



Standard Guide for Selection and Use of Liquid Coating Encapsulation Products for Leaded Paint in Buildings¹

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1. Scope

1.1 This guide is intended to provide building users such as commercial and private building owners, contractors, architects, homeowners and regulatory authorities with assistance in selecting an appropriate liquid coating encapsulation product for normal use situations for abating leaded paint. This guide also provides information that can be used to assist in the following: (1) determining whether a painted surface is suitable for encapsulation, (2) applying a liquid coating encapsulation product, (3) evaluating installed liquid coating encapsulation products, and (4) maintaining the encapsulated surface.

1.2 This guide applies to any liquid-applied product that relies primarily on adhesion for attachment to the surface and is designed to reduce human exposure to lead in paint.

1.3 This guide is not intended for use as a training manual. The information contained herein is not all-inclusive and does not provide comprehensive instructions for the selection, application, or maintenance of specific liquid coating encapsulation products. This guide is intended to supplement information supplied by encapsulation product manufacturers and safety requirements established by law. The user of this guide shall refer to the encapsulation product manufacturer's instructions for encapsulation product application and maintenance.

1.4 This guide does not cover minimum material performance requirements for liquid coating encapsulation products. Performance specifications for non-reinforced liquid coating encapsulation products are provided in Specification E 1795. Performance specifications for reinforced liquid coating encapsulation products are provided in Specification E 1797.

1.5 Encapsulation products for use on industrial steel structures are not covered in this guide. Industrial steel structures include, but are not limited to, bridges, water towers, and tanks.

1.6 Limited documentation is available on evaluating the field performance of liquid coating encapsulation products. A conservative approach to assessing the selection and use of liquid coating encapsulation products is thus adopted in this guide. As appropriate, the guidance provided within will be revised as additional knowledge regarding how these products perform over time is gained.

1.7 The user of this guide should follow all applicable state and local regulations regarding the use of encapsulation products.

1.8 The values stated in SI units are to be regarded as the standard. The values given in parentheses are for information only.

1.9 *This standard does not purport to address all of the safety concerns, if any, associated with its use. It is the responsibility of the user of this standard to establish appropriate safety and health practices and determine the applicability of regulatory limitations prior to use.*

2. Referenced Documents

2.1 ASTM Standards:

- D 16 Terminology Relating to Paint, Varnish, Lacquer, and Related Products²
- D 1005 Test Methods for Measurement of Dry-Film Thickness of Organic Coatings Using Micrometers²
- D 1212 Test Methods for Measurement of Wet Film Thickness of Organic Coatings²
- D 3359 Test Methods for Measuring Adhesion by Tape Test²
- D 4214 Test Methods for Evaluating Degree of Chalking of Exterior Paint Films²
- D 5064 Practice for Conducting a Patch Test to Assess Coating Compatibility³
- E 1605 Terminology Relating to Abatement of Hazards from Lead-Based Paint in Buildings and Related Structures⁴
- E 1795 Specification for Non-Reinforced Liquid Coating Encapsulation Products for Paint in Buildings⁴
- E 1797 Specification for Reinforced Liquid Coating Encapsulation Products for Leaded Paint in Buildings⁴

3. Terminology

3.1 *Definitions*—For definitions of terms used in this guide, refer to Terminologies D 16 and E 1605.

3.1.1 *base substrate*—a material upon which films, treatments, adhesives, sealants, membranes, and coatings are applied. The base substrate can also be considered to be the actual material of construction that the surface is attached to. This does not refer to the layers of paint under the outermost or surface layer.

3.1.2 *painted element*—a painted architectural or building component. See 5.2 for examples of painted elements.

3.1.3 *subsurface layers*—layers of material that may exist

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² Annual Book of ASTM Standards, Vol 06.01.

³ Annual Book of ASTM Standards, Vol 06.02.

⁴ Annual Book of ASTM Standards, Vol 04.07.

on a base substrate and which are underneath the outermost layer, or surface, on a base substrate.

3.1.4 *surface*—the outermost layer of material on a base substrate facing the inspector or occupants.

4. Significance and Use

4.1 Encapsulation provides a means of protecting occupants from exposure to lead in paint in buildings that are likely to remain standing for a long period of time. This nondestructive abatement strategy is useful in situations in which the primary structure needs to remain intact for either historical or economic reasons. Encapsulation offers an abatement strategy that may be more cost effective than abatement by removal of the paint.

4.2 There are many environmental and use conditions that affect leaded paint liquid coating encapsulation products, and different types of liquid coating encapsulation products have been developed specifically to meet the requirements of the various conditions. Product types include reinforced and non-reinforced liquid coatings, as well as products for interior or exterior use. These products may be applied over many different surfaces coated with one or more layers of leaded paint and possibly other coatings. Encapsulation products in service are subjected to many kinds of wear. Various colors and finishes are also available. This guide is intended to assist the purchaser in determining which product is most appropriate for the specific conditions under which the product will be used.

4.3 As described in this guide, an encapsulation product must be compatible with the surface to which it is applied. It shall be determined that the encapsulation product not only bonds to the top surface layer, but also does not cause the subsurface layers to separate. Also, the product shall not affect the properties of the leaded paint coated surface adversely.

5. Determining the Suitability of a Painted Element for Encapsulation

5.1 Prior to selecting a liquid coating encapsulation product, the base substrate, subsurface layers, and surface to be encapsulated should be assessed to determine whether they are suitable for encapsulation and to provide information to be used when selecting an encapsulation product type. The assessment should include evaluating both the condition of the base substrate, and the integrity of the existing subsurface layers and determining the surface use conditions, such as the degree of impact, abrasion, or weathering that the surface receives. Records that contain information concerning the location of the surface, the condition of the base substrate and subsurface layers, and whether the surface is suitable for encapsulation should be kept by the homeowner, architect, engineer, or landlord.

5.2 *Building Components*—When assessing surfaces to be encapsulated, all painted elements to be encapsulated should be identified and assessed individually since these components may experience different use and environmental conditions. Different painted elements within a room often have distinct paint histories, which can affect their suitability for encapsulation. Examples of painted elements include walls, doors, door jambs, window sills, window casings, and chair rails.

5.3 *Assessment of Base Substrates*—The base substrate may be composed of wood, metal, plaster, masonry, or other building material(s). The base substrate should be sound and intact, or made so, before application of the liquid coating encapsulation product. Encapsulating a surface that exhibits large-scale, systemic damage to the base substrate may not be effective since the damaged substrate may not have the structural integrity needed to support a liquid coating encapsulation product. The overall condition of the base substrate should be evaluated first for evidence of structural integrity and systemic damage, such as moisture or water damage, that might cause the surface to be ineligible for encapsulation until it is repaired. The source of the systemic damage should be ascertained and repaired before any further assessment continues. Next, the surface should be evaluated for localized damage such as cracks, holes, or other signs of deterioration. Spot repairs to correct localized damage may be necessary in order to provide a surface that can be encapsulated successfully.

5.4 *Assessment of Surface and Subsurface Layers:*

5.4.1 A comprehensive assessment of the condition of the existing surface and subsurface layers should be performed in order to determine whether the painted element can be encapsulated successfully. The condition of the existing surface and subsurface layers should be examined visually for signs of deterioration. The type and extent of the deterioration and whether the areas of deterioration are systemic, random, or localized should be evaluated. The surface should be assessed visually for cleanliness since food, oil, grease, and dirt can affect the adhesion of the encapsulant to the surface. The amount of abrasion that the surface experiences should be evaluated and repairs made to reduce abrasion if necessary. The surface should be examined for signs of chalking. Adhesion tests should be performed to evaluate the cohesive strength of the subsurface layers. The procedures for performing the entire assessment are explained below.

5.4.2 *Types of Surface and Subsurface Layer Deterioration*—The surface should be evaluated for evidence of chipping, flaking, peeling, cracking, checking, blistering, or broken paint. Small, localized areas of deteriorated paint that are not caused by an ongoing, underlying source can be repaired by priming, patching, bridging, smoothing, wet-sanding, or other methods. The painted element to be encapsulated should be evaluated for the amount of abrasion and repeated impact it experiences during use. Painted elements that experience extreme abrasion or repeated impact are generally not suitable for encapsulation. These painted elements include, but are not limited to window headers, stops, mullions, sashes and parting beads, inside door jambs, floors, and stair treads. Painted elements that contain surfaces that rub together, such as drawers or cabinet doors, might also be ineligible for encapsulation. The surface may be eligible for encapsulation if the source of abrasion can be eliminated by such steps as scaling windows or planing doors.

5.4.3 *Extent of Deterioration*—The painted element should be evaluated to determine what portion of it contains deteriorated paint. If relatively small, localized areas of the paint reveal evidence of chipping, flaking, peeling, cracking, or blistering, the deteriorated areas can be primed, wet-

sanded, or otherwise repaired to render an intact surface for encapsulation. If large areas exhibit signs of deterioration, other abatement methods should be considered since extensive surface preparation will be required. Large areas of deterioration can be indicative of underlying, ongoing sources of the deterioration including, but not limited to water leaks, thermal changes, incompatible paints, or excessive paint thicknesses.

5.4.4 Localized, Random, or Systemic Deterioration—The surface should be examined for evidence of persistent, underlying sources of deteriorated existing paint. Sources of deterioration include excessive moisture, sudden or dramatic temperature changes, high humidity conditions, incompatible paints, or excessive paint thicknesses. Areas of random deterioration or areas of deterioration that are widely dispersed over the entire surface can be evidence of an ongoing, underlying problem. The source of the deterioration should be identified and corrected before the encapsulation process begins. Smaller, localized areas of deterioration that have an external source, such as previous wear or abuse, can be repaired by patching, smoothing, bridging, wet-sanding, or other methods after the source has been eliminated.

5.4.5 Assessment of Painted Surfaces for Chalk—An assessment of the amount of chalk on the surface should be conducted in accordance with Test Methods D 4214. This can be accomplished by running one or more gloved fingers on the painted or coated surface. (A contrasting colored glove provides a more visible surface to evaluate for chalking.) Paint residue or chalk visible on the glove is evidence that the paint surface has degraded. This residue is different from household dust. If chalk is visible on the glove, the chalk should be removed or the surface should be treated with a suitable sealant or primer prior to the application of a liquid coating encapsulation product.

5.4.6 Pull-Off Tape Test for Adhesion—An initial tape test should be performed on each painted element to be encapsulated in order to quickly evaluate the adhesion between the layers of the existing paint. A surface is generally not suitable for encapsulation if any material comes off the surface onto the tape. The test results for a particular painted element might vary since the amount of deterioration between paint layers is often not uniform over the entire painted element. To perform the pull-off adhesion tape test, place a piece of pressure-sensitive tape³, 125 to 150 mm (5 to 6 in.) long by 50 mm (2 in.) wide, over the surface to be tested. The surface to be tested should be clean and dry. Press the tape firmly against the surface. Smooth the tape into place, and rub firmly with the eraser end of a pencil. Within 90 s of application, remove the tape smoothly and rapidly, at an angle as close to 180° as possible. Examine the tape. There should be no paint or any other material from the surface being tested on the back of the tape. The surface is generally not suitable for encapsulation, if any material comes off the surface onto the tape.

5.4.7 Assessment of Painted Surfaces for Adhesion—For painted elements passing the initial adhesion test, conduct the "X" cut adhesion test in accordance with Test Methods

D 3359, Method A. The minimum performance rating should be 3A to ensure that the existing paint has adequate adhesive and cohesive strength to support additional stresses caused by the application of an encapsulation product.

5.4.7.1 Causes of Poor Adhesion Test Results—An incompatibility between existing subsurface layers can cause one or more of the layers to pull away from the surface easily. Examples of incompatible existing layers include, but are not limited to the following: a layer of flat latex paint over an improperly prepared, glossy, oil-based enamel paint; a poor-quality paint layer that is not adhering well to the underlying base substrate; and multiple layers of paint that have begun to pull away from the base substrate or other existing subsurface layers. Extremely thick existing paint layers can also result in poor adhesion.

6. Selection of a Liquid Coating Encapsulation Product

6.1 This section provides guidance for selecting a liquid coating encapsulation product after the surfaces to be encapsulated have been assessed for suitability, as directed in Section 5. Encapsulation products have been developed for specific uses and should be used only in those areas recommended by the manufacturer. Contact the manufacturer or refer to product data sheets for information regarding appropriate use situations for the product. It is recommended that patch tests to assess the adhesion of the liquid coating encapsulation product be performed for all candidate products before starting the encapsulation project.

6.2 Primers—Some liquid coating encapsulation product manufacturers require special surface treatment such as the use of special commercial primers not supplied with their standard encapsulation products. Contact the encapsulation product manufacturer or refer to product data sheets for information regarding any specialty primers that should be used with the product.

6.3 Thickness—Extremely thick encapsulation products might obscure architectural details of the surface. Manufacturer's recommendations should be obtained when the product thickness might be of concern. Reinforced products are usually thicker than non-reinforced products.

6.4 Exterior Conditions—Encapsulation products used on exterior surfaces should resist degradation due to weather and local environmental conditions such as ultraviolet light, moisture, variations in temperature, oxidants, mildew, and acidic precipitation. The manufacturer should be consulted for recommendations regarding exterior use of a particular encapsulation product.

6.5 Alkalinity—Excessively alkaline surfaces may cause deterioration of some encapsulation products. If surfaces are alkaline (for example, concrete, fresh plaster, and mortar), an alkaline-resistant product should be chosen. Patch tests should be allowed to remain in place for as long a period of time as possible so that signs of incompatibility can be detected. If the alkalinity causes an encapsulation product to blister and burn during the patch test, the alkaline conditions should be corrected before application, or an additional liquid coating encapsulation product should be tested.

6.6 Surface Imperfections—Some surface imperfections can be hidden by certain encapsulation products. Manufacturer's recommendations regarding the selection and application of a particular product with the intent to hide surface

³ Adhesive tape, such as Permaceel 99 or JM No. 710 tape, has been found suitable for this purpose.

imperfections should be obtained. A reinforced encapsulation product can be used to bridge small cracks in some cases.

6.7 Deterioration—Certain encapsulation products can often span localized areas of deterioration on a surface and may add additional surface support by remaining intact even though the base substrate may otherwise crack or move. Reinforced encapsulation products may be appropriate for these conditions.

6.8 Aesthetic Properties—Factors such as a smooth or textured appearance, flat or glossy finish, the ability to maintain architectural details, and the availability of special colors and the ability to retain color over time may be of concern when selecting an encapsulation product.

6.9 Application Considerations—Several factors regarding application of the encapsulation product can influence product selection. These include, but are not limited to, the degree of skill and amount of time required for installation, the method of application for the product, product's cure time, and any requirements for worker or occupant protection while the product is being applied. These items are discussed further in Section 10.

6.10 Performance History—It is recommended that information concerning the past performance of the encapsulation product be obtained. Sources of this type of information include the manufacturer, consumer publications, and other state or local consumer agencies.

6.11 Product Warranty—The manufacturer should provide a clear understanding of the product warranty and conditions that surround it.

6.12 Repair and Maintenance—The manufacturer should provide instructions on how to monitor, maintain, and clean the encapsulated surface. See Section 12.

6.13 Material Performance Requirements—All liquid coating encapsulation products shall conform to the applicable minimum material performance requirements (for liquid coating encapsulation products) set forth by ASTM. The product selected should provide labeling and documentation stating that it has been tested independently by an accredited laboratory. The laboratory personnel should be qualified through training and experience and should have a working knowledge of the procedures and test methods to be used. The product selected should also meet all relevant local, state, and federal government regulations and ordinances.

6.14 Special Use Situations—While ASTM has established minimum performance values for liquid coating encapsulation products, surfaces experience different use and environmental conditions. No single encapsulation product can service every surface and use situation. The material performance properties of the encapsulation product and the intended use of the surface should be considered when selecting an encapsulation product. In certain use situations, it may be desirable that the encapsulation product perform beyond the ASTM minimum requirements of particular material performance properties.

6.14.1 Flexibility—Encapsulation products that are very flexible may be more likely to resist cracking when the substrate moves due to vibration, sudden or dramatic temperature changes, changes in moisture content, or settling. Encapsulation products that are less flexible can be

suitable for those surfaces that are not likely to receive much movement. If an encapsulation product is selected for wall surfaces, it should be able to receive a nail or screw without cracking or shattering.

6.14.2 Abrasion Resistance—For painted elements such as hand railings, moldings around doors and window openings where abrasive action typically occurs, an encapsulation product that has enhanced abrasion resistance might be more appropriate. Reinforced liquid coating encapsulation products generally provide high levels of abrasion resistance.

6.14.3 Impact Resistance—Painted elements that receive repeated impact require an encapsulation product that has strong impact resistance characteristics. These areas include, but are not limited to, surfaces adjacent to door openings, walls of recreation rooms, and entryways.

6.14.3.1 Impact resistance is generally a function of both the flexibility and tensile strength of the coating. Hard, inflexible liquid coating encapsulation products can be improved by using a reinforcement material as the material's tensile strength, and its ability to hold the coating together under impact provides the needed resistance to maintain the integrity of the surface.

6.14.3.2 Repeated impact can weaken the substrate causing failure of the encapsulation product through either loss of adhesion or structural failure of the base substrate. Coatings with high impact resistance may improve the ability of a weak base substrate material to withstand repeated impact.

6.14.3.3 Different reinforcement materials may offer different degrees of impact resistance. This factor should be considered when selecting the reinforcement material. The effect of the reinforcement material on impact resistance is generally measured by the strength of the reinforcing material alone, and not the cumulative effect of both the coating properties and the reinforcement material.

6.14.4 Chemical Resistance—Encapsulation products that demonstrate strong chemical resistance are appropriate for painted elements that are touched frequently, such as handrails and surfaces around door knobs. Encapsulation products that display strong chemical resistance and scrub resistance should be chosen for areas that receive regular exposure to household chemicals, such as cleaning materials, dirt, grease, and oil. These areas are typically found in kitchens, bathrooms, and recreating rooms.

6.14.5 Water Vapor Transmission—The water vapor transmission of an encapsulation product should be selected based on the amount, type, and duration of moisture the surface to be encapsulated typically receives and the duration of expected moisture movements through the building component and the building. Encapsulation products that display high water vapor permeability should be chosen for surfaces that are likely to become wet or moist, for example, exterior surfaces and bathrooms, when the expected moisture movement is compatible with such a product. Encapsulation products that display low water vapor transmission are generally suitable for most other interior surfaces.

6.14.6 Tensile Properties—The temperature expansion and contraction that the surface is likely to undergo due to temperature changes should be considered when choosing an encapsulation product. In general, coatings, including encapsulants, tend to have a thermal coefficient of expansion

that is greater than the coefficient of expansion for most building materials. Nevertheless, in order to maintain the integrity of the encapsulated surface, an encapsulation product that demonstrates superior performance for tensile properties should be chosen to encapsulate surfaces that are likely to experience significant temperature changes.

6.14.6.1 Since the tensile strength of liquid coating encapsulation products can be increased with the addition of reinforcement material, reinforced encapsulation products may be appropriate in situations in which increased tensile strength is desired. Increased tensile strength is desirable under conditions of substrate movement, (for example, lateral or torsional flex, thermal expansion and contraction, or vibration). Low tensile strength liquid coating encapsulation products such as cementitious products may be improved through the use of reinforcing fabrics or mesh embedded between layers of the encapsulation product system.

6.14.6.2 Tensile strength can affect elasticity, flexibility, and impact resistance negatively. Trade-offs need to be made among these properties when selecting a reinforced encapsulation product for a specific use condition.

6.14.6.3 Different reinforcement materials may offer different degrees of tensile strength. This factor should be considered when selecting the reinforcement material. The effect of the reinforcement material on tensile strength is generally measured by the strength of the reinforcing material alone, and not the cumulative effect of both the coating properties and the reinforcement material.

6.14.7 *Base Substrate Repair*—Base substrate repair can be enhanced through the use of reinforcing materials, especially fabrics embedded within the liquid encapsulation product at the time of application.

6.14.7.1 *Repair*—The repair of cracks, holes, or other minor deterioration of large surfaces, such as plaster walls, can be facilitated by the bridging effect of reinforcement materials. The cohesive attachment of the reinforcement material can redistribute stress over a broader expanse. Reinforced encapsulation products may be considered for use under the following conditions: when the surface or the base substrate exhibits cracks; when the filling or bridging capabilities, or both, of a non-reinforced encapsulation product system are exceeded; when continuous movement of the base substrate exceeds the tensile strength tolerances or elasticity, or both, of a non-reinforced encapsulant; and when continuous movement of base substrate crack(s) would, over time, weaken the coating through repetitive movement at isolated points on the surface.

6.14.7.2 *Cosmetic Repairs*—Cosmetic repairs can be achieved through the application of reinforcement materials. Reinforcement materials are often applied in thicknesses that afford the user an opportunity to smooth an otherwise rough surface without exposing the space or the worker to excessive sanding or disturbance of the area to impart a textured appearance designed to hide surface imperfection. Consideration should be given to reinforced encapsulation products for cosmetic repair under these following conditions: when peeling paint has left several subsurface layers exposed and “feathering” these edges would be considered either too dangerous from the exposure risk associated with sanding or too expensive on a labor cost basis; when the smoothing

effect of a non-woven reinforcing material is desired or the textured appearance of a woven reinforcement material is chosen as the finished appearance.

7. Performance of the Patch Test for Selecting Candidate Products

7.1 *Patch Test for Selecting Liquid Coating Encapsulation Product*—Once an encapsulation product is proposed for use on a particular surface, field patch tests should be conducted before the encapsulation process begins. This is to ensure that the liquid coating encapsulation product will perform under the specific combinations of surface conditions and use situations found throughout the encapsulation project. Multiple patch tests are recommended for surfaces that vary with respect to existing use, surface, and environmental conditions. It may be necessary to test multiple products since no single encapsulation product can generally service every surface and use situation. The results of patch tests should be evaluated thoroughly before selecting an encapsulation product. Surfaces may be retested with the same product if it is determined that the surface was not prepared properly before conducting the patch test. See Practice D 5064 for guidance on conducting patch tests.

7.1.1 *Location of Test Patches*—Patch tests should be performed on each type of painted element found in the entire encapsulation project. Patch tests should be performed on the following surfaces within each painted element:

7.1.1.1 Surfaces that require extensive surface preparation due to peeling, chipping, or flaking paint, water, or weather damage;

7.1.1.2 Areas that experience daily exposure to moisture, dirt, oil, grease, household chemicals, or exposure to extreme environmental conditions, such as variations in temperature, that may affect patch test results;

7.1.1.3 Surfaces that experience extreme use conditions, such as interior and exterior door frames and casings, window sills and casings, baseboards, stairways, hallways, handrails, and chair rails;

7.1.1.4 Surfaces with variations in painting history which can be identified by changes in the appearance of the surface with respect to gloss, color, or texture; and

7.1.1.5 Smooth, glossy surfaces that could prevent some liquid coating encapsulation products from adhering adequately.

7.1.2 *Surface Preparation*—The surface preparation methods used when conducting the patch test should be the same as those that will be used in the actual encapsulation project. The encapsulation product manufacturer should be consulted for specific instructions for surface preparation for each product being tested.

7.1.3 *Cure Time*—Since the cure time of various liquid coating encapsulation products can range from 24 h to a period of months for a complete cure, the manufacturer of each encapsulation product should be consulted to determine a suitable cure time for each product used for patch testing procedures. The patch tests can be done on partially cured patches in some cases. The longer the patch is in place prior to testing, the better the results will be able to predict long-term service.

7.1.4 *Adhesion Testing*—All liquid coating encapsulation products should be tested for adhesion in accordance with

Test Methods D 3359, Method A, when possible. The test may not be possible for some products because of the difficulty in cutting through them with a knife. Use the patch-edge method for these products. The minimum performance rating for Test Methods D 3359, Method A, should be 5A to ensure that the encapsulated system has adequate adhesive and cohesive strength. The size of the patch test area depends on the size and shape of the surface and the type of liquid coating encapsulation product being tested. For normal flat surfaces, a square patch with dimensions of 150 by 150 mm (6 by 6 in.) should be tested. A narrow test patch with the same area should be used for narrow surfaces such as door frames, baseboards, and window casings. Reinforced encapsulation products might be difficult to remove, so it is recommended that a smaller patch, 75 by 75 mm (3 by 3 in.), be used when testing these products.

7.1.5 Patch Edge Method—This test is used to evaluate whether the liquid coating encapsulation product can be peeled away from the surface. The test is performed as follows: make a cut along the edge of the patch through to the base substrate. Probe under the encapsulant at the cut with the point of a knife, attempting to peel or lift the patch from the topcoat or other delaminated layers within the existing paint layers. A small portion of the encapsulation product may be lifted; however, the surface is not suitable for encapsulation if a large portion of the encapsulation product can be easily lifted. If a failure occurs and it is determined that the surface has been prepared properly and the encapsulation product has been applied according to the manufacturer's directions, the encapsulation product is not appropriate for the surface and another product or system should be tested.

7.2 Interpreting the Results of Patch Tests—Several types of failure can occur with patch tests performed as part of liquid coating encapsulation product selection. Below are possible causes of failure and appropriate remedies. Patch tests may fail in some cases due to inadequate surface preparation or other conditions that can be corrected. It may be necessary in these instances to repeat failed patch tests after additional appropriate surface preparation or other steps to remedy the situation have been taken.

7.2.1 Loss of Adhesion Between Subsurface Paint Layers—Loss of adhesion between subsurface paint layers may cause the test to fail. In this situation, insufficient adhesion within the paint layers is the result of a weak bond in the history of the painted surface. This could be caused by inadequate deglossing, poor quality paint, or incompatible coatings. Loss of adhesion could also be caused by moisture. It is likely that the loss of adhesion was caused by moisture if the back of the patch is damp. These surfaces are not appropriate for encapsulation using liquid coating encapsulation products.

7.2.2 Loss of Adhesion Between the Paint and Base Substrate—A failed patch test could be due to loss of adhesion between the existing paint and the base substrate. Evidence of bare substrate and paint adhering to the back of the delaminated portion of the patch indicates that the test failed for this reason. These surfaces are not appropriate for encapsulation using liquid coating encapsulation products.

7.2.3 Loss of Adhesion Due to System Stress—Loss of adhesion can be caused by excessive weight or internal stress

of both the multiple layers of paint and the liquid coating encapsulation product. This excessive weight or stress can cause the paint layers to delaminate from the substrate. These surfaces are not appropriate for encapsulation using liquid coating encapsulation products.

7.2.4 Loss of Adhesion Between the Liquid Coating Encapsulation Product and the Surface—Loss of adhesion between the liquid coating encapsulation product and the surface could be caused by inappropriate preparation and application procedures. Verification that proper preparation and application procedures were followed should be made before concluding that the test failed. Causes for this type of failure include the following situations:

7.2.4.1 The liquid coating encapsulation product being tested was applied to a glossy surface without proper deglossing prior to application. The manufacturer's instructions for deglossing surfaces prior to product application should be followed.

7.2.4.2 An inadequate curing time was allowed for the liquid coating encapsulation product being tested. The encapsulation product should be allowed to cure according to the manufacturer's recommendations prior to testing.

7.2.4.3 The liquid coating encapsulation product being tested was applied to a dirty or greasy surface. The surface should be cleaned adequately before testing.

7.2.4.4 The liquid coating encapsulation product being tested was applied too heavily, causing additional internal stress to the system. The manufacturer's recommendations for appropriate product application thickness should be followed.

8. Pre-Job Activities

8.1 Removal of Occupants as Required—Some liquid coating encapsulation products can produce unfavorable odors or vapors that make it necessary to relocate occupants during the application or cure time of an encapsulation product, or both. The manufacturer's instructions should be consulted to determine whether occupants may be present in the area that is being encapsulated.

8.2 Coordination of Other Construction Activities—Dust and debris can contaminate an applied liquid coating encapsulation product before it is fully cured. Phases of the encapsulation project should be scheduled so that all dust and debris are cleaned thoroughly prior to encapsulation. After the encapsulation product has been applied, other construction activities should be restricted in the area to avoid contamination.

9. Surface Preparation

9.1 Examination of Conditions—Surfaces to be encapsulated should be sound and thoroughly dry before the liquid coating encapsulation product is applied. Application should not begin until all unsatisfactory conditions have been corrected.

9.2 Unsound Surfaces—Any patching or construction work to correct unsound surfaces in the area to be encapsulated, including work to repair sources of the damage, should be completed before the application of a liquid coating encapsulation product.

9.3 New Surfaces—Manufacturer's recommendations should be followed for liquid coating encapsulation product

selection and application for new or unpainted surfaces that are replacement components of the area to be encapsulated.

9.4 Improper Surface Conditions—Liquid coating encapsulation products should not be applied over dirt, dust, rust, scale, grease, moisture, mildew, or any other conditions that are detrimental to the formation of a durable encapsulated surface. These conditions should be corrected before application of the encapsulation product.

9.5 Porous Unprimed Surfaces—Tops, bottoms, and cut-outs of unprimed wood surfaces, such as doors, should be sealed with a coat of varnish or sealer prior to installation.

9.6 Removal of Hardware—Hardware and hardware accessories, such as lighting fixtures and plates that are not to be encapsulated should be removed in order to coat behind the hardware and on adjacent surfaces completely. Adequate protection should be provided if hardware cannot be removed. Hardware and fixtures should be reinstalled only after the encapsulation product has cured completely.

9.7 Cleaning—Surfaces to be encapsulated should be cleaned and prepared according to the manufacturer's instructions for particular substrate conditions. All dirt, oil, grease, or any other substance that could impair the bond of the liquid coating encapsulation product to the surface should be cleaned thoroughly prior to application of the product. An appropriate cleaning solution recommended by the manufacturer should be used. The cleaned area should be rinsed with water to remove any residue that might interfere with adhesion of the encapsulation product and allowed to dry thoroughly.

9.8 Deglossing:

9.8.1 Deglossing Process (Liquid)—For proper liquid coating encapsulation product adhesion, some deglossing might be necessary to provide a suitable surface for encapsulation. Deglossing can be accomplished by several methods. A strong cleaning solution will degloss most painted surfaces. A liquid sanding and deglossing agent can also be used to degloss surfaces. The manufacturer's instructions for proper use and safety precautions should be referred to when using liquid deglossing products.

9.8.2 Deglossing Process (Mechanical)—For extremely glossy and hard painted surfaces, wet sanding may be required to provide an acceptable surface for encapsulation. The area should be rinsed with clean water and allowed to dry thoroughly after deglossing is completed. The manufacturer's instructions for proper use and safety precautions should be referred to when using mechanical deglossing products.

9.9 Chalk and Efflorescence Removal—Chalk or efflorescence (crystallized salt) present on a surface should be removed prior to encapsulation. Chalk or efflorescence should be removed by scrubbing with a strong cleaning solution. The area should be rinsed and allowed to dry thoroughly after removing chalk or efflorescence.

9.10 Mildew Removal—Mildew spores should be killed before the application of a liquid coating encapsulation product. One method is to clean the surface with a solution of one part household bleach (sodium hypochlorite) to four parts water, applied with a sponge. Use gloves and eye protection. Adequate ventilation should be provided. The color of the mildew should change. After it is dry, the surface should be rinsed with clean water and then dried thoroughly.

The manufacturer's instructions should be followed if other mildewcides are used.

9.11 Safety and Disposal Precautions—Surface preparation and cleaning can produce harmful leaded dust and other contaminants. Protective clothing and protective equipment should be used for all surface preparation and cleaning procedures. Contaminated materials should be disposed of in accordance with state and local guidelines.

10. Application of Liquid Coating Encapsulation Products

10.1 Painted Elements—In general, liquid coating encapsulation products should usually be applied to the entire painted element being encapsulated in order to maintain the integrity of the encapsulated system.

10.2 Encapsulation Product Installers—Encapsulation products should be applied by persons instructed in their application in accordance with the manufacturer's instructions.

10.3 Worker Safety—All product labeling, data sheets, and specifications should be followed. The applicator should obtain, review and retain safety information provided by the manufacturer including, but not limited to, cautionary and warning labeling, instruction booklets, product literature, and material safety data sheets (MSDSs). The area in which the encapsulation product is being applied should be well ventilated. When applied, liquid coating encapsulation products may expose workers or occupants to dangerous solvents, unpleasant odors, curing agents, or other chemicals, either by inhalation or skin contact. Appropriate precautions should be taken when using these products.

10.4 Local Codes—The person applying the encapsulation product should comply with all local codes regarding the general use of coatings.

10.5 Delivery, Storage, and Handling—Liquid coating encapsulation product components, thinners, and cleaners should be delivered in their original, unopened containers bearing the manufacturer's labels. The manufacturer's instructions for proper storage and handling should be followed. Storage of materials both on and off the job site should be in the original containers with original labeling intact on the container. Liquid coating encapsulation product materials should be stored at the temperature recommended by the manufacturer.

10.6 Personal Protective Equipment—Certain techniques used when performing surface preparation and applying liquid coating encapsulation products, such as spray application, can create overspray and dusting. Personal protective equipment such as safety glasses, protective clothing, approved NIOSH or MSHA respirators, and hearing protection should be used. The manufacturer's specific instructions for personal protection and safety should be followed.

10.7 Masking Procedures—Appropriate masking materials should be used to protect areas adjacent to the job site. Masking materials such as drop cloths, masking paper, poly film, and masking tape should be used. Loose edges of masking materials should be secured to prevent "fly away" when using spray application techniques.

10.8 Job Conditions—Temperature of the air and substrate should be within the temperature range recommended by the manufacturer. The temperature of the substrate should be above the dew point. There should be no sweating

on the surface to be encapsulated. The surface should be clean and dry. Section 5 of this guide provides a detailed description of appropriate surface conditions.

10.9 *Spray Application*—The manufacturer's instructions for spray application procedures should be followed. The manufacturer's recommendations for pressure settings, distance from surface and spray gun movements and techniques should be followed. Any special techniques, such as overlapping spray gun passes or cross hatching of material, should be followed. Proper amounts of the liquid coating encapsulation product should be applied according to the manufacturer's recommended square foot coverage per gallon and proper mil thickness. See 11.3. Some liquid coating encapsulation products require that the entire work area be isolated during their application.

10.10 *Manual Application*—The manufacturer's instructions for manual application of specific liquid coating encapsulation products should be followed. Manual application tools, such as brushes, rollers, or trowels, should be in good condition when applying encapsulation products. Tools should be cleaned at the end of each use. Proper amounts of the encapsulation product should be applied according to the manufacturer's recommended square foot coverage per gallon and mil thickness. See 11.3.

10.11 *Primers:*

10.11.1 *Selection of Primers*—Some liquid coating encapsulation products require the use of special commercial primers not supplied with the standard encapsulation products. Contact the encapsulation product manufacturer or refer to product data sheets for information regarding any special primers that should be used with the product. It is important to choose a primer that is consistent with the product being used.

10.12 *Encapsulation Product Shelf Life*—Liquid coating encapsulation products should not be used beyond their recommended shelf life.

10.13 *Mixing of Materials*—If product mixing is necessary, encapsulation product manufacturer's recommendations for mixing procedures and pot life should be followed to ensure that the products cure and perform properly.

10.14 *Thinning of Materials*—Thinners, including water, should not be used unless recommended by the manufacturer. Only thinners recommended by the manufacturer should be used.

10.15 *Dry Times*—Atmospheric conditions affect the dry time of liquid coating encapsulation products. Encapsulation products yield maximum performance when fully cured. The dry time and cure time are not the same. Consult the manufacturer's instructions for the dry time and cure time. Many products are cured in the first few days; however, other products can take more than several weeks to be fully cured. The manufacturer's instructions should be consulted to determine the appropriate re-coat and dry time for an encapsulation product.

10.16 *Removal and Disposal of Masking Materials*—Masking materials should be removed as soon as possible after application of the liquid coating encapsulation product to prevent them from becoming permanently attached to the encapsulation product. Masking materials should be removed according to the encapsulation product manufacturer's instructions. Materials should be disposed of in accor-

dance with state and local guidelines.

10.17 *Cleanup*—The job site should be cleaned of any overspray and spills of liquid coating encapsulation products, protective cloths, and other materials used during application.

10.18 *Storage and Disposal of Excess Materials*—Materials such as encapsulation product components, primers, and cleaning products should be stored in an appropriate area in containers labeled by the manufacturer. The manufacturer's recommendation for storage conditions and shelf life of encapsulation products should be followed. State and local regulations should be followed when disposing of unused encapsulation products.

11. Techniques for Evaluating the Application of Liquid Coating Encapsulation Products

11.1 *General*—Proper application of liquid coating encapsulation products depends on many variables. The application process should be monitored and a final inspection should be conducted to ensure proper installation of encapsulation products.

11.2 *Visual Inspection*—The adequacy of application of a liquid coating encapsulation product should be assessed by inspecting the encapsulated surface and verifying the following conditions.

11.2.1 *Uniform Application*—The texture, thickness of coverage and gloss or sheen of the surface should be uniform across the surface of the encapsulant. Areas adjoining flat surfaces, such as edges, door frames, and window wrap around areas should display a uniform appearance with no blisters, blemishes, or holidays.

11.2.2 *Dryness*—The encapsulated surface should be completely dry and not sticky or tacky.

11.2.3 *Absence of Imperfections*—No blisters, blemishes, or holidays should be apparent.

11.3 *Coverage*—Film thickness (in mils) can be measured using a wet film (mil) gage. Test Method D 1212 contains information on measuring the wet film thickness. Test Method D 1005 contains information on measuring the dry film thickness. Film thickness is sometimes stated as a coverage rate per gallon of material. In this case, the film thickness of the applied product can be calculated by measuring the amount of product used per measured surface area; however, caution should be exercised when using this technique since factors such as irregular surfaces or porous surfaces may cause more encapsulant to be used. Film thicknesses in excess of the manufacturer's recommended film thickness can cause sagging or running.

12. Maintenance

12.1 *General*—Since encapsulation products do not remove lead from leaded paint surfaces, it is recommended that the condition of the encapsulation product be monitored on an ongoing basis. If damaged or worn, the product should be repaired properly in order to prevent the risk of lead exposure. After an encapsulation product is in place, owners and residents should know which surfaces are encapsulated, any specific limitations of the encapsulation product used, and how to avoid damage to the encapsulation product.

12.2 *Periodic Inspections*—It is recommended that peri-

odic inspections be performed with more frequent inspections initially after the product has been applied. More frequent inspections should be conducted if an encapsulated surface has been damaged or shows signs of excessive wear.

12.3 *Documentation and Record Keeping*—Records of the application and maintenance schedule of the encapsulated areas should be maintained. For each encapsulated area, the documentation should include the following:

12.3.1 The specific area encapsulated and identification of the encapsulation product used. Floor plans are often useful for recording the location of encapsulated areas.

12.3.2 The manufacturer's instructions for maintenance and repair of the encapsulation product used and a copy of the MSDS.

12.3.3 Any regulatory requirements that covered the encapsulation product when it was applied.

12.3.4 Records of each inspection of the encapsulated area, including the date of the inspection, the name of the person performing the inspection, and the condition of the encapsulation product, including signs of wear or deterioration, results of any tests performed, and any failures.

12.3.5 Any other important information regarding the encapsulated area.

13. Keywords

13.1 abatement; encapsulant; encapsulation; lead; leaded paint; liquid coating encapsulation products; non-reinforced liquid coating encapsulation product; reinforced liquid coating encapsulation product

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