of installation 24 hours before application.

1.4 Maintenance Instructions:

The owner shall be furnished a copy of the vinyl-coated fabric manurfacture's maintenance instructions containing the vinyl-coated fabric manufacturer's recommended cleaning materials and application methods including precautions in the use of cleaning materials which mat be detrimental to the surface if improperly applied.

Part 2. PRODUCTS

2.1 Materials:

Vinyl-coated fabric:

Pattern and color shall be selected by the construction engineer.

Fabric shall be Type II, Class 2 in conformance with Federal Specification CCC-W-408, or "Textural" as manufactured by the E.C. Bondy Co., or "Fashion" as manufactured by the Central Tire Co., or equal.

Weight of vinyl coating less backing shall be 7 ounces per square yard.

Fabric shall meet Taber abrasion resistance, tensile break strength, tear strength and adhesion of backing properties of Federal Specification CCC-T-19 1b.

Fabric shall meet the standards of stain resistance established in ASTM D1308-57.

Heavy bodied water soluble paste manufactured expressly for use shall be used with the vinyl-coated fabric furnished for installation.

Adhesive shall contain a mildew inhibitor.

Part 3. EXECUTION

3.1 Surface Preparation:

Surface shall be free of loose paint, scale, and water sensitive materials or pigments that bleed in water or oil; glossy paint surfaces shall be dulled and rinsed with water.

Substrate surfaces shall be examined and defects corrected before beginning work.

3.2 Installation of Vinyl-coated Fabric:

Installation shall be accomplished in the best standards of workmanship and in strict conformance to manufacturer's recommendations. All material shall be installed with smooth surface, free of wrinkles and projections and all edges neatly cut and trimmed. Where vinyl covering is applied to gypsum wallboard, the joints shall be butted. Lapping sheets and cutting joints shall not be acceptable.

Hardware, accessories, plates and similar items shall be removed to allow fabric to be installed, and then replaced.

SECTION 0912
Gypsum Veneer Plaster with Bonding Agent

Part 1. GENERAL

1.1 Work Covered Under Other Sections:

The scope of work for providing temporary utilities, security, safety and disposal of waste materials is covered under Section 0101 of these specifications.

1.2 Work Included Under This Section:

Work included under this section includes the furnishing of all labor, materials, and equipment required to apply a plaster veneer coat complete as called out in these specifications.

1.3 Product Storage, and Handling:

Plaster and other cementitious materials shall be kept dry until ready to be used, and wet or deteriorated materials shall be removed from project sites.

1.4 Job Conditions:

Temperature: Gypsum plaster shall not be applied unless a minimum temperature of 55°F has been and continues to be maintained in building for a minimum of two days prior to plaster application, during plastering, and a minimum of seven days after plaster is dry.

Ventilation: In glazed buildings, windows shall be kept open approximately 2 in. top and bottom and 4 in. for side pivoted or sliding windows.

Enclosed areas and during freezing weather, ventilation shall be provided by mechanical means.

In unglazed buildings subject to hot, dry winds or temperature differentials of 20°F or more, openings shall be screened with plastic film.

1.5 Gypsum Plaster:

Materials installed over radiant heating systems shall withstand temperatures of 115 degrees F.

Part 2. PRODUCTS

2.1 Materials:

Guaging Plaster shall conform to the requirements of ASTM C 28-68.

Normal Finishing Hydrated Lime shall conform to the requirements of ASTM C 6-49, Type N.

Veneer Plaster shall conform to the requirements of ASTM C 587-68.

Bonding Agent shall conform to the following:

Must be an aqueous phase, film forming, non-oxidizing, non-deteriorating, ready-to-use composition suitable for spary, brush, or roller application.

Must re-emulsify when touch dry (approx. 40 min. after applying) and anytime up to 10 days following application.

Must demonstrate a two-hour fire rating in an assembly tested according to ASTM E 119.

Film must remain flexible indefinitely and be free from tendency to harden or craze crack.

Must be capable of 5 cycles freeze (-10°F) and thaw with no effect on bonding performance.

Must be tested in bond from -35°F to +310°F without failure.

Must be unaffected by alkalinity of cement and of resistants to mild acids.

Must have tensile strength of 600 psi, ASTM C 190.

Must have shear strength of 400 psi, ASTM C 109.

Must have flexural strength of 600 psi, ASTM C 78.

Must be color tinted for identification.

2.2 Mixing:

General

Batches shall be sized for complete use within a maximum of one hour after mixing and to set within a maximum of four hours.

Partially set plaster shall not be retempered or used.

Frozen, caked, or lumpy material shall be removed from job site immediately.

Factory-prepared plaster shall be mixed in accordance with manufacturer's written instructions for type of surface to which applied.

Mechanical mixing

Mixer shall be cleaned of set or hardened materials before loading materials for new batch.

Mixer shall be maintained in continuous operation while adding and mixing materials.

Hand Mixing

Hand mixing shall be prohibited unless authorized by the construction engineer.

Mix Proportions

Veneer Plaster: Factory manufactured veneer plaster specified be manufacturer.

White Skim Coat (Alternate material to veneer plaster) shall be mixed using 80 lbs. dry line and 60 lbs. gauging plaster, and sufficient water to apply.

Bonding agent shall be mixed in accordance with the manufacturer's instructions.

Part 3 EXECUTION

3.1 Surface Preparation:

All foreign material shall be removed including dirt, dust, oil, grease, wax, efflorescence, loose paint, plaster, casein, other water soluable paint, glue, size, and wallpaper.

Recently painted surfaces shall be allowed to cure at least 60 days before application of bonding agent.

Glossy surfaces shall be dulled with an abrasive.

Sealer shall be applied over chalky paints.

3.2 Application of Bonding Agent:

Bonding agent shall be applied over the entire surface in a continuous film with brush, roller or spray.

3.3 Application of one-coat plaster:

Plaster shall be applied within a week after bonding agent is dry (no longer tacky); preferably immediately.

Veneer Plaster (preferred method):

A minimum 3/32-in. thick finish coat shall be applied. A uniformly thick, dense, and polished surface shall be provided.

White Skim Coat (alternate method):

A 1/16 to 3/16-in. thick coat shall be applied. A uniform, dense, and polished surface shall be provided, or textured to match existing wall surfaces.

SECTION 0913

Gypsum Plaster with Metal Lath

Part 1. GENERAL

1.1 Work Covered Under Other Sections:

The scope of work for providing temporary utilities, security, safety and disposal of waste materials is covered under Section 0101 of these specifications.

1.2 Work Included Under This Section:

Work included under this section includes the furnishing of all labor, materials, and equipment required to install a two-coat plaster system over stucco netting complete as called out in these specifications and amplified in Attachment A.2.

1.3 Product Storage and Handling:

Plaster and other cementitious materials shall be kept dry until ready to be used. Wet or deteriorated materials shall be removed from the project sites.

1.4 Job Conditions:

Gypsum plaster shall not be applied unless a minimum uniform temperature of 55°F has been and continues to be maintained in building for a minimum of two days prior to plaster application during plastering, and a minimum of seven days after plaster is dry.

Ventilation for the drying of plaster during and subsequent to application shall be provided in glazed buildings by keeping windows open approximately 2 inches top and bottom and 4 inches for side pivoted or sliding windows; for enclosed areas and during freezing weather, provide ventilation by mechanical means. In an unglazed building subject to hot, dry winds or day or night temperature differentials of 20°F (10°C) or more, openings be screened with plastic films.

1.5 Gypsum Plaster:

Materials installed over radiant heating system shall withstand the average temperature produced by the heating system, 110°-115°F.

Part 2. PRODUCTS

2.1 Materials:

Wood Fiber Plaster shall conform to ASTM C-28; Federal Specification SS-P-402, Type W.

High Calcined Gypsum Plaster shall conform to ASTM C-28,

Veneer Plaster shall conform to ASTM C-587

Keene Cement shall conform to ASTM C-61

Finishing Lime shall conform to ASTM C-206.

Sand Aggregate shall conform to ASTM C-35.

Stucco Neeting shall be 20 gauge, galvanized steel, or 17 gauge 1-1/2", paperbacked (conforming to Federal Specification UU-B-790) in rolls or sheets.

Corner Bead (External Corners only) shall be 26 gauge galvanized steel.

Nails, staples, screws shall be of sufficient length to penetrate into existing framing of minimum of 3/4".

2.2 Mixing:

General:

Batches shall be sized for complete use within a maximum of one hour after mixing and to set within a maximum of four hours.

Partially set plaster will not be retempered or used.

Frozen, caked, or lumpy material shall be removed from job site immediately.

Factory-prepared plaster shall be mixed in accordance with manufacturer's writter instructions for type of surface to which applied.

Mechanical Mixing:

Mixer shall be cleaned of set or hardened materials before loading materials tor new batch.

Mixer shall be maintained in continuous operation while adding and mixing materials.

Hand Mixing:

Hand mixing shall be prohibited unless authorized by the Construction Engineer.

Mix Proportions shall be:

Base Coat: Wood fiber plaster and sand formulated 1:1.

Finish Coat: Veneer plaster (preferred formulation for dry areas); mix proportions as recommended by manufacturer.

Keene cement lime sand float finish (alternate for dry areas); 100 lbs. lime to 400 lbs. silica sand per 100 lbs. Keene Cement.

Gyspum sand float (altenante for dry areas); 100 lbs. gypsum plaster to 200 lbs. sand.

Keene cement standard hard finish (to be used in wet areas); 100 lbs. Keene cement to 100 lbs. lime.

Part 3. EXECUTION

3.1 Preparation for Lathing:

Wood trim, projections and other items that interfere with a relatively straight plane shall be removed from surfaces to be covered.

Large voids shall be covered with a layer of paperbacked stucco netting fastened in such a manner that it will remain in place until attachment of the wire reinforcement used for the plastic base.

Corner bead shall be fastened to external angles and edges.

3.2 Lathing:

20 gauge stucco netting shall be applied with nails, screws, or staples of sufficient length to penetrate at least 3/4" into structural members.

Fastening debices shall be applied 8" o.c. on walls and 6" o.c. on ceilings, and at crossmembers of netting.

3.3 Plaster Application:

Base Coat:

A thickness of 3/8" shall be applied to all lathed surfaces by hand or machine.

Plaster shall be applied to floor wall angle to seal against vermin and rodent entry.

Finish Coat:

General:

A thickness of 1/8" shall be applied to bring total thickness of plaster membrane to 1/2".

Finish coat shall be applied to basecoat which is set and partially dry or to set dry basecoat which has been dampened by application of water.

Finish coat shall be cut through full depth with trowl at intersection of plaster walls and plaster ceilings.

Trowl Finishes:

Finish coat shall be scratched in with strong trowl pressure over basecoat, doubled back and filled out to a true, even surface.

Finish plaster shall be allowed to firm up.

Trowel Keene Cement finishes at appropriate time intervals until finish sets.

Sand-Float Finishes:

Sand-float finishes shall be applied over basecoat with a trowl to a true, even surface, and floated to product a surface having a texture that is free from slick spots or other blemishes.

SECTION 0914

Filled Paint

Part 1. GENERAL

1.1 Work Covered Under Other Sections:

The scope of work for providing temporary utilities, security, safety and disposal of waste materials is covered under Section 0101 of these specifications.

1.2 Work Included Under This Section:

Work included under this section includes the furnishing of all labor, materials, and equipment required to apply a high build textured coating complete as called out in these specifications.

Part 2. PRODUCTS

2.1 Filled Paint:

A high build medium textured coating containing a water reducible vinyl resin pigmented with a matrix of extender pigment and perlite aggregate (Pittsburgh Paints, Hide-A-Spray, fine texture or equal) shall be used. Color shall be determined by the Construction Engineer.

Part 3. EXECUTION

3.1 Surface Preparation:

Foreign material including dirt, dust, oil, grease, wax and efflorescence, loose paint and plaster, calcimine, casein, other water soluble paints, glue size or wallpaper shall be removed.

Recently painted surfaces shall be allowed to cure at least 60 days before application of bonding agent.

Glossy surfaces shall be dulled with an abrasive.

Sealer shall be applied over chalky paints.

3.2 Application of Filled Paint:

Paint shall be applied in accordance with manufacturer's instructions, to a minimum thickness of 10 mils wet, and cured.

SECTION 0915

Cementitious Coating

Part 1. GENERAL

1.1 Work Covered Under Other Sections:

The scope of work for providing temporary utilities, security, safety, and disposal of waste materials is covered under Section 0101 of these specifications.

1.2 Work Included Under This Section:

Work included under this section includes the furnishing of all labor, materials, and equipment required to apply a cementitious coating over surfaces covered with lead based paint as called out in these specifications.

Part 2. PRODUCTS

2.1 Material:

Cementitious Coating: A proprietary mixture including portland cement, silical sand and acrylic resin to which water is added to make a slurry. Application shall be as recommended by the manufacturer.

Except as otherwise specified, materials shall be equivalent to the finestone textured surfacing as manufactured by Finestone Corporation or approved equal.

2.2 Colors:

As called out in the Technical Scope of Work.

2.3 Mixing and Tinting:

Deliver paint ready-mixed to job sites.

Use tinting colors recommended by manufacturer.

Fungicidal agent, when applicable, shall be incorporated into the paint by the manufacturer.

Cleaning:

Touch up and restore finish where damaged. Remove spilled, splashed, or splattered paint from all surfaces. Do not mar surface finish of trim being cleaned. Leave storage space clean and in condition required for equivalent spaces in project.

Painting Schedule:

Surfaces not to be painted:

Face brick
Pre-finished wall, ceiling and floorcoverings
Items with factory applied final finish

Part 3. EXECUTION

3.1 Inspection:

Examine surfaces scheduled to receive finish for conditions that will adversely affect execution, permanence or quality of work and which cannot be put into an acceptable condition through preparatory work as included in Article 3.2, Preparation.

3.2 Preparation of Surfaces:

Remove foreign material including dirt, dust, oil, grease, wax and efflorescence.

Remove loose paint and plaster.

Calcimine, casein, other water soluble paints, glue size or wallpaper must not be present.

Glossy surfaces must be dulled with an abrasive.

Apply sealer over chalky paints.

Plaster (and Gypsum Wallboard):
Fill narrow, shallow cracks and small holes with spackling compound.

Rake deep, wide cracks and deep holes. Dampen with clear water. Fill with thin layers of patching plaster. Fill with thin layers of drywall joint cement.

Allow to dry. Sand smooth. Do not raise nap of paper on wallboard.

3.3 Application:

General Requirements:

Do not apply initial coating until moisture content of surface is within limitations recommended by paint manufacturer.

Apply cementitious coating with suitable brushes, (or) rollers.

Rate of application shall not exceed that as recommended by manufacturer for the surface involved.

Keep brushes, (and) rollers clean, dry, free from contaminates and suitable for the finish required.

Comply with recommendation of product manufacturer for drying time between succeeding coats.

Sand and dust between coats to remove defects visible from a distance of 5 feet.

Finish coat shall have orange peel texture, free of brush marks, streaks, laps or pile up of paints, and skipped or missed areas.

Coating thickness shall be 1/16".

Inspection:

Leave all parts of moldings and ornaments clean and true to details with no undue amount of paint in corners and depressions.

Make edges of paint adjoining other materials or colors clean and sharp with no overlapping.

Change colors at locations where colors differ between adjoining spaces or rooms and where door frames do not match wall colors.

SECTION 0918

Plywood

Part 1. GENERAL

1.1 Work covered Under Other Sections:

The scope of work for providing temporary utilities, security, safety and disposal of waste materials is covered under Section 0101 of these specifications.

1.2 Work Included Under This Section:

Work included under this section includes the furnishing of all labor, materials, and equipment required to install plywood over exterior porch floors.

Part 2. PRODUCTS

2.1 Plywood:

Plywood shall be 3/8" thick, exterior marine A-B grade. Plywood shall bear marks indicating the grade and standard by which it was produced, and shall conform to standards of the American Plywood Association.

2.2 Underlayment:

One layer of 15# roofing felt shall be laid on floor surfaces prior to placing and nailing plywood to old painted surfaces.

2.3 Nails:

Type and spacing of nails in floor shall be as specified by the construction engineer.

2.4 Screws:

Flatheaded cad-plated wood screws 1-1/2" long shall be spaced a maximum of 18" o.c. within 1-1/2" of the edge of all plywood applied to door surfaces.

Part 3. EXECUTION

3.1 Subflooring:

As indicated by the scope of work, any boards which are rotted or warped to the point that a solid surface will not result with the plywood cover shall be replaced.

3.2 Plywood on Floors:

Plywood shall be placed and fitted, joints filled, and edges and joints sanded to remove the possibility of splintering.

All edges of plywood shall be treated with two coats of "Wood-Life" preservative or equal. All exposed edges of plywood shall be trimmed with a minimum 1"x 2" fir trim or as determined by the construction engineer in the field.

SECTION 0921

Paint Removal - Scraping

Part 1. GENERAL

1.1 Work Covered Under Other Sections:

The scope of work for providing temporary utilities, security, safety and disposal of waste materials is covered under Section 0101 of these specifications.

1.2 Work Included Under This Section:

Work included under this section includes the furnishing of all labor, materials, and equipment required to remove lead bearing paint by scraping and sanding as called out in these specifications.

Part 2. EXECUTION

2.1 Paint shall be removed down to the substrate surface as completely as possible using scraping and/or sanding. In some cases, pigment may remain embedded in wood grain and similar porous materials.

2.2 Wood shall not be removed by scraping and/or sanding operation.

SECTION 0922

Solvent Based Paint Remover

Part 1. GENERAL

1.1 Work Covered Under Other Sections:

The scope of work for providing temporary utilities, security, safety and disposal of waste materials is covered under Section 0101 of these specifications.

1.2 Work Included Under This Section:

Work included under this section includes the furnishing of all labor, materials, and equipment required to remove lead bearing paint by scraping after the paint has been softened with a water wash paint remover, as called out in these specifications.

Part 2 PRODUCTS

2.1 Water Wash Paint Remover:

Remover shall be Marine-Industrial grade and shall contain methylene chloride, methyl alcohol, and an agent to cause the paint to emulsify with water.

Part 3 EXECUTION

3.1 Paint shall be allowed to blister and soften.

3.2 Softened paint shall be removed down to the substrate surface as completely as possible using scraping or brushing. In some cases, pigment may remain embedded in wood grain and similar porous materials.

Part 4 DAMAGES

4.1 The contractor shall protect adjacent areas from damages from solvent during the course of his work.

SECTION 0923

Paint Removal by Electric Heat Gun

Part 1. GENERAL

1.1 Work Covered Under Other Sections:

The scope of work for providing temporary utilities, security, safety, and disposal of waste materials is covered under Section 0101 of these specifications.

1.2 Work Included Under This Section:

Work included under this section includes the furnishing of all labor, materials, and equipment required to remove lead bearing paint by scraping after heating and softening with an electrically operated heat blower gun as called out in these specifications.

Part 2. EXECUTION

2.1 Paint shall be allowed to blister and soften.

2.2 Softened paint shall be removed down to the substrate surface as completely as possible using scraping and/or brushing. In some cases, pigment may remain embedded in wood grain and similar porous materials.

SECTION 0924

Paint Removal - Propane Torch

Part 1. GENERAL

1.1 Work Covered Under Other Sections:

The scope of work for providing temporary utilities, security, safety and disposal of waste materials is covered under Section 0101 of these specifications.

1.2 Work Included Under This Section:

Work included under this section includes the furnishing of all labor, materials, and equipment required to remove lead bearing paints by scraping after heating with a propane torch as called out in these specifications.

Part 2. EXECUTION

2.1 Paint shall be blistered and softened using a propane torch to apply heat.

2.2 Softened paint shall be removed down to the substrate as completely as possible using scraping or brushing. In some cases, pigment may remain embedded in wood grain and similar porous materials.

2.3 In no case shall the propane torch be used for stripping interior surfaces.

SECTION 0925

Paint Removal From Doors Using Dip Tank

Part 1 GENERAL

1.1 Work Covered Under Other Sections:

The scope of work for providing temporary utilities, security, safety and disposal of waste materials is covered under Section 0101 of these specifications.

1.2 Work Included Under This Section:

Work included under this section includes the furnishing of all labor, materials, and equipment required to remove paints with a hot alkaline solution complete as called out in these specifications.

part 2 PRODUCTS

2.1 Paint Remover:

A hot alkaline process shall be used.

2.2 Neutralizer:

Shall be as recommended by the paint remover manufacturer.

Part 3 EXECUTION

3.1 All metal components that could be attacked by paint remover shall be removed or treated as recommended by the paint remover manufacturer.

3.2 Paint shall be allowed to blister and soften.

3.3 Softened paint shall be removed as completely as possible using scraping or brushing. In some cases, pigment may remain embedded in wood grain and similar porous materials.

SECTION 0926

Paint Removal - Infra-Red Device

Part 1. GENERAL

1.1 Work Covered Under Other Sections:

The scope of work for providing temporary utilities, security, safety and disposal of waste materials is covered under Section 0101 of these specifications.

1.2 Work Included Under This Section:

Work included under this section includes the furnishing of all labor, materials, and equipment required to remove lead bearing paints by scraping after heating with infra-red device as called out in these specifications.

part 2. EXECUTION

2.1 Paint shall be blistered and softened using infra-red device to apply heat.

2.2 Softened paint shall be removed down to the substrate as completely as possible using scraping or brushing. In some cases, pigment may remain embeded in wood grain and similar porous materials.

NBS-114A (REV. 7-73)

| U.S. DEPT. OF COMM. BIBLIOGRAPHIC DATA SHEET | 1. PUBLICATION OR REPORT NO. NBSIR 75-974 | 2. Gov't Accession No. | 3. Recipient's Accession No. |
|---|---|---|---|

4. TITLE AND SUBTITLE

The Demonstration of Experimental Lead Paint Hazard Abatement Methods in Atlanta, Georgia

5. Publication Date: December 1975

6. Performing Organization Code


7. AUTHOR(S) Thomas H. Boone, Harvey W. Berger, A. Philip Cramp
Herbert A. Jackson


8. Performing Organ. Report No.


9. PERFORMING ORGANIZATION NAME AND ADDRESS

NATIONAL BUREAU OF STANDARDS
DEPARTMENT OF COMMERCE
WASHINGTON, D.C. 20234


10. Project/Task/Work Unit No. 4608400

11. Contract/Grant No. IAA-H-35-75

12. Sponsoring Organization Name and Complete Address *(Street, City, State, ZIP)*

Office of Policy Development and Research
Department of Housing and Urban Development
Washington, D.C. 20410

13. Type of Report & Period Covered: Interim FY'75

14. Sponsoring Agency Code

15. SUPPLEMENTARY NOTES


16. ABSTRACT *(A 200-word or less factual summary of most significant information. If document includes a significant bibliography or literature survey, mention it here.)*

This report describes the second stage of an experimental lead paint hazard abatement program carried out in 80 dwelling units in Atlanta, Georgia. The entire program will ultimately involve the abatement of lead paint hazards in a total of approximately 250 dwelling units distributed over three or more cities.

The procedures demonstrated in this field testing program were: paint removal using chemical solvents; paint removal using three heat producing devices; the replacement of components such as windows, doors, and wood trim and the installation of flexible sheet materials, rigid boards, plaster products and aggregate filled coatings, over existing lead paint on walls. Also evaluated was the covering of deteriorated, lead paint coated floors with plywood.

The report includes procedures for inspecting and selecting dwellings for lead paint hazard abatement, evaluations of the suitability and implementation characteristics of the abatement methods, and recommendations for their use.

Subsequent reports will present the results of comparable programs in additional cities and a final report will compare the cost-effectiveness of the alternative abatement methods.



17. KEY WORDS *(six to twelve entries; alphabetical order; capitalize only the first letter of the first key word unless a proper name; separated by semicolons)*

Abatement; barrier materials; building materials; children; housing; lead-based paint; lead poisoning; paint removal


18. AVAILABILITY

[X] Unlimited

[ ] For Official Distribution. Do Not Release to NTIS

[ ] Order From Sup. of Doc., U.S. Government Printing Office Washington, D.C. 20402, SD Cat. No. C13

[x] Order From National Technical Information Service (NTIS) Springfield, Virginia 22151

19. SECURITY CLASS (THIS REPORT): UNCLASSIFIED

21. NO. OF PAGES: 121

20. SECURITY CLASS (THIS PAGE): UNCLASSIFIED

22. Price: $5.50

USCOMM-DC 29042-P74