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Evaluation of Lead Paint Hazard Elimination Methods Part II

Milestone Report (7b)

David Waksman, Leopold F. Skoda, Elizabeth J. Clark, McClure Godettee

Center for Building Technology
Institute for Applied Technology
National Bureau of Standards
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U. S. DEPARTMENT OF COMMERCE, Frederick B. Dent, Secretary
NATIONAL BUREAU OF STANDARDS, Richard W. Roberts, Director

Abstract

Four major classifications of procedures that should be considered when selecting a method for the elimination of the leaded paint hazard are analyzed in this report. They are: surface repair methods, surface finish methods, cover up methods with unfinished membrane materials, and cover up methods with pre-finished rigid materials. The attributes associated with each type of method were considered and analyzed in terms of inaccessibility of the leaded paint and implementation considerations. Recommendations are made for the in-use performance properties of surfaces.

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Evaluation of Lead Paint Hazard Elimination Methods - Part II

1. Introduction

This report is a continuation of NBS Report 10652, "Evaluation of Lead Paint Removal and Detoxification Methods, Milestone Report (7a)."

Many factors should be considered in the selection of lead paint hazard elimination methods. In general, each dwelling unit should be treated as a separate entity due to the variations in architectural configuration, the structural condition of the unit and the location of the hazard. Certain hazard elimination techniques are not readily applicable if a building has reached a certain stage of deterioration, i.e. if there is poor plaster integrity, or if the leaded material has been used to coat a complex surface, i.e. if complex carvings or radiators coated with leaded paint are present.

The attributes that can be directly associated with potential hazard elimination methods are considered in this report. In addition to the primary attribute of hazard inaccessibility, which is required of every solution, there are secondary properties that can be related either to work involved in implementation of the process, or to characteristics that reflect the in-use performance of the residence after it has been treated.

The following properties were considered in evaluating hazard elimination methods:

a. Hazard Inaccessibility

b. Supportive Attributes

    i. Special Preconditions

    ii. Installation Health and Safety

iii. Ancillary Work

iv. Waste Disposal

c. Involvement

i. Community

ii. User

d. Degree of Finish, and

e. In-Use Performance

i. Occupant Health and Safety

ii. Durability and Stability

iii. User Acceptability

Although not all of the properties listed above are usually covered by local codes, they should still be considered in the selection of hazard elimination methods. Where properties are covered by local codes, these code requirements should be complied with.

The paths that can be followed in eliminating the leaded paint hazard are outlined in Figures I and II, Decision Model - Part 1 and 2, respectively.

The factors that should be considered when following the procedures outlined in Matrices I and IV, Removal Methods and Cover Up-Unfinished Rigid Material, respectively were discussed in Report #10652.

Detailed analyses are made in this report of those factors implicitly involved when the procedures shown in Figure III, Matrix II - Surface Repair Methods, Figure IV, Matrix III - Cover Up-Unfinished Membrane Material, Figure V, Matrix V - Cover Up Pre-finished Rigid Material, and/or Figure VI, Matrix VI - Surface Finish Methods, are used.

Each of the above matrices serves as an index for these detailed analyses.

HAZARD ELIMINATION DECISION MODEL - PART 1

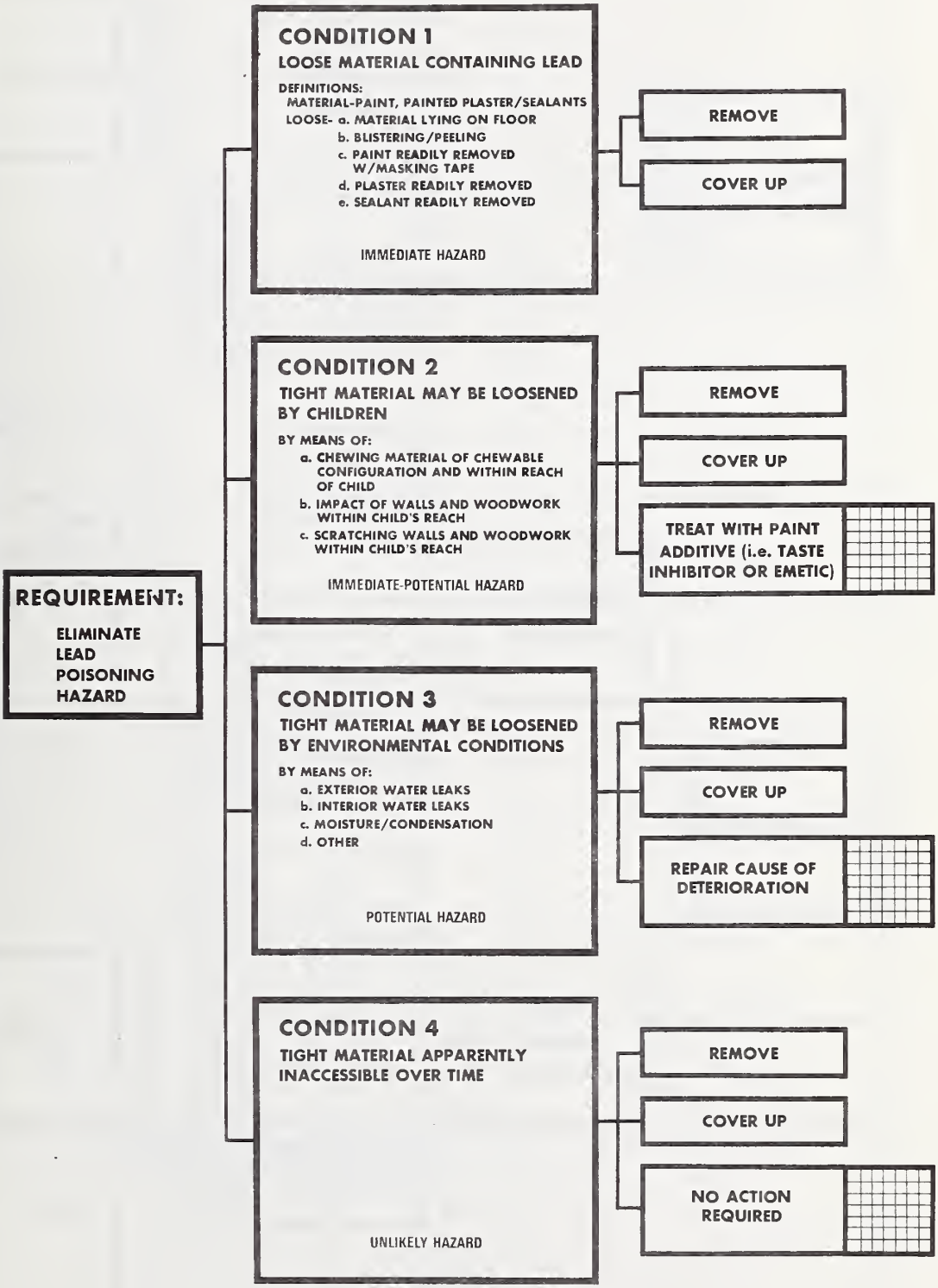

Figure I

DECISION MODEL PART 2

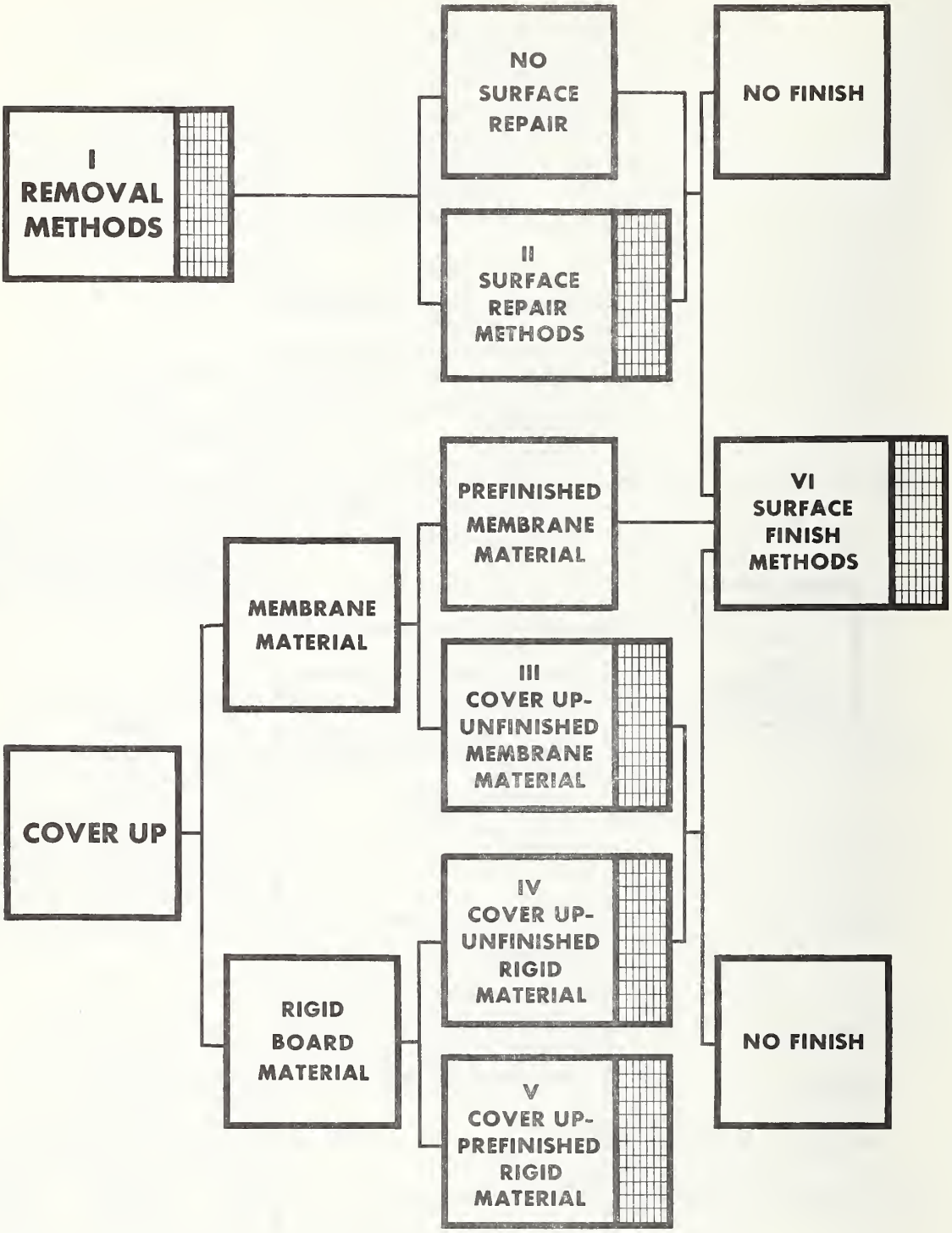

Figure II

SURFACE REPAIR METHODS

II

			HAZARD INACCESSIBILITY	SUPPORTIVE ATTRIBUTES: SPECIAL PRECONDITIONS	SUPPORTIVE ATTRIBUTES: INSTALLATION HEALTH & SAFETY	SUPPORTIVE ATTRIBUTES: ANCILLARY WORK	SUPPORTIVE ATTRIBUTES: WASTE DISPOSAL	INVOLVEMENT: COMMUNITY	INVOLVEMENT: USER	DEGREE OF FINISH	TIME	IMPLEMENTATION ATTRIBUTES: LABOR	IMPLEMENTATION ATTRIBUTES: MATERIAL	IMPLEMENTATION ATTRIBUTES: EQUIPMENT	IMPLEMENTATION ATTRIBUTES: TOTAL COST	TOTAL COST (SUPPORTIVE & IMPLEMENTATION)
			1	2	3	4	5	6	7	8	9	10	11	12	13	14
A	PATCH	1 WALLS														
		2 CEILING														
		3 WOOD-WORK														
		4 OTHER														
B	MAJOR REPAIR	1 WALLS														
		2 CEILING														
		3 WOOD-WORK														
		4 OTHER														
C	REPLACE	x PLASTER 1 WALLS														
		x PLASTER 2 CEILING														
		x PLASTER 3 WOOD-WORK														
		x PLASTER 4 OTHER														
		y RIGID BOARD MATERIALS (SEE COVER UP MATRIX)														

Figure III

COVER UP - UNFINISHED MEMBRANE MATERIAL

III		HAZARD (INACCESSIBILITY)	SUPPORTIVE ATTRIBUTES				INVOLVEMENT		DEGREE OF FINISH	TIME	IMPLEMENTATION ATTRIBUTES				TOTAL COST (SUPPORTIVE & IMPLEMENTATION)
			SPECIAL PRECONDITIONS	INSTALLATION HEALTH & SAFETY	ANCILLARY WORK	WASTE DISPOSAL	COMMUNITY	USER			LABOR	MATERIAL	EQUIPMENT	TOTAL COST	
		1	2	3	4	5	6	7	8	9	10	11	12	13	14
A FABRIC	1 WALLS														
	2 CEILING														
	3 WOOD-WORK														
	4 OTHER														
B PLASTER	1 WALLS														
	2 CEILING														
	3 WOOD-WORK														
	4 OTHER														
C CEMENTITIOUS MATERIAL	1 WALLS														
	2 CEILING														
	3 WOOD-WORK														
	4 OTHER														
D OTHER	1 WALLS														
	2 CEILING														
	3 WOOD-WORK														
	4 OTHER														

Figure IV

COVER UP - PRE-FINISHED RIGID MATERIAL

V		HAZARD (INACCESSIBILITY)	SUPPORTIVE ATTRIBUTES				INVOLVEMENT		DEGREE OF FINISH	TIME	IMPLEMENTATION ATTRIBUTES				TOTAL COST (SUPPORTIVE & IMPLEMENTATION)	IN-USE PERFORMANCE		
			SPECIAL PRECONDITIONS (SUPPORT REQUIREMENTS)	INSTALLATION HEALTH & SAFETY	ANCILLARY WORK	WASTE DISPOSAL	COMMUNITY	USER			LABOR	MATERIAL	EQUIPMENT	TOTAL COST		HEALTH & SAFETY	DURABILITY & STABILITY	ACCEPTABILITY
		1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17
A GYPSUM BOARD	PAPERED																	
	PLASTIC COATED																	
B PLYWOOD	PAINTED																	
	PLASTIC COATED																	
	PAPERED																	
C HARDBOARD	PAINTED																	
	PLASTIC COATED																	
	PAPERED																	
D METAL	PAINTED																	
	PLASTIC COATED																	
E REINFORCED PLASTIC																		
F CEILING BOARD & TILE	PAINTED																	
	PLASTIC MEMBRANE																	
G OTHER																		

Figure V

SURFACE FINISH METHODS

VI		HAZARD INACCESSIBILITY 1	SUPPORTIVE ATTRIBUTES: SPECIAL PRECONDITIONS 2	SUPPORTIVE ATTRIBUTES: INSTALLATION HEALTH & SAFETY 3	SUPPORTIVE ATTRIBUTES: ANCILLARY WORK 4	SUPPORTIVE ATTRIBUTES: WASTE DISPOSAL 5	INVOLVEMENT: COMMUNITY 6	INVOLVEMENT: USER 7	DEGREE OF FINISH 8	TIME 9	IMPLEMENTATION ATTRIBUTES: LABOR 10	IMPLEMENTATION ATTRIBUTES: MATERIAL 11	IMPLEMENTATION ATTRIBUTES: EQUIPMENT 12	IMPLEMENTATION ATTRIBUTES: TOTAL COST 13	TOTAL COST (SUPPORTIVE & IMPLEMENTATION) 14	IN-USE PERFORMANCE: HEALTH & SAFETY 15	IN-USE PERFORMANCE: DURABILITY & STABILITY 16	IN-USE PERFORMANCE: ACCEPTABILITY 17
A PAINT	1 WALLS																	
	2 CEILING																	
	3 WOOD. WORK																	
	4 OTHER																	
B MASONRY CONDITIONER	1 WALLS																	
	2 CEILING																	
	3 WOOD. WORK																	
	4 OTHER																	
C LIQUID COVERING	1 WALLS																	
	2 CEILING																	
	3 WOOD. WORK																	
	4 OTHER																	
D VINYL SHEET	1 WALLS																	
	2 CEILING																	
	3 WOOD. WORK																	
	4 OTHER																	
E WALLPAPER	1 WALLS																	
	2 CEILING																	
	3 WOOD. WORK																	
	4 OTHER																	
F FABRIC	1 WALLS																	
	2 CEILING																	
	3 WOOD. WORK																	
	4 OTHER																	
G PLASTER & CEMENTITIOUS MATERIAL	1 WALLS																	
	2 CEILING																	
	3 WOOD. WORK																	
	4 OTHER																	
H OTHER																		

Figure VI

2. Description of the Indexing System for Hazard Elimination Matrices

The indexing system can be used to locate detailed analyses of the factors that should be considered when evaluating a hazard elimination procedure. Each hazard elimination matrix is treated as a separate chapter.

The matrices are numbered with Roman Numerals from I thru VI. Going down the left column of a matrix each major category is assigned a capitol letter, with sub-classifications indicated by small letters. The place a method is being applied, e.g., walls, is designated by the numerals 1 thru 4.

For example, with index number III.A.1, the III represents the matrix for Cover Up-Unfinished Membrane Materials, A indicates fabric, and the numeral 1 stands for walls.

3. Analysis of Surface Repair Methods - Matrix II

(See figure III)

3.1. Definitions

A. Patch - Repairs made to walls or ceilings which contain voids or deteriorated areas less than 16 inches in diameter and comprise less than 20% of the total affected area. Sufficient backing material (wood, metal or plaster lath) must be present to allow direct application of patching material. Also may include minor work on woodwork, etc.

B. Major Repair - Repairs made to walls or ceilings

1) which contain voids or deteriorated areas greater than 16 inches in diameter;

2) where the backing material (wood, metal, plaster lath) has been destroyed and must be replaced prior to application of patching plaster;

3) where patch areas comprise more than 20% of the total affected area;

4) when the combination of patch areas and other areas in need of repair total less than 50% of the component area.

Also may include repair of woodwork, etc.

C. Replace - When more than 50% of a surface (i.e., single walls or ceilings) is in need of major repair, replacement may be more desirable than repair.

3.2. Hazard Inaccessibility

Patch,Major Repair,Replace Plaster (Walls, Ceilings, Woodwork, Other)

Intercepts: II.(A,B,C.x).(1,2,3,4)

Surface repair procedures help to control the hazard accessibility by reducing possible further deterioration of surfaces coated with leaded paint, e.g., walls and ceilings. If repair or replacement is of less than 100% of the total area, then the hazard is still present. Access to the remaining leaded paint can be gained by chewing tight paint on chewable surfaces, loosening of tight paint by the reach of an active child, or loosening of tight paint by natural causes, e.g., moisture. No matter how tight the bond may seem between substrate and leaded paint, the potentially dangerous material is still present. Patching or repairing deteriorated surfaces merely helps to reduce hazard accessibility in the area treated. Only complete removal of all leaded material guarantees total elimination of the hazard.

3.3. Special Preconditions

Patch - (Walls, Ceilings)

Intercepts: II.A(1,2)

Prior to initiation of any patch procedures, the extent of deteriorated areas and voids must be determined. All loose material must be removed to

a point where remaining material is adequately bonded to the backing system.

Supportive attributes for walls and ceilings require that the basic structural components such as studs and ceiling joists be sound and capable of performing their intended function. The decision concerning the ability of structural components to perform their original function must be based on the sound engineering judgment of a building inspector or a representative from the municipal building department.

Patching procedures may require the application of more than one material. If deterioration or voids extend to the backing system (wood, metal or plaster lath), then a base "scratch" coat of plaster must be applied first, followed by a "white" coat of finish material. If the base coat is adequate, then only a finish coat of plaster or spackling compound need be applied to complete the patch. The smallest areas to be patched would be small nail holes or cracks that cannot be covered by the decorative coating to be used on the walls or ceiling.

Patch - (Woodwork)

Intercepts: II.A.3

Patching procedures for woodwork involve filling small nail holes and cracks with a material such as plastic wood or other similar products. They also include restoring loose components by nailing and/or gluing.

The woodwork involved, which may include windows, doors and associated trim, base boards, kitchen cabinetry and balustrades, must be firmly attached to the structural components of the dwelling.

Major Repair - (Walls, Ceilings)

Intercepts: II.B.(1,2)

Before major repairs can be initiated on walls or ceilings, the studs and ceiling joists must be determined to be structurally sound and capable of supporting the application of both the new backing material and the plaster patching system. Where voids exist, the addition of new lath may be required to support the patching plaster. The plaster adjacent to the void must be removed to expose at least two studs or ceiling joists capable of supporting the new lath. The patching procedure to be used after the application of new backing material is described in Special Preconditions Patch - (Walls, Ceilings), Intercepts: II.A.(1,2) above.

The definition of a major repair stipulates that the combination of patch areas and other repair areas must not total more than 50% of the component area being considered. This percentage is an estimate, and the final decision regarding the process to be used should be based on a cost analysis of both major repair and complete replacement procedures.

Major Repair - (Woodwork)

Intercept: II.B.3

Major repairs to woodwork include the replacement of components of items such as window or door units. Examples would be replacement of a window sill, one side of a kitchen cabinet, or a balustrade spindle. Preconditions necessitating replacement would be that the existing component be cracked, split or deteriorated to a point where it can no longer perform its intended function. If a component is simply loose and can be repaired with the use of mechanical fasteners, it would not be considered as a major repair. The item being repaired must have sufficient integrity to permit the performance of its intended use when a component part is replaced.

Replace Plaster - (Walls, Ceilings)

Intercept: II.C.x.(1,2)

When walls and ceilings cannot be economically repaired by patching or major repair procedures, it is usually necessary to replace the entire wall or ceiling system. This procedure would require removal of all plaster and lath down to the basic structural members, i.e., studs or ceiling joists. Wood, metal or plaster lath is used to provide a mechanical bond between the plaster layer and the structural system. Removal of window and door trim, base boards, chair rails or wainscoting is also necessary as these items are always applied to the walls on top of the plaster and lath.

After removal of the plaster and lath, a judgment must be made as to the adequacy of the structural components to support the new lath and plaster system. If the components are adequate, then a new lath and plaster system can be applied. If the structural components are partially or totally inadequate, they must be replaced or supplemented to whatever extent is necessary to provide an adequate structural base for application of new lath and plaster.

In some cases, based on expert judgment, it may be possible to apply metal lath on top of the existing lath system, but the general rule would be to completely remove all lath. In certain isolated cases it may also be possible to apply new metal lath directly to existing walls or ceilings without removal of the plaster. However, this method would increase the wall thickness and thereby reduce the amount of floor area in rooms which may already violate code regulations dealing with the spatial requirements for dwelling units.

Replace Plaster - (Woodwork)

Intercepts: II.C.x.3

When a wall is replaced because of voids or deterioration, the woodwork must be removed. The possibility of re-using woodwork taken from walls in this condition is rather remote. It is usually necessary to replace the window and door trim, base boards, etc. The replacement of doors, door jambs, windows, window sills or any woodwork would be predicated on the ability of these components to perform their original function. This judgment would have to be made by an engineer or a municipal building inspector.

The need for replacement of kitchen cabinetry or kitchen and bathroom fixtures would also be determined by experienced personnel who could evaluate the worth of the components in question.

3.4. Installation Health and Safety

Patch, Major Repair - (Walls, Ceilings)

Intercepts: II.(A,B).(1,2)

The precautions to be taken during performance of plaster patching techniques are minimal. Care must be taken to avoid contact of wet materials with electrical outlets and switch boxes. When the patch is in the vicinity of a box or outlet, these electrical services should be rendered inoperative during patching procedures by disengaging the fuse of the circuit involved. In addition to following the above procedure, masking tape or some other covering material should be used to prevent the entry of wet material into the electrical services. Occupants should not be allowed in the immediate vicinity of any of the work being done.

Normal safety precautions from falling or flaking plaster in deteriorated areas should be observed, i.e., the use of hard hats, safety glasses and safety shoes.

Patch, Major Repair - (Woodwork)

Intercepts: II.(A,B).3

When portions of woodwork are in need of patching or major repair, care must be taken to avoid driving nails through electrical wiring, gas lines and water pipes that may have been located behind the original woodwork.

Replace Plaster - (Walls, Ceiling, Woodwork)

Intercepts: II.C.x.(1,2,3)

When plaster replacement within a dwelling unit is necessary, all of the precautions mentioned in Installation Health and Safety, II.(A,B).(1,2,3), are applicable. The additional use of respirators by workmen removing the old plaster is advisable. If renovation of the entire dwelling unit is to be performed, the occupants should be relocated for the time necessary to complete the work.

Precautions must be taken during application of lath material to prevent damage to the wiring and plumbing by driven nails or threaded fasteners. The hazard potential during renovation is greatest when replacement procedures are used for surface repair.

3.5. Ancillary Work

Patch, Major Repair - (Walls, Ceiling, Woodwork, Other)

Intercepts: II.(A,B).(1,2,3,4)

There should be no ancillary work needed in patch or major repair procedures as far as electrical or heating systems are concerned. When

wall or ceiling areas are removed because they have been damaged as a result of leakage, repairs to water lines or drain lines may be necessary.

Deterioration of the inner surfaces of external walls may be caused by water leakage through roofs or walls. When a situation of this kind exists it is usually considered a violation of housing regulations and appropriate repair procedures should be used. If any kind of leakage is suspected, judgment by a housing department inspector is needed to determine the action that must be taken to alleviate the problem.

Replace Plaster - (Walls, Ceilings, Woodwork, Other)

Intercepts: II.C.x.(1,2,3,4)

When replacement procedures are initiated, all services in the dwelling unit may require modification. Electric boxes and fixtures may have to be moved to compensate for any change in wall or ceiling thickness. When kitchen and bathroom walls are to be replaced, plumbing work may be required. The extent of plumbing and electrical work will depend on each individual case. The amount of work to be done cannot be readily estimated without seeing the specific job. When replacement of walls is necessary, it may be in the best of interests of the occupants and owner to replace the existing plumbing and electric wiring while it is convenient to do so.

3.6. Waste Disposal

All Intercepts

a. Hazardous

The leaded material generated in the removal process is quite hazardous. Care should be exercised to collect and package the leaded material to render it inaccessible and it should be disposed

of in a manner that would keep it inaccessible.

Hazardous waste should not be disposed of in a manner which could put it into the air, e.g, burning without provision for collection of the leaded ash and elimination of toxic gases. In addition, hazardous waste should not be disposed of such that leaded materials will be permitted to leach into water systems.

Removal and disposal should be in accordance with appropriate local ordinances, or by recognized safe procedures if local ordinances do not exist.

b. Non-hazardous

Non-hazardous waste should be removed with the same care and expediency as hazardous waste. Waste material can provide breeding grounds for vermin and thus present a health hazard. In addition, people, especially children, can injure themselves by coming into physical contact with the waste material.

Immediate removal and disposal should be in accordance with appropriate local ordinances.

3.7. Community Involvement

All Intercepts

Utilization of hazard elimination procedures that permit community involvement is very desirable. In addition to potential cost savings that can be realized through "self-help" labor, valuable skills can be gained by members of the community.

It should be feasible to train community members to assist in patching repair methods. However, the more extensive the repair work required to complete the job, the lower the potential for immediate com-

munity involvement due to the necessity for increased training. With major repairs and replacement methods, community workers would need comprehensive training under experienced personnel.

3.8. User Involvement

All Intercepts

In most cases, occupants would not have to be relocated during patching procedures. However, major repair and replacement methods generate dust and other potential hazards, therefore, relocation of the occupants would be necessary during implementation of these techniques.

3.9. Degree of Finish

All Intercepts

In general, surface repair methods are not intended to provide a final finish. The surfaces are unattractive, easily dirtied, difficult to clean and maintain, and susceptible to attack by moisture. Coating with a suitable surface finish (see Matrix VI, Surface Finish Methods for suitable surface treatments) is desirable.

4. Analysis of Cover Up-Unfinished Membrane Material - Matrix III

(See figure IV)

4.1. Definitions

A. Fabric - Heavy duty fabrics, such as canvas or glass cloth which may be attached by means of suitable adhesives. These fabrics can be obtained either unfinished, or coated with a decorative finish.

B. Plaster - A paste-type material composed of gypsum that hardens on drying and can be used for coating walls, ceilings, and partitions. Plaster can be applied in three ways: 1.) to lath directly attached to existing walls; 2.) to lath after existing plaster has been removed;

3.) as a veneer coating over existing wall surfaces without the use of lath. (The first two application procedures are discussed in this section; additional information on these methods is given in the discussion of Matrix II - Surface Repair Methods. The use of veneer plaster as a finish coat for dry wall installations is treated in the analysis of Matrix VI - Surface Finish Methods.)

C. Cementitious Material - A slurry of portland cement plus additives, that may be applied as a veneer coating by brush or trowel. This slurry may be reinforced with fibrous material to improve its physical properties such as tensile strength, impact resistance, etc.

D. Other - Any material applied in paste or film form, reinforced or nonreinforced, that does not contain gypsum or portland cement as a base. Materials of this kind include the many plastic materials that can be applied by spray, brush, roller or trowel.

4.2. Hazard Inaccessibility

Fabric, Cementitious Material, Other - (Walls and Ceilings)

Intercepts: III.(A,C,D).(1,2)

Fabrics and other flexible membrane-type materials are almost always laminated to walls and ceilings with adhesives. These materials should be applied over tight paint only after loose paint and plaster have been removed and large holes patched.

Cementitious material will similarly be applied over tight paint after loose paint and plaster have been removed. Surface preparation to provide good adhesion is essential; bonding agents may be used.

The above cover-up procedures would not be recommended for use in areas within reach of a child since it would be relatively easy for the child to gain access to the hazardous material by tearing or impacting the surface.

In areas above the normal reach of children, the above cover-up methods would be more satisfactory, although there is still a possibility of delamination due to natural causes, e.g., moisture. When the above covering materials are adhered to a paint substrate, delamination of the paint from the walls and ceilings may result in subsequent failure of the covering material.

Plaster - (Walls, Ceilings)

Intercepts: III.B.(1,2)

When plaster is applied on lath, as discussed in the Special Preconditions, Intercepts III.B.(1,2) there would be little potential for recurrence of the leaded paint hazard.

If plaster is used as a veneer over tight paint, the comments written above for cementitious material are applicable. In general, the bond of plaster to paint will not be adequate unless further surface preparation is undertaken.

Fabric - (Woodwork)

Intercept: III.A.3

Fabric cover up of woodwork may be possible in very limited cases, and only as a temporary measure. In areas within reach of a child, where it would be relatively easy to remove the fabric from the woodwork, this type of application is not desirable.

Plaster, Cementitious Material - (Woodwork)

Intercepts: III.(B,C).3

Cover up of woodwork with plaster or cementitious material is possible but not practical. Items that could be covered would be installations such as wainscoting, balustrades or wooden stairwells, subject

to the special supportive preconditions given below. The degree of hazard inaccessibility is dependent on the abuse that the material is subjected to after application. The resistance of these materials to impact forces is rather low and, therefore, they are not considered to be adequate for permanent hazard elimination.

4.3. Special Preconditions

Fabric - (Walls, Ceilings, Woodwork)

Intercepts: II.A.(1,2,3)

The application of fabric-type material requires that all loose material be removed, all imperfections be patched or repaired, and that an adequate bond be realized between the substrate and the fabric. Imperfections in the substrate surface must be held to a minimum since fabric-type materials will "telegraph" the surface condition. Any holes greater than 1/16 in. diameter must be patched. High gloss surfaces must be roughened in order to produce a surface that will bond the fabric to the substrate. The surface roughening can be accomplished by manual sanding or by the use of a liquid surface treatment.

Moisture resistant adhesives should be used in areas subjected to moisture.

Plaster - (Walls, Ceilings)

Intercepts: III.B.(1,2)

The use of plaster systems as a cover up method for walls and ceilings would require the application of wood, expanded metal, or plaster board lath to the walls or ceiling. The function of the lath is to provide a mechanical bond between the plaster and the structural system.

It may be necessary to replace the entire wall or ceiling lath system if it is not sound. This procedure would require removal of all plaster

and lath down to the basic structural members, i.e., studs or ceiling joists. Removal of window and door trim, base boards, and/or wainscoting would also be required since these items are generally applied to the walls on top of the plaster and lath.

Exploratory removal or plaster and lath should be made to determine the ability of the structural members to support the new lath and plaster system. If the structural components are adequate, then a new lath and plaster system can be applied. If the structural components are partially or totally inadequate, they must be replaced or repaired to supply adequate structural support prior to application of the new lath and plaster system.

In some cases, it may be possible to apply metal lath on top of the existing lath system, but the general rule would be to completely remove all existing lath. In certain isolated cases it may also be possible to apply new metal lath directly to existing walls or ceilings without removal of the plaster, however this method would increase the wall thickness and thereby further reduce the amount of floor area in rooms which may already be too small by currently accepted standards.

Plaster - (Woodwork)

Intercept: III.B.3

The cover up of woodwork by plaster would require the application of a bonding medium to the woodwork prior to plastering. This bonding medium may be either expanded metal lath, plaster lath or a bonding agent.

Cementitious Material - (Walls, Ceilings, Woodwork)

Intercept: III.C.(1,2,3)

Supportive preconditions for the application of cementitious materials to walls, ceilings and woodwork require that the surfaces be free of

loose or high gloss material; in addition, woodwork must be firmly attached to structural components. When suitable bonding agents are used, adequate adhesion to the substrate can be obtained.

Other - (Walls, Ceilings, Woodwork, Other)

Intercepts: III.D.(1,2,3,4)

The application of other unfinished membrane materials would require basically the same supportive preconditions as for fabrics or cementitious materials. However, the degree to which the existing systems must be patched may not be as extensive as for fabric, depending on the texture of these materials. The substrate surface must be free of loose material, large voids and/or glossy surfaces so that a satisfactory bond can be realized.

4.4. Installation Health and Safety

Fabric - (Walls, Ceilings, Woodwork, Other)

Intercepts: III.A.(1,2,3,4)

No particular problem exists when installation of fabic material is used as the hazard elimination method. The adhesives used for this application are generally of the harmless wheat paste variety. When other adhesives, having dangerous solvents that are flammable and/or toxic are used, suitable precautions should be taken.

Hazards may be introduced in the preparation of substrates prior to the application of fabrics. Leaded dust may be produced by sanding and hazardous fumes may be generated when liquid type surface conditioners are used to eliminate gloss. In either case, adequate ventilation is necessary and workers should use respirators and goggles. When liquid surface conditioners and/or adhesives containing volatile organic chemicals are

used, care should be exercised. With extensive use, potentially dangerous concentrations of fumes that are toxic and/or explosive may build up. Municipal codes may limit or forbid their use for this reason.

Plaster, Cementitious Material (Walls, Ceilings, Woodwork, Other)

Intercepts: III.(B,C).(1,2,3,4)

The precautions to be taken during application of plaster or cementitious materials are minimal. Care must be taken to avoid contact of wet materials with electrical outlets and switch boxes. These electrical services should be rendered inoperative during the procedures by disengaging the fuse of the circuit involved. In addition to this procedure, masking tape or some other covering material should be used to prevent the entry of wet material into electrical services. When attaching lath with nails to supportive members, care should be exercised to avoid damaging electrical wiring and plumbing. Occupants should not be allowed in the immediate vicinity during completion of any of these procedures.

The normal safety precautions from falling or flaking plaster in deteriorated areas should be observed, i.e, the use of hard hats, safety glasses, and safety shoes.

Other (Walls, Ceilings, Woodwork, Other)

Intercepts: III.D.(1,2,3,4)

Specific instructions for other materials cannot be determined until those materials are designated. The normal precautions taken when preparing leaded surfaces are mandatory. Special precautions that may be required for a specific product should be outlined by the manufacturer. If the manufacturer does not specify particular hazards then an analysis of the system components will probably reveal any necessary precautions which should be observed.

4.5. Ancillary Work

All Intercepts

Ancillary work connected with cover-up methods may involve electrical, plumbing and heat distribution systems. The distribution systems should be performing their intended function satisfactorily at the time that hazard elimination techniques are initiated. If they are not, then a possible code violation exists that should be rectified. Such violations should be recognized as separate problems, not part of the hazard elimination program. However, if it is possible, correction of these code violations should be carried out in conjunction with hazard elimination since it will usually be easier and more economical.

The basic problems encountered depend on what material is used. The relocation of electrical, plumbing and heating fixtures is dependent on the total added thickness to the walls and ceilings, which is a function of the hazard elimination technique.

Electrical

Local codes will outline acceptable procedures for resetting outlets, switches and distribution boxes. When within-the-wall wiring is used, then the outlet boxes may be extended with appropriate adapters, or deep boxes may have to be used. Both of these adaptations are dependent on the amount of available wire within the existing outlet boxes. If there is a sufficient amount of wire available, the problems are minimal. If there is an insufficient length of wire available, then junction boxes must be used to extend new wire to the relocated outlets and switches. Then a surface mounted electrical distribution system is present then the entire system may have to be removed and reattached to the new wall surfaces.

Plumbing

Plumbing problems will occur primarily in bathrooms and kitchens. If at all possible, a hazard elimination method that does not require relocating plumbing fixtures should be used. Sinks, bathtubs and water closets are generally attached to existing walls. In many cases, fixture movement problems can be eliminated by either framing around the fixtures or using thin covering materials that can be cut to fit around the fixtures. If it is necessary to move a sink, then the plumbing work simply requires the use of longer lengths of pipes to the supply and waste drain lines. Water closet relocations are much more difficult, in that the main drain connection establishes the location of the unit. Any relocation would necessarily require moving the waste drain line, which would necessitate tearing up the bathroom floor. The possibility of replacing the existing water closet with one of different design that could utilize the existing waste drain may be the economical solution to the problem. Wall areas around bathtubs can be covered without relocation of fixtures if the covering system is no greater than 1/2 inch thick. Shower fixtures and in-wall valves and faucets can be extended with adapter fittings up to 1/2 inch in most cases.

The problem of deteriorated plumbing systems is ever present and when old systems are disturbed, failures can be expected, thereby resulting in costly repairs.

Heating Systems

The three types of heating systems that may be encountered are fuel burning space heaters, central distribution type heating systems, and electrical units.

The fuel burning space heaters would include coal stoves, oil stoves, and gas stoves. The oil and gas stoves could either be convection heaters or fan driven units, and be free standing, suspended, or built-in wall units. Of the fuel burning systems, only the suspended heaters and built-in wall units must be dealt with when cover-up methods are used. Suspended heater systems may have to be removed during installation of cover up systems but no alterations would be necessary, except possibly to the suspension hangers. Built-in heater units would have to be moved or the trim reset to conform to the established plane of the new wall covering system. Relocation would require adequate framing to structurally support the new location, as well as extension of the piping and exhaust systems.

Central distribution systems can use hot water, steam, or forced hot air. The heat distribution outlets for the hot water and steam will consist of either free standing radiators or baseboard type radiators. The forced hot air systems will use either wall mounted registers or floor mounted registers. In the case of hot water or steam radiators, the relocation can be accomplished with a minimum amount of plumbing; this would consist of lengthening the pipe lines or using offset adapter couplings. In the case of baseboard systems, it may be necessary to relocate the units to conform to the thickness of the added material. This would require additional lengths of pipe and consideration should be given to structural support and attachment. Forced hot air systems would only require short metal extensions to existing duct work to conform to the new wall system.

Electrical heating systems can use either free standing or wall mounted units. The free standing units do not require any relocation

considerations, but the wall mounted heaters would have to be relocated and properly supported structurally to conform to the new wall system. Extension of electrical connections may be required which would conform to extension procedures described under electrical ancillary work.

When working with, or around any fuel dependent heating or electrical heating devices, extreme care should be exercised in order to prevent a fire hazard, i.e., noncombustible materials should be used.

4.6. Waste Disposal

All Intercepts

Hazardous

The leaded material generated in the removal process is quite hazardous. Care should be exercised to collect and package the leaded material to render it inaccessible and it should be disposed of in a manner that would keep it inaccessible.

The hazardous waste should not be disposed of in a manner which could put it into the air, e.g., burning without provision for collection of the leaded ash and elimination of toxic gases. In addition, the hazardous waste should not be disposed of in a way that will permit leaded materials to leach into water systems.

Removal and disposal should be in accordance with local ordinances or by recognized safe procedures if local ordinances do not exist.

Non-hazardous

Non-hazardous waste should be removed with the same care and expediency as hazardous waste. Waste material can provide breeding grounds for vermin. In addition, people, especially children, can injure themselves by coming into physical contact with the waste material.

Immediate removal and disposal should be in accordance with local ordinances.

4.7. Community Involvement

All Intercepts

A minimum amount of training is needed for the application of fabrics or cementitious material. Thus, these methods would be compatible with involvement by community members. Since plaster application techniques require more extensive training there is a lower potential for community involvement. With other more innovative membrane materials the application procedures would most likely be more complex and require quite highly trained personnel.

4.8. User Involvement

All Intercepts

With the application of fabric or cementitious material, relocation of the dwelling occupants depends on the amount of surface preparation necessary. In most cases, keeping the residents out of the immediate work area would be sufficient. Since plaster removal methods may generate dust and other potential hazards, the relocation of occupants would probably be necessary during the implementation phase.

4.9. Degree of Finish

All Intercepts

Some fabric materials may have a surface which could be considered finished and requiring no coating material. Other fabrics as well as the surfaces provided by plaster, cementitious materials, and other membranes are unattractive, easily dirtied, difficult to clean and maintain, and susceptible to attack by moisture. Coating with a suitable

surface finish is desirable (see Matrix VI, Surface Finish Methods for suitable surface treatments).

5. Analysis of Cover Up - Pre-finished Rigid Materials - Matrix V*

(See figure V)

5.1. Definitions

A. Gypsum Board - Gypsum sheet supplied with a factory applied decorative paper or plastic membrane on one surface. Painting normally required for unfinished dry wall is not needed.

B. Plywood Board - Factory supplied wood laminates with a decorative surface of paint, plastic film, paper, or a finished wood veneer. When properly installed, no further surface treatment is required.

C. Hardboard - Factory supplied wood particle composition board with a decorative surface of paint, plastic film or paper. When properly installed, no further surface treatment is required.

D. Metal - Factory predecorated panels of aluminum or steel finished with either paint or a plastic film. Many installations of this material are done on a custom fabrication basis.

E. Reinforced Plastic - Plastic resin panels reinforced with glass fibers usually supplied with a decorative gel-coat finish. The panels may be finished with paint or a plastic film, if desired.

F. Ceiling Board and Tile - These products may be produced from vegetable fibers, mineral wool, glass fibers, metal, plastic, hardboard or similar materials. Porous non-bridging paints and plastic films are generally used as surface finishes. Tile can be

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*Recommended installation procedures, developed by the manufacturers of the various products discussed in this section, should be used.

directly attached to the ceiling. Panels are usually used in combination with proprietary ceiling panel suspension systems.

G. Other - This category includes any of the composite materials that are on the market, e.g., foam core materials sandwiched between plastic films, or similar paper honey-comb core materials.

5.2. Hazard Inaccessibility

Gypsum Board, Plywood, Hardboard, Metal Reinforced Plastic, Other (Walls)

Intercepts: V.(A,B,C,D,E,G)

Under normal usage conditions, pre-finished rigid materials are satisfactory for eliminating the hazard in areas that are covered with them.

When toys, tools, furniture, or other mechanical means are used to destroy the covering material, access can be gained to the leaded paint. Impact resistance, which is a measure of the resistance of a material to puncture, is a function of the thickness and hardness or density of a material. Thus for a particular type of material, a 1/4 inch thick product is more susceptible to damage than one which is 3/8 inch or 1/2 inch thick. Very little information is available about the forces that can be generated by children in the age group under consideration, although this is an important factor. This does not imply that only children will destroy the covering material; it can also be destroyed by others.

Gypsum Board, Plywood Hardboard, Metal, Reinforced Plastic, Ceiling Board and Tile, Other (Ceilings)

Intercepts: V.(A,B,C,D,E,F,G)

Under normal usage conditons, cover-up methods for ceilings, with prefinished rigid materials, would provide the maximum possible inac-

cessibility of hazardous materials. Since the leaded material is still present, however, there is still a very slight potential for recurrence of the problem.

Boards or tiles may be attached directly to the ceiling or ceiling panel suspension systems may be used. The panels in ceiling suspension systems may be removable and consequently the hazard is more potentially accessible than in those systems where rigid materials are fastened directly to the ceiling.

Ceiling cover-up by other than prefinished rigid materials is covered by Matrix III, Cover Up-Unfinished Membrane Material, e.g., plaster and cementitious material, and by Matrix VI, Surface Finish Methods, e.g., paint, wallpaper, and fabric.

Gypsum Board, Plywood, Hardboard, Metal, Reinforced Plastic (Woodwork)

Intercepts: V.(A,B,C,D,E)

When it is possible to use the existing wood trim for attachment purposes, cover-up methods of woodwork using plywood, hardboard, and gypsum board can be applied to window and door trim, baseboards, wainscoting, and in limited cases, stairway balustrades. In most cases windowsills and window sashes cannot be covered by any of these materials. Although plywood and hardboard can be used to cover doors and cabinetry (excluding leading edges), gypsum board is not applicable for these purposes.

Metal is not a very suitable covering material for woodwork and is only practical for use on doors.

Reinforced plastics are not very applicable for covering up woodwork other than doors since it is difficult to attach plastic panels to non-planar surfaces.

Maximum hazard inaccessibility would be provided by metal, plastic, hardboard, gypsum board, and plywood where they can be used; assuming normal usage by the occupants rather than malicious destruction that would allow the hazard to become accessible.

Cover-up of woodwork including windowsills and sashes could be accomplished by using other materials that are applied in the liquid or plastic state and become rigid after curing. These possibilities are described in Matrix III, Cover Up-Unfinished Membrane Materials, e.g., plaster, cementitious material, and other non toxic materials.

5.3. Special Preconditions

Gypsum Board, Plywood, Hardboard, Metal, Reinforced Plastic, Other (Walls)

Intercepts: V.(A.B.C.D.E.G)

a. Gypsum board, plywood and hardboard.

Support requirements for the application of rigid materials are governed by local code requirements or the engineering judgment of the municipal building department officials. Three application methods can be used; direct attachment, attachment to furring, and re-framing attachments. In all three cases the materials to be attached are either mechanically fastened or applied with a combination of adhesives and mechanical fasteners.

For the direct attachment method the existing walls should not be buckled, bulged, or contain large voids. If this condition is met mechanical fastening can be used with no further preparation required. When a combination of adhesives and mechanical fasteners is to be used, the walls must, in addition, be free of dirt, loose plaster and/or loose paint and be adequately prepared for the use of adhesives.

When the above conditions are not met but the structural components are sound, furring can be used to support the surfacing material. It would be advisable to use furring strips in combination with sound and adequately attached baseboards and window and door trim to support the wall covering. Furring strips should be selected so that they provide a surface in the same plane as the existing trim. When the existing trim is not sound and adequately attached, it must be removed and the entire wall surface furred. The surfacing material can then be applied to the furring by the two techniques described above.

When the existing structural components (wall or ceiling assembly) are not sound enough to permit the use of furring, then re-framing is necessary. This method provides a structural framework for the attachment of finish materials. Existing exterior walls, and floor and ceiling joists must be sound enough to permit the attachment of the new structural framework. The surfacing material can then be attached to the reframed walls by either of the two prescribed methods.

b. Metal, Reinforced Plastic and Other

Support requirements for the application of these rigid materials are governed by local code requirements or the engineering judgment of the municipal building department officials. Recommended support systems applicable to the type of panel selected should be installed.

In general, since support systems will be fastened to floor and ceiling joists, these joists must have sufficient structural integrity to permit attachment of the support framework.

When exterior walls, are judged to be inadequate, the structure must be condemned. Inadequate floor or ceiling joists can be repaired or replaced, if this is economically feasible.

Gypsum Board Plywood, Hardboard, Metal, Reinforced Plastic, Ceiling Board and Tile, Other (Ceilings)

Intercepts: V.(A,B,C,D,E,F,G)

Support requirements for ceiling installations are similar to the conditions described for wall installations. The three techniques used are: direct attachment, furred attachment, and the use of suspended ceiling systems.

For direct attachment of gypsum board, plywood, hardboard, or ceiling tile, the existing ceiling surface should not be buckled, bulged or contain large voids when mechanical fastening is to be used. When a combination of adhesives and mechanical fasteners is to be used, the ceiling surface must be free of dirt, loose plaster and/or paint and should be adequate for the use of adhesives.

When engineering judgment concludes that the surface is unsuitable for direct attachment, i.e. the surface is not planar, then a furring system or a suspended system should be used. Ceiling conditions must be structurally adequate for attachment of the system when furred or suspended ceiling panels are used.

Gypsum Board, Plywood, Hardboard, Metal, Reinforced Plastic, (Woodwork)

Intercepts: V.(A,B,C,D,E)

a. Gypsum board, plywood, and hardboard

The use of rigid materials to cover woodwork is not feasible in many cases when the woodwork is not planar. Before implementation it

must be determined that the elements to be covered will be capable of performing their original function after covering. In addition, the woodwork should be firmly attached to the substrate prior to covering.

In the case of gypsum board, window and door trim, baseboards, wainscoting and balustrades would be covered as outlined in Special Preconditions for Walls, Intercepts V.(A,B,D,C,E,G). Plywood and hardboard can be used to cover woodwork and also could be used to cover doors and cabinetry.

b. Metal and Reinforced Plastic

Covering-up of woodwork with metal would be a custom installation for each situation encountered. One practical use of metal would be for covering up of doors. If metal is used, then the requirements would be the same as for the gypsum, plywood, and hardboard, i.e., those elements to be covered must be capable of performing their original function after covering. Reinforced plastic may be used, but is not recommended unless special attachment procedures or techniques are developed.

5.4. Installation Health and Safety

All Intercepts

Cutting sheet materials to size in closed, unventilated areas presents a health hazard to both workers and occupants when fine dust is generated in the process. When it is possible, products should be scored and snapped to avoid the dust that arises in the sawing process. Work should either be done outside the dwelling unit, or the occupants should be removed from the work area. Adequate air flow should be maintained in the cutting area to remove dust. Ideally, dust bags should

be used with power tools. Whenever possible, respirators and safety glasses should be worn. Collection and disposal of dust should be required since this dust may be hazardous.

5.5. Ancillary Work

All Intercepts

Ancillary work connected with cover-up methods using pre-finished rigid materials will involve electrical, plumbing and heat distribution systems. The distribution systems should be performing their intended function satisfactorily when hazard elimination techniques are initiated. If they are not, a code violation exists that should be rectified. Such violations should be recognized as separate problems, not to be treated as part of the hazard elimination program.

The basic problems encountered depend on the material chosen and the method or attachment. When direct attachment or furred attachment procedures are used, relocation of electrical, plumbing and heating fixtures is dependent on the total added thickness to the walls and ceilings. When reframing techniques are used, complete renovation of the distribution systems may be necessary.

(Electrical)

See page 25.

(Plumbing)

See page 26.

(Heating)

See pages 26-28

5.6. Waste Disposal

All Intercepts

See pages 28-29.

5.7. Community Involvement

All Intercepts

It would be very desirable to utilize "self-help" labor for the installation of rigid board products. With proper supervision, a minimal amount of training would be required, and considerable cost savings could be realized. In addition, the skills attained in such a program could provide the basis for better job opportunities for the workers involved.

5.8. User Involvement

All Intercepts

Occupants should be removed from the room in which cover-up work is done to avoid exposing them to potential hazards.

When cutting products to size generates a considerable amount of dust, the cutting operation should be located at a place which does not expose the occupants to dust.

5.9. Degree of Finish

All Intercepts

If properly finished, these materials should be satisfactory for normal usage conditions in housing. They should have adequate appearance, be easy to clean, be resistant to moisture, etc.

For specific recommendations of desirable in-use properties, see sections 5.11, 5.12, and 5.13.

5.10. Time, Implementation Attributes, Total Cost

All Intercepts

These factors will be treated in a separate economic analysis report.

5.11. In Use Performance: Occupant Health and Safety*

All Intercepts

a. Fire Resistance

Building materials used in a dwelling should be capable of containing a fire for a sufficient period of time to permit evacuation of occupants and to allow fire fighters to bring the fire under control.

Materials that have high surface flame spread values, and that produce excessive amounts of smoke or toxic gases on burning should not be used in construction or rehabilitation of housing.

The requirements set by the Federal Housing Administration (FHA) for building material flame spread ratings [1]** should be used as a means for establishing flammability of covering materials. FHA requirements for interior finishes in various locations of a building are summarized in Table 1, Flame Spread Rating Limitations of Interior Finishes.

b. Toxicity

Materials used in hazard elimination should be chosen with a concern for the health and safety of the dwelling occupant.

Care should be exercised to avoid the introduction of toxic substances in the course of eliminating the leaded paint hazard.

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*These performance recommendations are intended for use as guidelines when applicable local code requirements are not available.

**Figures in brackets indicate the literature references at the end of the paper.

Table 1

Flame Spread Rating Limitations of Interior Finishes

Location Within Building (1) (2)	Surface Flame Spread Rating-Maximum Range (3)	Flame Spread Classification (4)
Enclosed Stairways and Other Vertical Openings	0-25	Class A
Corridors or Hallways and Other Exists (5)	0-75	Class A or B
Within Living Unit except for Kitchen Space (6)	0-200	Class A, B or C
Kitchen Space Within Living Unit (7)	0-75	Class A or B
Public Rooms and Entrance Spaces	0-75	Class A or B
Service Rooms, enclosing Heat Producing or Other Mechanical Equipment, and all other fire hazardous areas	0-25	Class A

Notes:

(1) Windows, doors not greater than 25 sq. ft. area, and trim around openings may be excluded in the calculation of flame spread limitations for rooms or other spaces. In no case shall the flame spread of doors exceed the acceptable limits for the room where it is used.

(2) Finished floors and floor coverings are not included in flame spread requirements, however where either a floor or floor covering proposed is considered to be a fire hazard by the FHA, it may be required to meet the rating given in this table for the location in which it is used.

(3) Any finish material shown by test to have a life hazard greater than that indicated by the flame spread classification due to the amount or character of smoke or toxic gases generated, shall be included in the grouping appropriate to the actual hazard as determined by FHA.

(4) Groupings of Flame Spread Ratings

Flame Spread ratings may be grouped into Interior Finish Classes, in accordance with NFPA Standard No. 101, "Life Safety Code", as follows:

a. Class A Interior Finish = Flame Spread, 0-25.

b. Class B Interior Finish = Flame Spread, 25-75.

c. Class C Interior Finish = Flame Spread, 75-200.

(5) Some conditions require materials having flame spread ratings of not greater than 25.

Where required, exit stairways are so located that passage through an interior space such as a lobby, corridor, or other similar space is necessary to reach the exterior, the interior space shall be equipped with an approved automatic sprinkler system, unless the construction of the space (floor, walls, ceiling) is 2-hr. non-combustible with Class A interior finish in Types 1, 2 and 3a; and 1-hr. rating with Class A interior finish in Types 3b and 4 construction.

(6) For twenty-five (25) percent of the combined wall area of any single room within a living unit, except kitchen space, the finish material may have a flame spread rating up to 225.

(7) The flame spread rating of kitchen cabinets and counter tops shall not exceed Class C or 200. (The recommendations for cabinet location given in the FHA Minimum Property Standards, p. 83, should be followed when cabinets are installed near ranges, cooking units, or other sources of heat.)

Finishes which contain toxic compounds as pigments or additives, should be banned if the quantities exceed those permitted in American Standard Association Specifications Z66.1-1964, "To Minimize Hazards to Children from Residual Surface Coating Materials"[2].

c. Anthropometric Fit

All living spaces should contribute to the safety and well being of the occupant.

Ceiling heights, room sizes, lighting, ventilation and the projection of columns, ducts, plumbing and similar items should meet the recommendations made in the FHA Minimum Property Standards[3].

d. Vermin Resistance

Surface elements in a dwelling unit should not be conductive to the harboring or feeding or vermin.

Cracks or holes in, or between, surfaces such as walls, ceilings, woodwork, etc. should be sealed to provide a barrier to the passage of vermin.

In addition, the materials should not be capable of providing sustenance to vermin.

Two tests that can be used to evaluate the vermin resistance of paints, adhesives, etc., are:

1. Standard Method of Test for Susceptibility of Dry Adhesive Films to Attack by Roaches (ASTM Designation D 1382-64)[4], and
2. Standard Method of Test for Susceptibility of Dry Adhesive Films to Attck by Laboratory Rats. (ASTM Designation D 1383-64)[5].

When adhesives, paints, or similar liquid materials are tested, the percent destruction of the uncoated blank should be the same as that for the coated material.

e. Mold Growth Resistance

Mildew is a dark fungus growth that thrives on paint films, wood and other organic substrates in the presence of humid conditions. This growth is difficult to remove and is usually characterized by black spores resembling fly specs or long string-like fibers.

The growth of mold on interior walls and ceilings is usually enhanced by periodic or persistently damp in-door conditions. It can be reduced by providing adequate cross-flow ventilation.

As a health precaution, the finish of interior wall and ceiling surfaces should be resistant to the growth of fungi (mildew) indigenous to the particular geographic region. When materials are tested in accordance with the Federal Test Method for Mildew Resistance [6], there should be no evidence of mold growth.

f. Dirt Collection Resistance

The resistance of a coating to the collection or adherance of dirt is a desirable property to be considered in the selection of finishes. The finish on walls, ceilings, and other surfaces should be resistant to the adherence of dirt.

The primary factors affecting the adhesion of dirt are: 1.) film density, 2.) the chemical nature of components, and 3.) the texture of finish.

5.12. In Use Performance: Durability and Stability*

All Intercepts

a. Structural Integrity

The structural components to be evaluated include foundation walls, floor joists, wall studs, ceiling joists and roof rafters.

The primary judgments concern the integrity of the total structure and whether the components meet the FHA minimum property requirements as to size, spacing and spans [3].

If the dwelling unit does not conform to the FHA Standards then a decision must be made to either make the needed structural repairs or to condemn the dwelling.

When the dwelling unit conforms to the FHA Standards then the interior wall and surfacing materials must be evaluated to determine which available materials or systems would satisfactorily eliminate the hazard, and to identify the optimum solution.

b. Scrape Adhesion

Scrape Adhesion is a measure of the bond between coatings and substrates. It is difficult to precisely define the adhesion of a surface covering material since this property is dependent upon many factors. In addition to being a function of the particular type of covering, the adhesion is also dependent on the degree of penetration into the substrate, the method of application, the type of substrate preparation, subsequent curing of the coated surface, and similar considerations.

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*These performance recommendations are intended for use as guidelines when applicable local code requirements are not available.

The scrape adhesion of coatings may be evaluated using the Federal Test Method for Adhesion of Coatings with Scrape Adhesion Apparatus [8] (ASTM D-2197 Standard Methods of Test for Adhesion of Organic Coatings [9] is equivalent).

The values found in Table 2, Evaluation of Adhesion with Balanced Beam Scrape Adhesion Tester can be used to rate the adhesion properties of materials.

Table 2*
Evaluation of Adhesion with Balanced Beam Scrape Adhesion Tester

Load Applied (Kg)	Rating
0.5-1	Poor
1.5-2.5	Fair
3.0-4.0	Good
4.5-5.0	Very Good
Above 5.0	Excellent

*Gardner Laboratory, Inc., Bethesda, Maryland, Bulletin No. SG-1605, Rev. 10/64.

This method covers the determination of the adhesion of coatings of paint, varnish, lacquer, and related products when applied to flat panel surfaces. It is not applicable for the measurement of the adhesion of sheet materials to a substrate.

c. Impact Resistance

In addition to structural functions, walls and ceilings divide a dwelling unit into habitable spaces. Normal usage of habitable spaces does not subject walls and ceilings to severe impact forces. However, accidental impact and abuse of surfaces do occur and the material used on a wall or ceiling must afford some degree of impact resistance.

A laboratory method suitable for evaluating coated surfaces is described in ASTM D 2794, "Resistance of Organic Coatings to the Effects of Rapid Deformation" [10]. This test procedure which uses test panels, can be modified to include factory finished coating systems on any substrate. When tested in accordance with ASTM D 2794, the impact force resisted by painted gypsum wallboard without complete penetration of the wallboard is 20 inch lbs. This value represents the minimum force that might be reasonably resisted by any finished wall system. The material tested to arrive at this figure was 3/8 in. thick standard wallboard. When materials are tested that demonstrate brittle fracture (cracking beyond the immediate test area), damage must not occur beyond an area bounded by a circle with a radius of 3 inches from the point of impact.

This criteria is a minimum that should be required for wall surfacing materials to be used up to a height of 56 inches which is the nominal height that can be reached by a six year old boy standing on the floor. Since ceiling surfaces would not be subjected to the same abuse as lower wall surfaces the impact criteria for ceilings need not be as severe.

d. Abrasion Resistance

An important property of any finish for a wall covering material is its ability to withstand abrasive forces. Abrasion resistance is a function of surface hardness, coating thickness and cohesion of the coating material. Results of abrasion tests therefore can be interpreted as a measure of the durability of a coating as well as its ability to resist direct abrasive forces. Surface coatings are rarely

subjected to abrasive forces under normal usage conditions but are frequently subjected to abrasion when cleaning procedures are used to remove accumulated dirt.

A practical test method for evaluating the resistance of interior coating materials to abrasion is outlined in the Federal Test Method for Scrub Resistance [11]. An acceptable coating of good durability should be capable of withstanding 1000 cycles of scrubbing.

e. Moisture Resistance

Areas, such as laundry rooms, bathrooms, and kitchens require a high resistance to moisture. Special provisions should be taken to provide wall and ceiling surfaces that are resistant to the frequent exposure to water and condensation and also to the migration of water vapor.

Surface finished should provide the functional attribute of moisture resistance. Where optimum moisture resistance is considered necessary, the finish to be applied to the wall or ceiling should have a maximum moisture vapor transmission of 1.2 perms* at 75°F when tested as outlined in ASTM Designation E 96, Water Vapor Transmission of Materials in Sheet Form [12]. The combination of the specified coating and recommended primer should have a moisture vapor transmission value of less than 1.0 perm.

Typically formulated paints considered appropriate for such a specialized function include:

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*A perm is defined as the water vapor transmission rate of one grain of water vapor per square foot per hour per inch of mercury difference in vapor pressure. (A grain is defined as 0.0648 grams.)

1. Rubber-base paints
2. Epoxy paints
3. Urethanes
4. Glaze coatings
5. Alkyd enamels

f. Vibration Resistance

When external sources of vibration are present near a dwelling unit, consideration should be given to the type of material that is to be used for covering walls and ceilings. When this situation exists, engineering judgment must be relied upon to determine the installation techniques and the materials to be used. Since building vibration problems have not been fully investigated by the engineering profession, design criteria for rehabilitation of dwellings subject to continuous or intermittent vibration have not yet been established.

g. Colorfastness

Paints and other surface finish materials used to protect and decorate wall and/or ceiling surfaces should retain their color for their intended lifetime (a minimum of 3 years in the case of paints and 20 years in the case of more permanent finishes such as those provided on factory finished products such as wood paneling, vinyl covered wallboard and similar products).

After accelerated weathering [13] for 200 hours, the color difference [14] for opaque finishes should not be greater than three units.

For white paint the yellowness index difference [15] after 200 hours of accelerated weathering [13] shall not exceed 1.5 units.

h. Aging Resistance

Field applied coating-type surface finishing materials, such as paint, should have an expected serviceability life of three to five years depending on the usage conditions to which they are subjected. More permanent surface finishing materials, such as factory finished wood paneling or plastic coated panels, should be capable of performing their intended function for fifteen to twenty years without requiring major repair.

Surfaces that are capable of meeting the recommendations for In-Use Performance outlined in this report should give satisfactory service.

Commonly used substrates that may require a final finish include plaster, gypsum board, plywood, hardboard and similar materials. These types of substrates should perform satisfactorily for a minimum of 20 years when subjected to normal usage. Repair procedures should be limited to minor replacement of areas that have been subjected to unusual abuse by occupants or areas that may have been subjected to excessive moisture exposure due to mechanical failure of water supplies or waste removal systems. This aging resistance criteria is based on the supposition that installation procedures as recommended by the manufacturer of a particular material have been followed.

Prefinished wall systems of proven durability, and innovative systems should be subjected to the performance test procedures referred to in this report. Innovative systems should also be subjected to other test procedures that demonstrate their flexural, tensile and structural impact strengths. These properties should compare favorably

wich test results of conventional substrates that are known to perform satisfactorily.

i. Adhesion of Leaded Paint

If the leaded paint is tightly adhered to the surface to which it was applied and there is little likelihood of its becoming a hazard in the future, its removal is not imperative. This could be the case if, in addition to being tightly adhered, it is outside of the reach of children, and in a location where deterioration due to water leaks, moisture, and similar causes is not likely, e.g., bedrooms vis-a-vis kitchens and bathrooms.

When covering materials are to be applied with adhesives directly over lead paint, the paint must be tightly adhered and remain tightly adhered, or the facing will subsequently delaminate.

Paint adhesion can be evaluated by using the cross-cut test method. Two sets of 11 parallel lines, 1/16 inch apart, are cut to intersect at right angles, thus forming a grid of 100 squares, each approximately 1/16 inch by 1/16 inch. Adhesion is measured by determining the sample surface area that is removed when a piece of masking tape is adhered to the test grid and then pulled off the painted surface. The cuts are made just deep enough to go through the paint coating but not into the substrate surface to which it is applied. A razor knife can be used to cut the test grid with the aid of a template. In general, fragments of the coating along the scribe marks and/or where they intersect will be removed rather than discrete squares.

Paint is tightly adhered and does not require removal or covering up if less than 10% of the grid surface is removed in a random dis-

tribution over the entire grid and if less than 5% of the total grid surface area is removed from any single 5 square by 5 square area.

j. Adhesive Durability and Stability*

The adhesives used to laminate covering materials to walls and other surfaces should be chosen carefully to ensure the long term durability and stability of the system.

Durability factors that should be considered include: compatibility with the materials that the adhesive is in contact with, bond strength, deterioration due to aging, and attack by moisture. Certification that an adhesive product meets the following requirements should be required before permitting its use:

1. The compatibility of adhesives, coatings and sealers with materials they come in contact with can be evaluated by following the procedures outlined in ASTM Designation C 590 [16]. There should be no sign of substrate deterioration (corrosion, blistering, cracking, etc.) when tested as specified.
2. Bond strength can be evaluated by means of a static load test similar to that described in section 6.1.3 of ASTM Designation D 1779 [17]. Surfaces that will actually be in contact with the adhesive should be duplicated for this test

*Adhesive test requirements are discussed in detail in this section since comprehensive specification dealing with the requirements for wall covering adhesives could not be found in the literature. Test requirements given for adhesive performance are tentative, and thus subject to to change.

if possible. If both the wall covering material and the substrate to which it is adhered are rigid board type materials, samples of the configuration described in the above method can be used. When the wall covering material is flexible, or semirigid, it should be firmly attached to a rigid substrate with epoxy cement or mechanical fasteners and thus made rigid before testing. If adhesion is to a painted substrate, painted gypsum board would be used for one of the test discs. Adhesive coverage rates should be the same as those which would be used in actual installations.

After preparation and before testing, the test samples should be preconditioned for 7 days at 50±2 percent relative humidity and 23°±2°C (73°±4°F), with no load attached.

Following the preconditioning phase, the test specimens should be suspended with weights added to the lower hood to bring the total load to 0.25* pound per square inch (psi), (including the weight of the lower disk and hook). The adhesive layer is noted within 28 days.

3. Deterioration due to aging can be determined by using the tensile shear test procedure given in Commercial Standard 168-50 [18], which is similar to the one outlined in Federal Test Method Standard No. 175, Method 1033.1-T []9] (also ASTM Designation D 1002 [20]). Specimens shall be prepared

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*Note: With a contact area of 25% of the total surface area, an adhesive having a bond strength of 0.25 psi is recommended for use with a load not to exceed 2 1/4 pounds per square foot. Heavier material can be supported by increasing the contact area of the adhesive used and/or by raising the bond strength of the adhesives used in proportion to the gain in weight.

by bonding, with the adhesive, 2 strips of 1 in. wide by 4 in. long, 3/4 in., 5-ply exterior grade plywood. The two plywood strips shall overlap for an area of 2±0.1 square inches.

After preconditioning for 21 days at 23°±2°C (73°±4°F) and 50±2 percent relative humidity, the samples shall be aged in a circulating-air oven at 65°±2°C (149°±4°F) and a relative humidity of less than 10 percent for 7 days. The specimens shall be conditioned to temperature equilibrium by allowing them to stand at 23°±2°C for 1 hour, and then tested immediately.

The specimens shall be broken in a suitable tensile testing machine at a rate of jaw separation of 2 in. per minute. The specimens shall be held in the grips so that the outer 1.5 in. of each end are in contact with the jaws and so that the long axis of the test specimen shall coincide with the direction of applied force through the center line of the grip assembly. Separate blocks, the thickness of the adherents shall be used in the grips to insure that the adhesive bond is subjected to tensile-shear.

The average tensile-shear value for 10 samples shall be not less than 10 psi.

4. Moisture resistance should be considered if an adhesive is to be used in wet areas. Test specimens should be prepared and preconditioned as described in the aging test. Following preconditioning, the specimens should be immersed in water at

23°±2°C for 24 hours, then conditioned for 48 hours or more at 23°±2°C and 50±2 percent relative humidity. The specimens then should be tested following the procedures outlined in the aging test.

The average tensile-shear value for 10 samples shall not be less than 10 psi.

5.13. In-Use Performance: Acceptability

All Intercepts

a. Washability

The washability of surface finishes reflects the ease of removal of dirt without its original properties being affected. Coatings should be resistant to the retention of soil and the effects of soil removal techniques.

Testing should be performed, as outlined in the Federal Test Method for Washability of Paints [7], with the following modifications:

Semigloss and Gloss - Determine the washability characteristics of the paint in accordance with the washability test and evaluate by comparing with the values given below.

Flats - Determine washability in accordance with the washability test except:

(a) Measure 85° specular gloss according to a gloss test [21]

(b) Recharge the sponge after every 25 cycles until a total of 100 cycles has been run.

When tested as specified above, the soil shall be substantially removed without any exposure of the undercoat. The reflectance of the cleaned area shall not be less than 95 percent of the value

measured on the unsoiled area before test. The 85° gloss shall be not greater than 15 units (flats), the 60° gloss shall not increase more than 125 percent or 2 units, whichever is greater.

Usually, the higher the sheen, the greater the washability and durability. However, this does not mean that flats are not washable. When properly formulated, low gloss high density coatings can be very washable. Coatings that display excellent washability properties permit ease of removal of stains and normal dirt accumulations; changes in appearance are minimized and durability of the film is maintained.

b. Maintainability of the Surface

Surface maintainability is a factor that must be considered when wall and ceiling material selections are made. Ease of repair should be of primary concern in applications where the probability of damage is high. When the frequency of repair is low, more latitude can be used in the selection of surface finish materials. Damage, e.g., localized indentations, that may result from either intentional or accidental abuse should be considered under maintainability. Major damage which would affect the structural integrity of the wall-ceiling system used, would not be considered under surface maintainability.

Materials can be grouped into the following three maintainability classes:

Class I - field painted substrates such as gypsum board, two coat plaster, veneer plaster, plywood and hardboard.

Class II - factory finished gypsum board, plywood, hardboard and fiberglass panels.

Class III - plain and reinforced cementitious coverings, resin base sheet material, spray applied fiberglass reinforced plastics and "other" innovative systems.

Smooth installations of Class I materials would be the easiest and least expensive to repair. Powdered and pre-mixed spackling compounds are readily available and "putty knife" applications of these materials to repair indentations, deep scratches and gouges are easily performed by semi-skilled labor. The repair areas can then be recoated with paint to complete the repair procedure. When textured surfaces of these materials are damaged, the repair procedures are complicated by the desirability to reproduce the surface texture, and may require the services of skilled labor experienced in this kind of repair.

The repair of Class II materials is further complicated (when compared to textured Class I surfaces) by the need to reproduce color and patterns as well as texture on the damaged areas. Filler material must either be premixed to match the existing surface or tinted after filling. The filler material would necessarily vary in composition to be compatible with the surface being repaired. The repair of wood or simulated wood grain or patterned finishes that may be reproduced on sheet overlays would require skilled labor to reproduce.

Class III materials offer essentially the same problems inherent in Class II materials concerning adhesion, color matching and texture. An added disadvantage may be that repair procedures may either require the services of the material manufacturer's representative, or in the case of innovative systems adequate repair procedures may not have been fully developed.

c. Acoustic Properties

Consideration should be given to the acoustic properties of the walls and ceilings of a rehabilitated dwelling unit. The sound transmission class should be at least as high as what it was before rehabilitation. Table 3, Classification of Sound Insulating Properties of Partitions According to Their Average Transmission Loss, can be used as a guide in establishing the transmission loss that should be specified. Sound transmission classes of construction materials can generally be determined by referring to material manufacturers' specifications or industry standards.

The minimum sound transmission class acceptable for intra-dwelling space dividers is 35 db.

d. Color and Reflectance

Color plays an important role in the modern educational, recreational, and residential environment. It contributes to better vision, increased output, morale, safety, and moods of the inhabitants while protecting and decorating the surface.

Although the selection of color is a matter of personal preference, there are certain guidelines that should be followed. Better vision is promoted by selecting colors within the following reflectance range for the designated areas.

Recommended Reflectance Values [22]

Ceiling	65% to 85%
Walls	35% to 65%
Floors	10% to 20%

Table 3*

Classification of Sound Insulating Properties of Partitions According to Their Average Transmission Loss.

Transmission Loss of Wall	Hearing Conditions	Rating
30 db. or less	Normal speech can be understood quite easily and distinctly through the wall.	Poor
30 to 35 db.	Loud speech can be understood fairly well. Normal speech can be heard but not easily understood.	Fair
35 to 40 db.	Loud speech can be heard, but is not easily intelligible. Normal speech can be heard only faintly, if at all.	Good
40 to 45 db.	Loud speech can be faintly heard but not understood. Normal speech is inaudible.	Very good - recommended for dividing walls between apartments.
45 db. or greater	Very loud sounds, such as loud singing, brass musical instruments, or a radio at full volume can be heard only faintly or not at all.	Excellent - recommended for band rooms, music practice rooms, radio and sound studios.

*Diehl, J. R., Manual of Lathing and Plastering, p. 252, Gypsum Association Edition, Noble, New York (1965).

There are many colors that produce particular effects and proper use necessitates consideration of area, natural or artificial light, climate, and intended use. Primary factors in the selection of color should be attractiveness, preference and functional advantages [23].

e. Attachment Capability

Walls and other large vertical surfaces should permit the installation of cabinets, shelves, lighting fixtures, pictures, etc., without requiring costly modifications.

f. Appearance

Appearance of the final finish reflects the expertise of the craftsman as well as the quality of the applied finish.

When paints are used, each coat should be applied at proper consistency and brushed evenly, free of brush marks, sags and runs. The paint should be applied so that overlapping on glass or hardware should be avoided.

The applied organic coating should provide a film sufficiently thick to afford:

1. Functionality
2. Decoration
3. Protection

The film should be uniform in color and gloss.

The above qualities should also be required of other surface finish methods.

6. Analysis of Surface Finish Methods - Matrix VI
(See figure VI)

6.1. Definitions

A. Paint - A liquid mixture of pigments and a vehicle, either organic or aqueous, that dries to form a cohesive and adherent coating when applied to a surface as a thin film. Generally applied by means of a brush, roller or spray gun.

B. Masonry Conditioner - A liquid paint type primer-sealer coating that penetrates into masonry, and affords good resistance to the alkalis present in masonry. Frequently formulated with tung oil or acrylic based vehicles.

C. Liquid Covering - Any of the plastic based liquid paint type coatings available on the market, e.g., epoxy, polyurethane, vinyl. These coverings may be mixtures of more than one component, and are generally more durable than common paint formulations. Special application equipment may be required; manufacturer's recommendations should be followed.

D. Vinyl Sheet - Flexible vinyl material, available in either sheets or rolls, that is usually laminated to walls with adhesives. It can be used to provide both a protective and a decorative finish.

E. Wallpaper - Paper based coverings that can be used as a decorative and protective finish. It is usually applied with water soluble adhesives and is not recommended for use where exposure to moisture is likely.

F. Fabric - Heavy duty woven materials, such as canvas that may be prefinished with a decorative and protective coating, usually plastic based. Fabrics are generally applied with adhesives.

G. Plaster and Cementitious Material - Paste type materials, based on either gypsum or portland cement, that can be applied wet as a veneer to provide a hard surface finish on drying. These materials may be pigmented if desired. They are not recommended for use where exposure to moisture is likely unless an additional protective finish is provided.

H. Other - Any other finish material, applied in paste or film form, reinforced or non-reinforced, that does not contain gypsum or portland cement as a base. Materials of this kind include the many reinforced industrial facings that may be applied with adhesives.

6.2. Hazard Inaccessibility

General

Surface finish methods can serve two purposes in the hazard elimination process:

a. As protective and decorative coatings to prevent the deterioration of unfinished covering materials used to prevent access to leaded paints. This additional finish coating is necessary to prevent attack by environmental conditions which would give rise to the degradation of the barrier material and possible recurrence of the hazard.

b. As protective coatings applied directly over tight leaded paint to protect it from future loosening as a result of exposure to moisture, aging, or other causes of degradation.

Paint, Masonry Conditioner, Liquid Covering, Vinyl Sheet, Wallpaper, Fabric, Plaster and Cementitious Material, Other (Walls, Ceilings)

Intercepts: VI.(A,B,C,D,E,F,G,H).(1,2)

Surface finishes do not serve as the primary barrier against access to leaded paint when they are used in combination with unfinished covering materials. Hazard inaccessibility for these cases is discussed in con-

junction with Matrices III and IV which deal with unfinished membrane and unfinished rigid materials, respectively.

Paint, masonry conditioners, or other liquid coverings can be used to retard the loosening of tightly adhered paint in dry areas beyond the reach of children. Since these protective coatings have limited resistance to the damage caused by children, they are only appropriate for use on ceilings and wall areas beyond a child's reach.

Plaster and cementitious-type materials may be applied as a veneer over a substrate to which paint is tightly adhered. In general, however, since these materials require a porous substrate for good adhesion, their suitability for use over a painted surface is questionable but may be enhanced by the use of surface roughening agents prior to application over such painted surfaces. These veneers do not, in any case, provide a very effective barrier in areas that can be reached by children because they can be easily chipped and damaged.

Other materials that may be used include the various resin bonded fiber composite materials that are currently available, using asbestos or similar fibers as reinforcement. Application methods similar to those for fabrics would probably be used.

Subsequent loosening of the tight leaded paint, to which all of the above coverings would be bonded, could cause the recurrence of exposure to the hazardous materials.

Paint, Masonry Conditioner, Liquid Covering, Vinyl Sheet, Wallpaper, Fabric, Plaster and Cementitious Material, Other - (Woodwork, Other)

Intercepts: VI.(A,B,C,D,E,F,G,H).(3,4)

The effectiveness of surface finish techniques to provide a barrier to leaded paint on woodwork has not been demonstrated. It is generally more practical to remove the leaded paint from the woodwork or other surfames (such as exposed pipes) or totally replace those items.

If surface finish methods are to be used as a barrier, materials such as fabric, vinyl sheet, wallpaper and some "other" products should be chosen, rather than paint-like coatings. When subjected to chewing, impact, or other child related activities those materials are more likely to maintain their integrity than paint or masonry conditioners. However, once the protective film is ruptured, removal of the material by a child and subsequent reexposure to the hazard can result.

6.3. Special Preconditions

Paint, Masonry Conditioner, Liquid Covering - (Walls, Ceilings)

Intercepts: VI.(A,B,C).(1,2)

The use of paint, masonry conditioner, or other liquid coverings for finishing surfaces requires that:

a. The substrate should be solid and rigid, with plaster firmly attached to the lath. All weak areas should be removed and replastered (see figure III, Matrix II, Surface Repair Methods).

b. Any old paint which is not firmly attached to the substrate should be removed.

The satisfactory adhesion of paint, masonry conditioner, and other liquid coverings requires a certain degree of penetration into the existing substrate. Areas that are coated with a high gloss paint, i.e., enamel, should either be primed or roughened so that an adequate bond will result. Surface roughening of high gloss areas can be accom-

plished by hand sanding or by the use of surface conditioners that achieve the same result. In addition, all surfaces should be free of dust, dirt and grease. Areas that have been patched with plaster or spackling compounds should be primed and sealed. If these procedures are not followed, the adhesion of the new paint will be reduced.

Some of the aforementioned coatings are apt to contain strong solvents which may cause softening and/or lifting of the old paint. Preliminary test applications should be made to establish whether the old and new coatings are compatible.

In areas where moisture is frequently present, (bathrooms and kitchens) low permeability coatings should be used. Solvent-thinned alkyd enamels, or 2-component enamels, such as the epoxy or polyester types, are advisable. Since flat latex paint films are generally more permeable to moisture vapor than solvent-thinned paint films, alkyd-base primer-sealers are commonly used.

Vinyl Sheet, Wallpaper, Fabric, Other (Walls, Ceilings)

Intercepts: VI.(D,E,F,H,).(1,2)

All of the Special Preconditions stated for Intercepts VI.(A,B,C).(1,2) are pertinent to the application of vinyl sheet, fabric, and wall paper except that costly paint-type primers are not necessary for use on new plaster, although they may be used. New plaster surfaces can be less expensively primed or "sized" with a dilute adhesive coat that is allowed to dry. A manufactured sizing material may also be applied prior to application of sheet material.

Low permeability, water resistant coverings and moisture resistant laminating adhesives should be used in areas where exposure to moisture is likely to occur.

Plaster and Cementitious Material (Walls, Ceilings)

Intercepts: VI.G.(1,2)

The Special Preconditions stated for Intercepts VI.(A,B,C).(1,2) are applicable for these materials.

Veneer plaster and other cementitious coatings are not generally used as surface finishes in high moisture areas unless protective moisture-resistant coatings are applied.

A porous, absorbent substrate is necessary in order to obtain good adhesion of these materials. Veneer coatings can be used as finish coats on dry wall thus considerably reducing the need for other finish work.

With suitable priming, cement-type materials may be applied over tight paint with some degree of success.

When these materials are intended for use as a final surface finish care must be taken to evenly disperse coloring pigments.

Paint, Masonry Conditioner, Liquid Covering, Vinyl Sheet, Wallpaper, Fabric, Plaster and Cementitious Material, Other - (Woodwork, Other)

Intercepts: VI.(A,B,C,D,E,F,G,H).(3,4)

The surface preparation requirements previously mentioned for walls and ceilings are also applicable to woodwork and other surfaces.

In general, it will be more desirable to either replace woodwork or remove the paint by various methods.

Liquid or cement-type surface covering techniques can be used on almost any surface configuration. Vinyl sheet, wallpaper, and fabric would be most applicable where smooth surface configurations are present, e.g., untextured wainscoting, smooth stairwells, etc.

6.4. Installation Health and Safety

All Intercepts

Volatile organic solvents may be present in paint type liquid covering materials, liquid surface roughgeners, or the adhesives used to apply membrane materials. Since most of these solvents are toxic and/or flammable, adequate ventilation should be provided ot prevent the build up of hazardous solvent fume levels in work areas. Adequate fire protection is essential when these solvents are used.

If sanding is used to roughen surfaces, adequate protection against the fine dust created should be provided.

Respirators may be necessary to protect against dust and/or fumes.

Electrical outlets should be covered to protect them from dust, paints, and adhesives. Since solvents can attack the insulation on electrical wiring, care should be exercised to avoid such damage.

6.5. Ancillary Work

All Intercepts

Any necessary ancillary work should have been performed during implementation of work described by figure III, Matrix II, Surface Repair Methods.

6.6. Waste Disposal

All Intercepts

It is not expected that any hazardous waste would be generated with these methods. Non-hazardous waste should be removed immediately from those areas accessible to people. Waste material can provide breeding grounds for vermin which present a health hazard. In addition people, especially children, can injure themselves by coming into physical contact with the waste material.

Immediate removal and disposal should be carried out in accordance with local ordinances.

6.7. Community Involvement

All Intercepts

Paint, masonry conditioners, and liquid coverings used as finish methods are the easiest to implement in terms of community involvement. Very little instruction is needed and the safety problems are minimal. The application of vinyl sheet, wallpaper, and fabric would require a greater degree of training and more supervision than painting. However, these methods would also be compatible with participation by the community. The application of plaster or cementitious material as a veneer requires greater skill and experience. Training and supervision for the community members would be necessary but these are skills which could be carried over to the job market.

6.8. User Involvement

All Intercepts

With all of these methods, it would be advisable to keep the occupants away from the immediate work area. If fumes or dust are generated, the occupants should be removed, and adequate ventilation provided.

6.9 Degree of Finish

All Intercepts

All of the methods discussed in this section provide a final finish on the surface which has been treated. The texture of the finished surface will depend upon the material used.

For satisfactory in-use performance, the materials should comply with the recommendations referred to in section 6.11.In-Use-Performance.

6.10. Time, Implementation Attributes, and Total Cost

All Intercepts

To be considered in a separate cost analysis report.

6.11. In-Use Performance: Occupant Health and Safety, Durability and Stability, Acceptability

All Intercepts

The comments for the In-Use Performance of surface finishes (Matrix VI) are the same as those given for prefinished rigid materials (Matrix V).

See the analyses given in sections 5.11, 5.12, 5.13.

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Four major classifications of procedures that should be considered when selecting a method for the elimination of the lead paint hazard are analyzed in this report. They are: surface repair methods, surface finish methods, cover up methods with unfinished membrane materials, and cover up methods with pre-finished rigid materials. The attributes associated with each type of method were considered and analyzed in terms of inaccessibility of the leaded paint and implementation considerations. Recommendations are made for the in-use performance properties of surfaces.

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