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GUIDELINES

FOR THE USE OF ENCAPSULANTS

ON ASBESTOS-CONTAINING MATERIALS

Office of Toxic Substances,
United States Environmental Protection Agency

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NOTE

Mention of any product or company names does not constitute recommendation or endorsement by EPA or by any of its contractors.

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INTRODUCTION

As part of its program to address the problems caused by friable asbestos-containing materials in buildings, the Environmental Protection Agency has written these Guidelines for the Use of Encapsulants on Asbestos-Containing Materials. The practice of applying an encapsulant to asbestos-containing materials in buildings in order to prevent or reduce the release of asbestos fibers is called encapsulation.

The first chapter of this document discusses the advantages and disadvantages of encapsulation. It is written primarily for building owners and school administrators who have identified asbestos problems, and is intended to help them decide whether encapsulation is appropriate in their buildings.

The rest of the document discusses the points to consider when choosing an encapsulant and the techniques to use when applying it. This information should be useful to contractors who are performing encapsulation jobs, as well as to building owners and school administrators who are preparing contract documents for encapsulation work or are monitoring work in progress.

The entire document should be used in conjunction with another EPA publication entitled Asbestos-Containing Materials in School Buildings: A Guidance Document. EPA strongly advises that anyone concerned with asbestos problems in buildings consult Asbestos-Containing Materials in School Buildings: A Guidance Document, which discusses in detail the advantages and disadvantages of various ways to prevent or reduce exposure to asbestos.

Another EPA document, Guidelines for Removal of Friable Asbestos-Containing Material, discusses in detail proper work practices and worker protection procedures which apply to removal and

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encapsulation jobs. To obtain copies of Asbestos-Containing Materials in School Buildings: A Guidance Document or Guidelines for Removal of Friable Asbestos-Containing Material, call toll free 800-424-9065 (in Washington, DC, 554-1404).

Persons interested in identifying a specific encapsulant should contact the EPA's Regional Asbestos Coordinators, listed in Appendix A to this document (page 36). The Asbestos Coordinators can provide information on commercially available encapsulants, answer questions, offer individual guidance, and discuss recent developments with regard to asbestos in buildings. Any contractor, school administrator, or building owner is encouraged to call the Asbestos Coordinator for his or her Region.

This guidance document was prepared by the Chemical Control Division of EPA's Office of Toxic Substances with the help of Mr. William Mirick of Battelle Columbus Laboratories. A number of EPA and outside experts have reviewed earlier drafts of the document, and their comments are reflected in this final version.

This document should not be confused with the reports on encapsulants prepared by Battelle Columbus Laboratories: their purpose is to evaluate specific commercially available products, while this document is intended to provide general guidance on when and how to encapsulate asbestos-containing material.

The guidelines in this document for deciding whether encapsulation is advisable and for determining what encapsulant to use are based on the best technology presently available, but adherence to the guidelines will not necessarily insure that the proper decisions will be made. Similarly, although the

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guidelines for application of encapsulants in Chapter Five are based on the best currently available technology, and are designed to reduce building contamination and exposure of workers to asbestos, adherence to them will not necessarily guarantee a risk-free procedure for asbestos encapsulation.

CHAPTER ONE:

ADVANTAGES AND DISADVANTAGES OF THE USE OF ENCAPSULANTS

Encapsulation can solve some asbestos exposure problems easily and adequately. In other situations, however, encapsulation is definitely not advisable, and attempts to use encapsulants in these situations may lead to greater exposure problems than would have occurred if nothing had been done.

Encapsulation is often advisable in situations where the asbestos-containing material is virtually impossible to remove. For example, asbestos was often spray-applied to extremely complex surfaces, such as pipe and duct work or ceilings with numerous surface irregularities. Since it would be very difficult to remove asbestos from such complex surfaces, encapsulation may be a good solution. The use of encapsulants is often also advisable on denser, harder materials (called "trowelled-on" or "cementitious") which contain asbestos. Although cementitious materials typically do not present exposure problems as severe as those caused by fluffy or spongy asbestos-containing materials, it may be advisable to encapsulate them as a precaution against future deterioration and damage.

However, encapsulation is not always advisable even in these situations. Often it is not as easy and inexpensive as it may appear at first. Further, using an encapsulant on asbestos-containing fireproofing material may affect the material's fireproofing ability, causing problems with the building's fire rating and fire insurance. Encapsulating asbestos-containing material may also make it difficult to remove the material later in compliance with EPA regulations (see below, pages 5-6).

Aside from these general problems, encapsulation has a number of specific limitations as well; because of these limitations, it is rarely a suitable approach to asbestos exposure problems if the problems are severe. If asbestos-containing material has poor cohesive strength, or has been damaged by water, or is not firmly attached to the underlying surface, or is accessible to the users of the building, then encapsulation is not a suitable approach.

Encapsulation is also not advisable on friable materials. Friable materials have poor cohesive strength; they can be pulled apart easily with the hands, or crushed or reduced to powder by hand pressure.* Fluffy, spongy asbestos-containing materials are often highly friable; if they are, they should not be encapsulated (see below, page 6).

Given all these variables, the performance of an encapsulant on a particular piece of asbestos-containing material is unpredictable. The problem is complicated by the fact that a given encapsulant may perform very differently when applied to two different types of material. It may perform extremely well on one material and fail completely on another. For this reason, EPA strongly recommends that any encapsulant be tested in the field on the actual material before a final decision to use it is made (see Chapter Five, page 30).

The remainder of this chapter discusses some of the advantages and disadvantages of the use of encapsulants. Each of these should be considered carefully before any decision is made to encapsulate.

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* See Asbestos-Containing Materials in School Buildings: A Guidance Document, Part 1, pages 3 and 13, for a more detailed discussion of friability.

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Advantages of Encapsulation

1. Encapsulation can control asbestos exposure problems without necessitating the removal of the asbestos-containing material.

Encapsulation may be a practical means of preventing the release of asbestos fibers into the air and reducing the building users' exposure to asbestos. Since it should make the removal of the asbestos-containing material unnecessary, encapsulation retains most of the advantages of having the material in the building. Encapsulation avoids the expense and additional time required to replace the asbestos-containing material, which is often necessary after removal jobs.

2. Encapsulation is usually the quickest method of control.

Encapsulation is a considerably less complicated task than removal or the construction of barrier systems. Removal, in particular, is likely to be a more involved and time-consuming process, especially since the asbestos-containing material must often be replaced with a similar, but asbestos-free, product (fiber glass or cellulose, for example).

However, this difference in time requirements is not as great as it may appear at first glance, since certain measures to protect the workers and to prevent contamination of the outside air are necessary during any corrective action (removal, enclosure, or encapsulation). These measures add to the time required for any of these techniques.*

3. Encapsulation is usually the least expensive control method in the short run.

Since encapsulation is a simpler process than removal, it is usually less expensive. Prices for any sort of asbestos control vary widely, depending on local wage rates, the type and location of the surface area, and the materials which are used.

One should bear in mind that the real cost of any asbestos control technique is likely to be greater than it first appears, because factors other than the basic cost of the job must be included. For example, the costs of periodic inspection for damage and aging should be included in an economic analysis of encapsulation. The long-term costs of using encapsulants may also include periodic recoating, a consideration which may make encapsulation much more expensive than it looks at first.

4. Encapsulation is often a good control method for cementitious asbestos-containing material.

Cementitious materials are usually composed of asbestos and other materials (e.g., vermiculite and perlite), mixed with cement. They are dense and usually fairly hard, and have a coarse, textured appearance. Although they can be damaged by hand, they are not fluffy or spongy. They are less than 3/4 inch thick

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* The protective measures are discussed in Chapter Five of this document, in Asbestos-Containing Materials in School Buildings: A Guidance Document, and in Guidelines for Removal of Friable Asbestos-Containing Material.

(usually 1/8 inch to 1/2 inch) and usually contain less than 15% asbestos. Cementitious materials can deteriorate with age and can be friable, but in general they do not present exposure problems as severe as those caused by fluffier materials because their asbestos content and friability tend to be lower.

For cementitious materials in good condition, encapsulation is often a good solution because it can help to control future release of fibers easily and inexpensively. However, if cementitious material is water damaged or accessible to the building's users, or if it is not firmly adhering to the substrate, it should not be encapsulated (see below).

Disadvantages of Encapsulation

1. The asbestos source remains in the building.

Encapsulation controls the release of fibers from asbestos-containing material, but it does not provide a lasting solution since the asbestos remains in the building. For this reason, the encapsulated material must be checked periodically to ensure that the encapsulant coat has not been damaged. Whenever the building is renovated, or whenever repair work is conducted near the material, the workers must be careful not to damage the sealed asbestos-containing material. It also appears that encapsulants, once applied, will deteriorate over time, and that the need for recoating will recur periodically throughout the life of the building.

2. Encapsulated material may be difficult to remove in compliance with EPA regulations.

When the building is eventually demolished, or when the asbestos-containing material has to be removed, another serious problem may occur. Under EPA regulations, before any building containing friable asbestos-containing material is demolished or before any friable asbestos-containing material is removed from a building, the material must be wetted down (to prevent the release of asbestos fibers into the environment), removed separately, and buried.

Since encapsulants generally form a water-tight barrier, their use makes subsequent wetting of the asbestos-containing material difficult at best. Encapsulation may therefore make it difficult to comply with EPA regulations during later removal or demolition projects.

3. Encapsulation is not suitable for asbestos-containing material which has poor cohesive or adhesive strength.

Encapsulation should not be considered on any asbestos-containing material with poor cohesive strength. Some material with poor cohesive strength is friable, that is, it can be crushed or reduced to powder in the hand. Even if material is not friable, it may have poor cohesive strength: an example is material which is separating from itself in layers. If materials with poor cohesive strength are encapsulated, the weight of the encapsulant may cause them to deteriorate or delaminate even faster.

Similarly, encapsulants should not be applied to asbestos-containing material which has poor adhesive bonding to the substrate. The substrate is the underlying surface (for example, concrete or structural steel) to which the asbestos-containing material has been applied. If an encapsulant is applied to materials with poor ashesion to the substrate, the additional weight of the encapsulant may cause the material to separate completely from the substrate and fall.

A simple test which has been used widely to determine whether asbestos-containing material has sufficient cohesive and adhesive strength to sustain the weight of an encapsulant is described in Appendix B (page 37).

4. Encapsulation is not suitable for water damaged materials.

In any case where the asbestos-containing material has been damaged by water from roof or plumbing leaks, or where such damage might occur, encapsulants should not be used. Water leaking through asbestos-containing material will dissolve some of the binders that hold it together and to the substrate. This means that water damaged materials tend to have poor adhesive and cohesive strength, and encapsulants are not appropriate for such materials.

In addition, if areas subject to water damage are encapsulated, water may be trapped in the material behind the encapsulant, dissolving still more of the binding agent. Eventually the combined weight of the encapsulant and the trapped water may cause the asbestos-containing material to fall, taking the encapsulant
layer with it and releasing asbestos fibers into the surrounding air.

If the source of the water damage is repaired and the damaged material is selectively removed and replaced, encapsulation may be considered if the other conditions outlined in this chapter are met.

5. Encapsulation is not suitable for materials which are accessible to the users of the building.

Encapsulants are designed to withstand some impact and abrasion. However, EPA knows of no encapsulant which can withstand repeated impact, and if encapsulated material is damaged by accident or vandalism asbestos fibers may be released. This problem is one of the major limitations of the usefulness of encapsulants.

Because of this limitation, encapsulation should not be considered on asbestos-containing materials which are accessible to, or routinely disturbed by, the building's users. Surfaces which are less than about ten feet from the floor or are routinely disturbed during maintenance, as well as surfaces such as the ceilings of gymnasiums (which can be damaged by balls and other objects), should not be encapsulated.

6. Encapsulation is not advisable for asbestos-containing materials more than one inch thick.

Encapsulation also should not be considered on asbestos-containing materials which are more than an inch thick. Tests have indicated that even the best penetrating encapsulants, which are designed to saturate asbestos-containing material and bind it together and to the substrate, cannot completely penetrate material which is more than one inch thick.* Users of encapsulants should not expect penetration of greater than one inch; therefore, encapsulants cannot be expected to improve the adhesion of a thicker material to the underlying surface. The weight added to the material by any bridging or penetrating encapsulant may cause a failure of the material's cohesive or adhesive strength. The exception to this rule is asbestos-

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* The tests are described in Evaluation of Sealants for Sprayed-On Asbestos-Containing Materials in Buildings (see Introduction).

containing material insulation material on pipes and ducts, which may be suitable for encapsulation even if it is more than one inch thick.

7. Encapsulation is not advisable in buildings and rooms which are subject to vibration.

Vibration appears to possess the ability to shake spray-applied asbestos-containing material from the substrate even if the material has been encapsulated. In buildings and rooms which are subject to high vibration, encapsulation is not recommended. This problem is most serious in airports, in buildings near heavily travelled roadways or railroads, and in rooms with heavy machinery or fans. However, EPA also recommends strongly that asbestos-containing materials in rooms beneath gymnasiums and other high-activity areas not be encapsulated.

8. Encapsulation of asbestos-containing fireproofing material may reduce the fireproofing qualities of the material.

Asbestos-containing material often functions in buildings as fireproofing. If it is encapsulated, its fireproofing qualities may be impaired. This, in turn, may affect the fire rating of the building.

EPA is currently conducting further research into this aspect of encapsulation. Although it does not preclude consideration of the use of encapsulants, building owners may wish to consider this factor before making a decision to encapsulate.

9. Encapsulation may reduce or destroy the acoustical properties of the asbestos-containing material.

Asbestos-containing materials were often applied for acoustical insulation. If an encapsulant is applied to asbestos-containing material, the ability of the material to deaden sound tends to be diminished.

However, this factor does not, by itself, preclude the possibility that encapsulation is feasible. The other techniques for controlling asbestos exposure also have detrimental effects on the acoustical properties of asbestos-containing materials. Enclosure may also reduce the acoustical properties of the material. If asbestos-containing material is removed, it often must be replaced by an environmentally acceptable substance with similar acoustical qualities, such as fiber glass or cellulose.

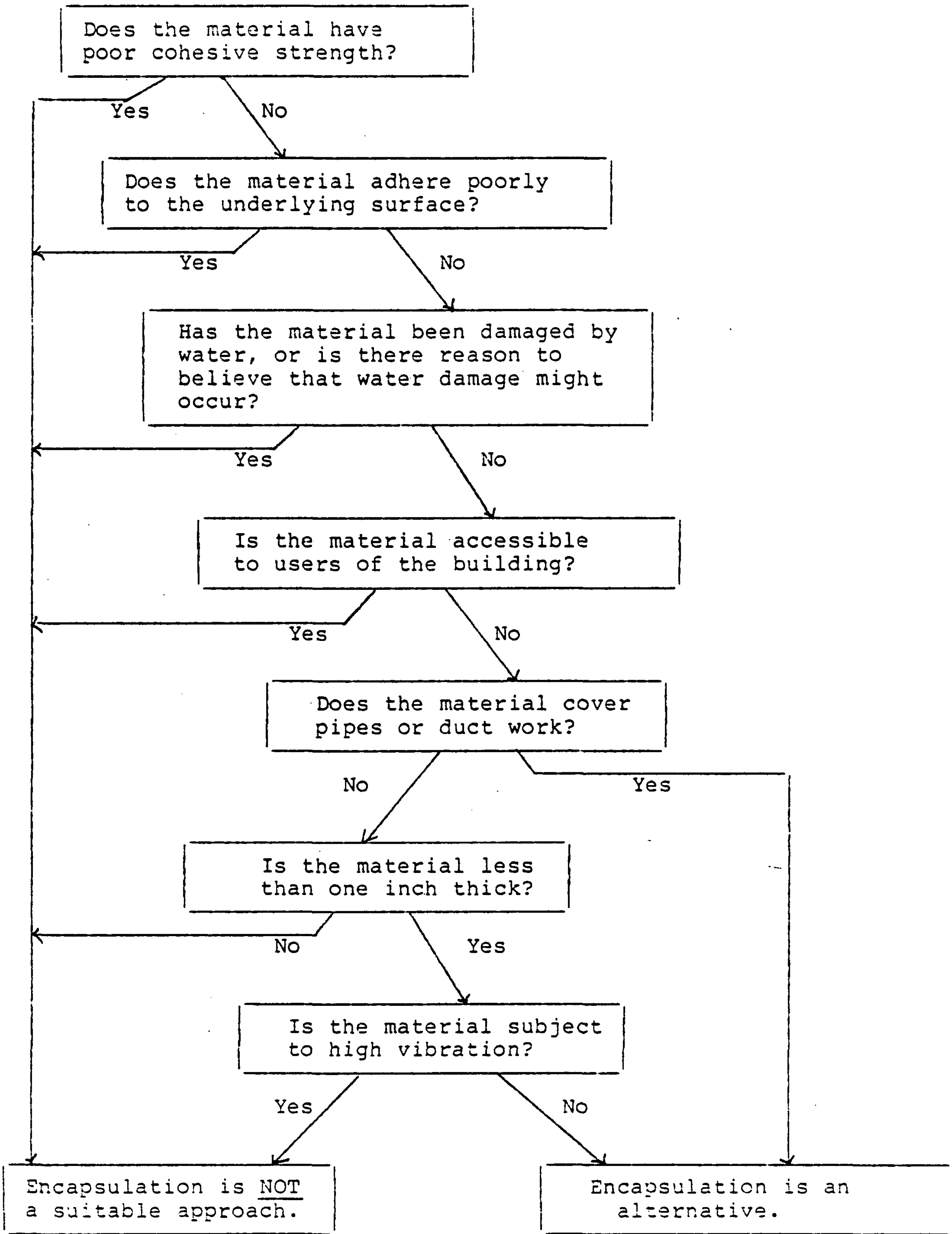
* * *

In summary, encapsulation can be a practical method to control the release of asbestos fibers, but certain limitations make it useful only in a relatively small number of cases. Where asbestos-containing material is accessible to the users of the building, has poor cohesive or adhesive strength, is water damaged, or is more than an inch thick, encapsulation is not recommended. Encapsulation is also not recommended on friable materials. EPA estimates that encapsulation is an appropriate control technique in no more than 10% to 15% of all cases where asbestos-containing material requires corrective action.

The following chart combines most of the information presented in this chapter in a simple format designed to help building owners and school administrators decide whether encapsulation is appropriate in their buildings. It is designed only to supplement the discussion and should not be used by itself.

TABLE 1

APPROPRIATE SITUATIONS FOR ENCAPSULATION



CHAPTER TWO:

THE CHOICE BETWEEN BRIDGING AND PENETRATING ENCAPSULANTS

If the decision to encapsulate has already been made, the next question is whether to use a bridging or a penetrating encapsulant. The purpose of a bridging encapsulant is to form a tough membrane over the surface of the asbestos-containing material which should prevent the release of asbestos fibers. A penetrating encapsulant is designed to saturate the material and, as it dries, to bind the asbestos fibers to one another and to the other substances in the material.

Penetrating encapsulants, in general, have lower viscosities than bridging encapsulants. This means that they are thinner and flow more easily. Viscosity is measured in centipoises; water, for instance, has a viscosity of one centipoise. Penetrating encapsulants usually have viscosities up to one hundred centipoises, while many bridging encapsulants are so thick that their viscosity is measured in thousands of centipoises. Penetrating encapsulants usually also have a lower solid content than bridging encapsulants.

Another difference between bridging and penetrating encapsulants is that bridging encapsulants are almost always pigmented for aesthetic purposes. On the other hand, almost no penetrating encapsulants contain pigment because its presence would inhibit their penetration. Dyes (not pigments) can be added to penetrating encapsulants to color them (see Chapter Five, page 32).

The choice of what kind of encapsulant to use often depends on the characteristics of the material which is to be encapsulated. This chapter discusses a number of characteristics of asbestos-containing material and shows how each affects the choice between bridging and penetrating encapsulants.

Friability

As explained in Chapter One, material with high friability should not be encapsulated. If, however, the decision has been made to encapsulate asbestos-containing material which is moderately friable and less than one inch thick, penetrating encapsulants are preferable. Penetrating encapsulants are designed to reduce the friability of the material by soaking into it, binding the fibers together, and increasing the material's cohesive strength.

Because bridging encapsulants are not designed to penetrate into the asbestos-containing material, they will not increase its cohesive strength. The use of bridging encapsulants on friable material may make the problem worse, because the weight of the encapsulant may make the material delaminate even faster.

There are two exceptions to this point. One is discussed below (page 16) in the section on the shape of the surface: for friable asbestos-containing material on complex surfaces such as pipes and ducts, a bridging encapsulant may actually be preferable to a penetrating one. The second relates to cementitious materials, which, even if they are somewhat friable, may be treated with a bridging encapsulant (see page 16).

Water Damage

With regard to water damaged materials, there is no real distinction between bridging and penetrating encapsulants. For the reasons given in Chapter One, water damaged material should not be encapsulated.

Imperfect Adhesion to the Substrate

Asbestos-containing material which adheres imperfectly to the substrate should not ordinarily be encapsulated either with bridging or with penetrating encapsulants, since the additional weight of the encapsulant may cause the material to fall. If an encapsulant penetrates all the way through the material to the substrate and binds it to the substrate, this problem may be avoided, but this will not often be the case.

Bridging encapsulants, which are not designed to penetrate through the material, will obviously not improve the material's adhesion to the underlying surface. Most penetrating encapsulants penetrate less than an inch into spray-applied asbestos material, and are unlikely to bind thicker asbestos-containing materials to the substrate. If the material adheres imperfectly to the substrate, it should be removed or enclosed rather than encapsulated.

Accessibility

Most surfaces in any building are occasionally exposed to damage from the building's users. On surfaces for which this exposure occurs routinely, encapsulation is not recommended (see Chapter One, pages 7-8). If, however, the decision is made to use an encapsulant on a surface which is disturbed occasionally by custodians and maintenance workers, a penetrating encapsulant is probably preferable.

Tests conducted for EPA indicate that penetrating encapsulants are slightly more susceptible to damage from impact and abrasion than bridging encapsulants. * However, the consequences of failure in the case of a bridging encapsulant are likely to be more severe. The membrane created by a bridging encapsulant covers, but does not bind, the asbestos fibers behind it. If this membrane is damaged, fibers can easily escape into the air. Penetrating encapsulants, on the other hand, should continue to hold the fibers in clumps, preventing their widespread release into the air.

However, the use of a penetrating encapsulant is no guarantee of success. If asbestos-containing material which has been treated with a penetrating encapsulant is damaged, the clumps of fibers falling to the floor may be ground underfoot and may eventually bring about increased levels of exposure. Further, unless the encapsulant has penetrated completely through the material, unencapsulated material may be exposed when the encapsulant is damaged. Hence, although penetrating encapsulants are preferable to bridging encapsulants on material which will be exposed to human contact, the best solution for material which is frequently contacted is removal or enclosure.

Acoustical Properties

Asbestos-containing material which serves as acoustical insulation (e.g., in auditoriums and theaters) is likely not to function as well after any encapsulant has been applied.

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* The tests are described in Evaluation of Sealants for Sprayed-On Asbestos-Containing Materials in Buildings, a report prepared for EPA by Battelle Columbus Laboratories. It is available from EPA's Industry Assistance Office (call 800-424-9065; in Washington D.C., 554-1404).

Sprayed-on material absorbs sound because of its dead air spaces and because of its irregular surface. Penetrating encapsulants reduce the dead air space, while bridging encapsulants create a smooth layer on the surface. Either will impair the material's acoustic properties to some extent.

Cementitious Materials

Cementitious materials are described in Chapter One, pages 4-5. It is important to recognize the distinction between cementitious materials, which are dense and relatively hard, and fluffy, spongy asbestos-containing materials. Although both may deteriorate with age and either may be friable, cementitious materials typically present less severe exposure problems because of their thinness, lower susceptibility to damage, and generally low asbestos content.

For cementitious materials, a bridging encapsulant is preferable to a penetrating encapsulant. A bridging encapsulant should effectively prevent the release of fibers from cementitious materials. If the material is hard, completely undamaged, and inaccessible to building users, the use of a good quality latex paint with a high rubber content may also provide adequate protection against future fiber release (see Chapter Four, page 24).

The Shape of the Surface

Asbestos-containing material on a large, flat ceiling without projecting beams or other irregularities is not well suited to a bridging encapsulant, unless the material is cementitious and in good condition. On complex surfaces involving numerous beams, pipes, and ducts, however, a bridging encapsulant may well be preferable. It will wrap around the irregularities in the surface, enveloping the material and binding it within the continuous membrane of the encapsulant.

Surfaces Which Have Previously Been Encapsulated or Painted

Penetrating encapsulants are not suitable for use on material which has already been encapsulated or painted. They cannot penetrate the water-tight surface formed by the old coat of encapsulant or paint, and thus cannot function properly. Heavy accumulation of dirt or soot on the surface of asbestos-containing materials may also prevent the penetration of encapsulants.

When recoating a surface that was previously encapsulated with either a penetrating or a bridging encapsulant, a bridging encapsulant should be used. It is important to choose an encapsulant which can adhere to the older encapsulant layer: for example, if a butyl rubber bridging encapsulant was used in the first place, it is probably advisable to recoat it with a similar product. Note that material which is poorly attached to the substrate should not be encapsulated, even if it has previously been painted.

For material which has previously been treated with latex paint, it may be advisable to recoat it with a good quality, high rubber paint (see Chapter Four).

A table summarizing the differences between bridging and penetrating encapsulants appears on the next page. It is designed to supplement the discussion in this chapter and should not be used by itself.

TABLE 2

COMPARISON OF BRIDGING AND PENETRATING ENCAPSULANTS

	Bridging encapsulant	Penetrating encapsulant
Improves cohesive strength of material (i.e., reduces friability)?	no	yes
Appropriate for material which adheres poorly to substrate?	no	no
Appropriate for water-damaged material?	no	no
Allows fiber release readily if damaged?	yes	sometimes (see page 15)
Impairs acoustic insulating properties of material?	yes	yes
Preferable for material on pipes and ducts?	yes	no
Preferable for cementitious material?	yes	no
Appropriate for material which has already been painted or encapsulated?	yes	no

CHAPTER THREE:

CHOOSING THE RIGHT ENCAPSULANT

The field of asbestos encapsulation is a new one, and both contractors and building owners suffer from a lack of hard information about how different encapsulants compare with one another. This chapter offers general guidelines to help contractors and building owners choose an encapsulant.

The best way to choose an encapsulant is to field test several encapsulants on the material to be encapsulated. When possible, field trials should be performed prior to the final selection of an encapsulant. The information in this chapter, combined with the knowledge gained from field tests, should insure that a proper encapsulant is selected.

This chapter does not contain information on specific products. For information on currently available encapsulants, please contact the Regional Asbestos Coordinators (see Appendix A).

The American Society for Testing and Materials (ASTM) is writing standards by which encapsulants can be judged. ASTM plans to publish these standards at some time in 1981.*

This chapter is based on early versions of the ASTM standards. It discusses a number of characteristics of encapsulants which one should consider carefully before choosing a specific

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* For more information, contact ASTM at 1916 Race Street, Philadelphia, Pennsylvania 19103.

product. These general characteristics can be used with Battelle's information on specific products to choose the best encapsulant for a particular job. The first three characteristics are especially important: they are toxicity, flammability, and method of application.

Toxicity

An encapsulant should not release toxic substances into the air when it is applied. Solvent-based encapsulants, or encapsulants for which the vehicle (the liquid in which the solid parts of the encapsulant are suspended) consists entirely of hydrocarbons, are not recommended because their use may be dangerous to workers. The rooms where encapsulants are applied should be isolated by plastic barriers,* and if the encapsulant does release toxic fumes in the enclosed space the workers could quickly be in serious danger.

The encapsulant also should not release any toxic materials after it is dry. Even if it burns, the encapsulant should not release toxic gases or an undue amount of smoke.

For information on the toxic gas generation of encapsulants, please consult the Battelle report, or write to the manufacturers asking for their products' performances on tests described in the National Bureau of Standards's Technical Notes 757 and 808. Manufacturers should be willing to supply this information, since this is an important characteristic of any encapsulant.

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* See Asbestos-Containing Materials in School Buildings: A Guidance Document, Part 1, pp. 20-25, as well as Guidelines for Removal of Friable Asbestos-Containing Material, for information on isolation of the work area.

Flammability

The encapsulant, once applied, should not be flammable. This is especially important because asbestos-containing material usually serves as a fire retardant in buildings; use of an encapsulant which impairs these fire retardant properties may endanger the lives of the building's users.

Encapsulant manufacturers generally run tests on their products to insure that they will not increase the flammability of the encapsulated material. By consulting Battelle's report, or by writing to manufacturers and asking for the results for their products of ASTM Standard Test E 162, contractors and building owners can get an idea of how encapsulants compare. EPA recommends strongly that encapsulants be used which have Class "A" fire ratings based on this test.

Method of Application

The use of a roller or brush on friable asbestos-containing materials is very likely to lead to dangerous fiber release. Encapsulants must be applicable by spray equipment.

Encapsulants which must be applied by air spray equipment strike the asbestos-containing material at greater pressure than those applied by airless spray, and therefore are more likely to dislodge asbestos fibers from the surface of the material. Encapsulants which can be applied by airless spray equipment are therefore preferable to those which must be applied by air spray.

Other Qualities

There are six other characteristics described by Battelle or ASTM as desirable properties of encapsulants. The first four are essential, while the last two are less critical. Each is discussed briefly below.

1. The encapsulant should either penetrate into the material and bind the fibers together, or form a tough membrane over the surface of the material. These qualities are discussed in detail in Chapters One and Two, and should be considered essential.

2. The encapsulant should be able to withstand some abuse without allowing the release of any fibers, particularly in cases where the asbestos-containing material is likely to be occasionally disturbed.

3. The encapsulant should be water insoluble when cured.

4. The encapsulant should still have sufficient integrity, after a minimum of six years, to allow recoating. In other words, it should be fairly durable.

5. The encapsulant should not destroy the acoustical properties of the asbestos-containing material. This quality is obviously more important in some cases than in others, and any encapsulant will probably impair the acoustical properties of the encapsulated material to some extent (see above, pages 9-10 and 15-16). Building owners who plan to encapsulate auditoriums or theaters may wish to contact an acoustical consultant or acoustical engineer.

6. <u>The encapsulant should allow for topcoating by conventional paints where this is required for aesthetic reasons.</u> This quality, again, will be more important in some cases than in others.

* * *

These guidelines, used in conjunction with the information available from the Regional Asbestos Coordinators, should help contractors and building owners select an acceptable encapsulant. However, the best way to tell whether an encapsulant will perform on a given surface is to field test it by applying it to a small section of the surface (see page 30). EPA recommends that several encapsulants be field tested in this manner before a final decision is made regarding which one to use.

CHAPTER FOUR:

LATEX PAINTS:

FOR USE ONLY ON CEMENTITIOUS MATERIALS

The application of latex paint as a control technique for any asbestos-containing material which is fibrous, fluffy, spongy, or highly friable is not recommended. Latex paints are not designed to encapsulate such materials and cannot be expected to do so effectively. Latex paints should be considered for use only on undamaged cementitious materials, such as acoustical plasters.

The major component of a cementitious, acoustical plaster is usually a dense, non-fibrous mixture of granular material. The only fibrous component is the asbestos, usually at a concentration of less than 15%. This material has a coarse sand, textured appearance and is most often 1/8 inch to 1/2 inch thick, with a maximum thickness of 3/4 inch. Such materials are friable if they are soft and can easily be indented by hand pressure, and if a powder residue remains on the hand when the material is rubbed.

If asbestos-containing material is unsuitable for encapsulation, it is not suitable for application of latex paint either. The limitations of latex paint are even more acute than those of encapsulants, so latex paint should not be applied to any asbestos-containing material which is water damaged, accessible to the building's users, more than 3/4 inch thick, or adhering poorly to the substrate.

Cementitious material may be considered for treatment with latex paint if the material is in good condition, has not been damaged by water,* and is not easily accessible. For cementitious asbestos-containing materials which have previously been covered with latex paint, a coat of good quality latex paint with a high rubber content may be the most effective treatment because it is most likely to adhere to the older layer of paint.

Although research on the use of latex paint to encapsulate cementitious asbestos-containing materials has been very limited, the following guidelines are offered to aid in the selection of an appropriate latex paint.

Two major components in latex paint are the pigment and the vehicle (the vehicle is the liquid in which the pigment is suspended; it contains mainly water). The label should show the percentage, by weight, of pigment and vehicle. Often the vehicle percentage is subdivided into percent water and percent vehicle resin solids or vehicle binder solids.

Good quality latex paint has a 60% or more vehicle content with a high percentage of vehicle resin solids: of the vehicle, at least 25% should be vehicle resin solids. If the percentage of vehicle resin solids is not stated on the label, it can be determined by subtracting the percent pigment from the percent total solids. In general, the higher the percentage of vehicle resin solids, the more durable and more flexible the coat of paint will be. If the latex paint does not have a high percentage of vehicle resin solids, it may be inflexible and become brittle or crack with age. Accidental disturbance of the coating by building users, or uneven settling of the building,

* If the cementitious material has small, isolated water damaged areas, treatment with latex paint may be considered if the source of the water damage is repaired and the damaged material is removed and replaced. This applies only if the material is otherwise in good condition and is not accessible to building users.

may easily crack or otherwise damage inflexible latex membranes, allowing the release of asbestos fibers.

The application rate of latex paint should be 75 to 100 square feet per gallon. This application rate should result in a mambrane with a dry film thickness grater than 4 mils (0.004 inch). An airless spray gun should be used to apply the paint. EPA recommends that the cementitious material first be sprayed with a light mist coat with the gun held 18" to 24" away from the material. This light mist coat should seal loose fibers into the surface and prevent the cementitious material to continue to soak up the latex paint rather than build a membrane. Once this has been allowed to dry completely, a thicker coat can be added; this two-step application is considered to be the first coat.

Wait until each coat dries before adding another one. Each subsequent coat should be applied at a 90 degree angle to the direction of the preceding coat application. This application technique should prevent any holes or voids from being formed in the membrane and should assure complete coverage of the cementitious material.

Note that, in the application of latex paint, all precautions described in Chapter Five should be followed, just as though an encapsulant was being applied.

Once again, the use of latex paints should be considered only on <u>cementitious</u> material in good condition. For <u>any</u> spongy or fluffy material containing asbestos, the use of latex paints is <u>not</u> recommended.

CHAPTER FIVE:

ENCAPSULANT APPLICATION

The importance of proper application of an encapsulant cannot be overstressed. The quality of the contractors' work will not only determine the effectiveness of the encapsulation, but may also affect the health of the workers themselves. Many failures of encapsulated materials are due to poor application rather than the quality of the encapsulant or the material that was encapsulated. No encapsulant, if improperly applied, can prevent the release of asbestos fibers; careless procedures can easily expose workers and the building users to asbestos, as well as involving additional costs to correct the problems caused by the failure of the application. For these reasons, all contractors who are preparing to encapsulate asbestos-containing materials, and all administrators who are writing contract documents, should read this chapter carefully.

Applicable Regulations and Further Information

The Occupational Health and Safety Administration (OSHA) regulates workplace practices and the levels of airborne asbestos to which workers may be exposed. EPA also has issued regulations which govern emissions from asbestos work and asbestos disposal, and has developed general recommendations for use in preparing encapsulation contracts. If the recommendations are used in preparing contract documents, and if the contract specifications are strictly enforced, workers and users of the building will be protected from undue exposure to asbestos.

Asbestos-Containing Materials in School Buildings: A Guidance Document contains the complete text of the OSHA and EPA regulations governing encapsulation work as well as sample specifications for encapsulation contracts. Guidelines for Removal of Friable Asbestos-Containing Material also contains information on proper work area set-up, worker protection, and work practices (see Introduction for more information on these documents).

Materials and Equipment

Encapsulation requires not only all materials standard for indoor paint application but a number of others as well. Respirators and disposable clothing for workers, as well as sealable, impermeable containers for the disposal of asbestos-contaminated waste, are required by OSHA regulations. Plastic sheeting and duct tape to seal off the work area, and portable shower facilities for worker decontamination, are recommended by EPA. Contractors desiring more information on materials should contact their Regional Asbestos Coordinators, or consult the EPA documents cited in the Introduction.

EPA recommends that encapsulants be applied to the asbestos-containing material with airless spray equipment. Although the use of an airless gun does not completely eliminate the dislodging of asbestos fibers during the encapsulation job, this release is substantially less than is the case with conventional air spray equipment.

Worker Training

EPA strongly recommends that all workers be thoroughly educated in a number of subjects related to encapsulation before they begin work. These subjects include the use and maintenance of respirators, the use of protective clothing, proper safety procedures, personal decontamination procedures, techniques to control fiber release in the work area, and proper application procedures. OSHA requires that each employer establish a program to train workers in the care and use of respirators and to ensure proper storage of respirators when they are not in use.

Construction of Decontamination Area and Preparation of Work Area

Before encapsulation work begins, a decontamination area should be constructed and the work area should be sealed off from the rest of the building. These procedures are discussed in considerable detail in Asbestos-Containing Materials in School Buildings: A Guidance Document and in Guidelines for Removal of Friable Asbestos-Containing Material, so they are not treated extensively here.

Briefly, the procedures involve the construction of a clean room and a contaminated equipment room with a shower between them, and with airlocks consisting of plastic curtains to prevent the escape of fibers into the outside air. The work area should be completely isolated from the rest of the building with barriers constructed from 4- to 6-mil polyethylene sheets, and floors and walls in the work area should be covered with polyethylene sheets as well.

Work Practices and Personal Decontamination Procedures

These topics, too, are covered extensively by Asbestos-Containing Materials in School Buildings: A Guidance Document and in Guidelines for Removal of Friable Asbestos-Containing Material. Contractors and specification writers should consult these documents. Any person entering the work area must wear a suitable respirator and disposable clothing. No clothing which will be worn in the street can be worn in the work area. The same also applies to shoes: if shoes are worn in the work area, they must be left in the contaminated room at the end of each work shift.

No one may remove his or her respirator while in the work area. Whenever leaving the work area, workers must remove their contaminated disposable clothing and, in the shower, saturate themselves and their respirators thoroughly before removing their respirators. They should clean themselves and their respirators thoroughly before changing into their street clothing. Compliance with these specifications is necessary to protect the health of the workers and prevent contamination of the outside environment.

Field Testing of Encapsulants

EPA recommends that the contractor and building owner arrange to field test several encapsulants before a final decision is made as to which to use. This will not only insure that the encapsulant which is used is suitable for the material, but will also enable the contractor to gain first-hand experience in applying the particular encapsulant to the particular surface.

After the work area has been isolated with polyethylene from the rest of the building, field test the encapsulants by applying each to a small area of surface. The contractor should use the techniques and procedures he expects to use on the surface area as a whole, and observe the results to see which encapsulant will do the best job. He can also experiment with different drying times, pressure settings, and so forth, and select the best techniques when he begins the application of the encapsulant selected. In testing an encapsulant in the field, the building owner should check that the encapsulant cures to a durable finish in a resonable time and that it adheres firmly to the asbestos-containing material. He should also take a small core sample from the test patch to check the thickness of the coating (for a building encapsulant or thickness of penetration (for a penetrating encapsulant).

Application of Encapsulant

The pressure of airless spray equipment is adjustable. The correct nozzle pressure varies from 400 to 1500 pounds per square inch, depending primarily on the encapsulant's viscosity and secondarily on its solids content. In general, the lower a substance's viscosity and percentage of solids, the lower the pressures at which it can be sprayed. Since higher pressures cause more asbestos fibers to be blown away from the surface, the equipment should be set at the lowest operable pressure.

A second factor that affects application is the size of the tip of the airless spray gun. Like pressure settings, tip sizes should be selected on the basis of the viscosity and percent solids of an encapsulant. One way to test for proper tip size is to spray the encapsulant briefly onto a surface from about 12 inches away. An appropriately sized tip will spray the encapsulant in a fan approximately eight inches wide; it will also distribute the encapsulant uniformly within the fan. An improper tip will often concentrate the encapsulant at the fan's edges.

Particularly on more friable material, it is usually a good practice to apply first a light mist coat of the encapsulant. The purpose of this preliminary coat is to moisten and seal loose fibers and keep them from breaking away from the surface. This mist coat should be applied in three or four quick passes with the gun held 18 to 24 inches from the surface.

After an area of 16 to 20 square feet has been given the mist coat, the applicator can proceed immediately to apply a heavier coating of the encapsulant, using eight or ten passes with the gun held 10 to 12 inches from the material. The gun should be kept in constant motion to create a smooth and even coat.

This two-step application is considered to be the first coat. Most encapsulants should be applied in two or three separate coats, with time allowed after each coat for the encapsulant to cure. Note that the amount of drying time varies from encapsulant to encapsulant, and that manufacturers' recommendations should be followed. In general, penetrating encapsulants should be allowed to cure for only about four hours before the second coat is applied; if the first coat cures completely, it will not allow the second coat to penetrate into the material. Bridging encapsulants should be allowed to cure for somewhat longer before another coat is added. Each subsequent coat should be applied at a 90 degree angle to the direction of the preceding coat application, to assure complete coverage of the asbestos-containing material.

It is important not to apply too much encapsulant in each coat. A penetrating encapsulant, if applied too thickly, can block the surface of the material as it cures, preventing any subsequent coats from penetrating into the material. Further, over-application of a penetrating encapsulant can cause the asbestos-containing material to become too wet and to break loose from the substrate. This second problem is also important for bridging encapsulants.

One method for preventing over-application is for the sprayer to keep a mental note of the number of passes made with the spray gun. An experienced applicator will also be able to tell by listening to the sound the encapsulant makes when it hits the surface: when the material becomes saturated, there will be a distinct sound change. Third, the changing color of the material as it is sealed can give an indication of how much encapsulant constitutes a coat (if a penetrating encapsulant is unpigmented, food coloring or a similar dye--not a pigment-- can be added to give it a slight tint). Applying a different color encapsulant for each coat will help to ensure complete covering.

Dilution also plays an important role in encapsulant application. Some encapsulants must be diluted with water. Even if dilution is not required, it often makes it possible to apply the encapsulant at a lower pressure to reduce the release of fibers. Dilution may also improve the penetrating quality of the encapsulant. Most manufacturers give recommendations concerning dilution on the labels of their encapsulants. Some experimentation will also help determine when dilution is useful.

Most manufacturers will provide on request a data sheet including recommendations for tip size, spray pressure, number of coats to be applied, drying time, and so forth. Contractors and other interested parties are strongly advised to obtain this information.

Coverage

One-coat coverage rates for most penetrating encapsulants range from 10 to 40 square feet of friable asbestos-containing material per gallon of encapsulant. Bridging encapsulants may yield slightly higher coverage, with one gallon providing one-coat coverage of 20 to 40 square feet. These figures are based on Battelle's studies of encapsulants, and tend to be lower than manufacturers may claim.

The coverage rate of a penetrating encapsulant is dependent primarily on the thickness of the material to be encapsulated and the ability of the encapsulant to wet the material. The thicker the material, the more encapsulant will be required to fill it completely and penetrate to the substrate. Better penetrating encapsulants often have lower coverage rates because they penetrate more deeply into the material.

Coverage with bridging encapsulants is also affected by such variables as the degree of their penetration and the texture of the surface. Unsurprisingly, the rate of coverage tends to be lower on irregular surfaces.

High Humidity Areas

It is often difficult to encapsulate asbestos-containing material in humid air, since the material may already be damp and thus tend to absorb much less of the encapsulant than if encapsulation were performed under dry conditions. This problem can be caused by the humidity of the outside air or by conditions within a building (e.g., the presence of an indoor swimming pool). To avoid the first problem, encapsulation jobs should be undertaken, as much as possible, on dry days. For the second problem, measures can be taken to reduce the indoor humidity; swimming pools can be drained and windows opened a few days before the job begins to allow the material to dry out.

Asbestos Exposure Problems During Application of Encapsulants

Problems of worker exposure to asbestos during encapsulation jobs can usually be attributed to failure to follow EPA and OSHA regulations or guidelines: by attempting to encapsulate highly friable material which should really be removed, by spraying encapsulants at too high a pressure setting, or by holding the spray gun too close to the surface. Any of these mistakes can cause the encapsulant spray to dislodge pieces of asbestos-containing material into the air, resulting in serious problems of worker exposure to airborne asbestos. Failure to follow EPA and OSHA regulations and guidelines could also result in total faiure of the encapsulation.

Exposure problems can also result from failure to observe EPA recommendations for fiber containment during encapsulation jobs. Consult Asbestos-Containing Materials in School Buildings: A Guidance Document and Guidelines for Removal of Friable Asbestos-Containing Material, and follow these recommendations carefully. Failure to do so can result in exposure of workers and building users to hazardous levels of airborne asbestos, and may subject the responsible party to punitive action by EPA or OSHA.

APPENDIX A

Regional Asbestos Coordinators

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APPENDIX B.

A TEST
WHICH INDICATES WHETHER FRIABLE ASBESTOS-CONTAINING MATERIAL CAN SUSTAIN THE WEIGHT OF AN ENCAPSULANT

Introduction

This test, which has been adapted from the American Society for Testing and Materials (ASTM) Standard Test Method E 736-80, has been used extensively in some parts of the country.

Purpose

This test indicates whether friable asbestos-containing materials have sufficient adhesive and cohesive strength to sustain the weight of an encapsulant.

Materials

1. A cap, 3¼" in diameter and approximately ½" deep. A hook shall be attached at the center.

2. An adhesive system of urethane resin to form a rigid foam.

3. A two pound weight.

Method

1. Select at random three locations on the asbestos-containing material on which to perform the test. Then, at each location, perform the following steps:

2. Mix a sufficient quantity of the urethane resin system in the cap, and place the cap immediately placed against the friable asbestos-containing material being tested.

3. Hold the cap in place until the resin has completely foamed and has set sufficiently to become self supporting.

4. After the foam becomes hard, engage the weight carefully on the hook. This applies a uniform force of 36 pounds per square foot perpendicular to the surface.

5. The material must support the weight for one (1) minute at each test location in order to pass the test.

Note: The adhered cap can be removed by carefully cutting the foam away from the asbestos-containing material with a sharp knife or hacksaw blade, or it can be left in place for future tests.

Interpretation of Results

If friable asbestos-containing material does not pass this test, encapsulation is probably not an appropriate method for controlling fiber release.