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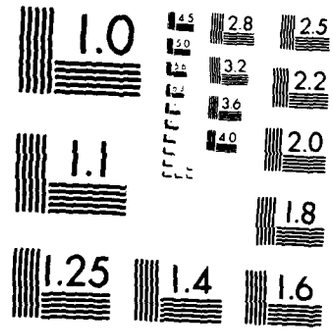

TECHNICAL REPORT R-900

Encapsulation of friable insulation materials containing asbestos

by
E. E. Lory and
M. J. Hienzsch

May 1983

Naval Civil Engineering Laboratory
Port Hueneme, California 93043

Sponsored by the Naval Facilities Engineering Command

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METRIC CONVERSION FACTORS

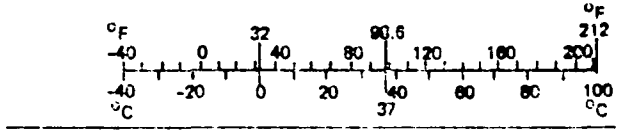
Approximate Conversions to Metric Measures

Symbol	When You Know	Multiply by	To Find	Symbol
		LENGTH		
in	inches	*2.5	centimeters	cm
ft	feet	30	centimeters	cm
yd	yards	0.9	meters	m
mi	miles	1.6	kilometers	km
		AREA		
in^2	square inches	6.5	square centimeters	cm^2
ft^2	square feet	0.09	square meters	m^2
yd^2	square yards	0.8	square meters	m^2
mi^2	square miles	2.6	square kilometers	km^2
	acres	0.4	hectares	ha
		MASS (weight)		
oz	ounces	28	grams	g
lb	pounds	0.45	kilograms	kg
	short tons (2,000 lb)	0.9	tonnes	t
		VOLUME		
tsp	teaspoons	5	milliliters	ml
Tbsp	tablespoons	15	milliliters	ml
fl oz	fluid ounces	30	milliliters	ml
c	cups	0.24	liters	l
pt	pints	0.47	liters	l
qt	quarts	0.95	liters	l
gal	gallons	3.8	liters	l
ft^3	cubic feet	0.03	cubic meters	m^3
yd^3	cubic yards	0.76	cubic meters	m^3
		TEMPERATURE (exact)		
°F	Fahrenheit temperature	5/9 (after subtracting 32)	Celsius temperature	°C

*1 in. = 2.54 (exactly). For other exact conversions and more detailed tables, see NBS Misc. Publ. 286, Units of Weights and Measures, Price $2.25, SD Catalog No. C13.10:286.

Approximate Conversions from Metric Measures

Symbol	When You Know	Multiply by	To Find	Symbol
		LENGTH		
mm	millimeters	0.04	inches	in
cm	centimeters	0.4	inches	in
m	meters	3.3	feet	ft
m	meters	1.1	yards	yd
km	kilometers	0.6	miles	mi
		AREA		
cm^2	square centimeters	0.16	square inches	in^2
m^2	square meters	1.2	square yards	yd^2
km^2	square kilometers	0.4	square miles	mi^2
ha	hectares (10,000 m^2)	2.5	acres	
		MASS (weight)		
g	grams	0.035	ounces	oz
kg	kilograms	2.2	pounds	lb
t	tonnes (1,000 kg)	1.1	short tons	
		VOLUME		
ml	milliliters	0.03	fluid ounces	fl oz
l	liters	2.1	pints	pt
l	liters	1.06	quarts	qt
l	liters	0.26	gallons	gal
m^3	cubic meters	35	cubic feet	ft^3
m^3	cubic meters	1.3	cubic yards	yd^3
		TEMPERATURE (exact)		
°C	Celsius temperature	9/5 (then add 32)	Fahrenheit temperature	°F



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This document presents information on the encapsulation of asbestos-containing friable insulation materials (FIM). Encapsulation, which is a procedure to seal in asbestos fibers that may be subject to ready release on mininal disturbance, is a new alternative approach to the abatement of hazards from asbestos insulating materials. Encapsulation may be used in specific sites and cases instead of removal of asbestos-containing FIM. This document –

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introduces the facilities architect or engineer to encapsulant materials, established and planned testing criteria, application techniques, the advantages and drawbacks to using encapsulants, and a guide specification for encapsulation of asbestos-containing FIM.

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This document presents information on the encapsulation of asbestos-containing friable insulation materials (FIM). Encapsulation, which is a procedure to seal in asbestos fibers that may be subject to ready release on minimal disturbance, is a new alternative approach to the abatement of hazards from asbestos insulating materials. Encapsulation may be used in specific sites and cases instead of removal of asbestos-containing FIM. This document introduces the facilities architect or engineer to encapsulant materials, established and planned testing criteria, application techniques, the advantages and drawbacks to using encapsulants, and a guide specification for encapsulation of asbestos-containing FIM.

FOREWORD

With the recognition of the health problems posed by airborne asbestos fibers released from building insulation systems, the Navy has investigated various measures that abate the hazard. The encapsulation or sealing of asbestos fibers into their existing insulation matrix is one acceptable abatement procedure. It is generally less expensive than removing the insulation, and sometimes is an appropriate choice for the Naval Facilities Establishment. Paint and coating manufacturers have responded to the need for encapsulants by offering a wide variety of materials. However, there currently are no standards that set performance criteria for these encapsulant materials; thus, the burden is placed on the consumer to make an informed decision about which product will work best for each situation. This document introduces the Naval Facilities architect or engineer to encapsulant materials, established and planned testing criteria, application techniques, the advantages and drawbacks of the use of encapsulants, and a guide specification for encapsulation of asbestos-containing insulation materials.

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INTRODUCTION

The Naval Civil Engineering Laboratory (NCEL) was tasked by the Naval Facilities Engineering Command (NAVFAC) to investigate the current state-of-the-art of encapsulating agents and their application methods for use on friable insulation materials (FIM) containing asbestos at Navy installations.

With approximately 200 shore facilities insulated with friable materials containing asbestos in various amounts and states of repair, the cost of hazard abatement is awesome. For this reason, NAVFAC has devised a system of prioritization by hazard severity and, at the same time, directed research into various techniques for asbestos fiber containment as opposed to completely removing the insulation. One such technique, encapsulation, provides an impervious coating on an insulation system to prevent the fallout of health-damaging microscopic fibers.

The encapsulation of asbestos-containing materials is a new field in the construction industry as well as for architects and engineers involved in such projects. This document informs the Naval facilities engineer and architect on how to select the appropriate encapsulation method, the choices of available materials and application techniques, material testing standards, and problems associated with encapsulation projects. The information was developed through NCEL's own research, pertinent literature, and contacts with manufacturers, construction contractors, and industry associations.

BACKGROUND

Friable insulating material (FIM) is defined as any insulation that can be collected by pushing or boring a plastic sampler into, or moving a scraper across, the surface of the material. Ease of sampling constitutes a measure of the friability of the material. FIM suspected of or actually containing asbestos is separated into three general categories: (1) fibrous insulation, (2) granular/cementitious insulation, and (3) insulating/fireproofing concrete.

Typical fibrous insulation that contains asbestos is sprayed on, is generally very soft and resilient to the touch, and is either tamped smooth or left with a rough, irregular surface after application.

Granular/cementitious FIM has a coarse, sandy appearance and is generally used for sound absorption and decorative purposes. It feels hard to the touch, and yet is susceptible to mechanical surface abrasion. The material known as "acoustical plaster" falls into this category.

Insulating/fireproofing concrete FIM often has a foamy appearance and may contain vermiculite or mica. It can vary in feel from soft and spongy to very hard. This type of FIM is used for fireproofing of steel and concrete structural members. Although it is often out of sight behind furred walls and ceilings, it still poses a potential hazard during renovation or if exposed to the airstream in plenums.

Each application is unique because of the various types, mixes, and quantities of asbestos fibers used, other added non-asbestos fibers, and the many kinds of fillers/strengtheners and binding agents. This wide variety of materials and insulation systems poses problems in the selection of compatible encapsulating agents.

The recommended methods of abating asbestos hazards in facilities are: the installation of an enclosure system, encapsulation, or complete removal. These three methods are briefly addressed in Reference 1.* Reference 1 should be referred to for background information on the evaluation techniques of asbestos hazards.

ENCAPSULATION OF FRIABLE INSULATION MATERIALS CONTAINING ASBESTOS

What Is Encapsulation, and What Is Its Purpose?

Encapsulation, in the context of this document, is the application of a liquid material, the encapsulant, on friable insulation containing asbestos. The term encapsulant is often used synonymously with sealer, sealant, and coatings. Encapsulants currently available include water-based latex polymers, water-soluble epoxy resins, and organic solvent-based polymers. The purpose of applying an encapsulant is to lock the asbestos fibers into their existing insulation matrix and prevent them from being jarred loose and becoming airborne.

In buildings, most of the potential health hazard from asbestos stems from microscopic asbestos fibers suspended in air that are subsequently inhaled. The airborne fibers are the result of fallout from asbestos-containing insulation caused by various factors such as: accidental disturbance, aging of the insulation matrix, building vibrations, vandalism, strong air currents moving across the surface, and water damage.

When Should Encapsulation Be Considered?

Encapsulants should be applied only to sound insulation material. Prime prerequisites for encapsulation are:

- The asbestos-containing material must firmly adhere to its substrate.
- The asbestos-containing material has good cohesive strength.

*Naval Civil Engineering Laboratory. Technical Report R-833: Management procedure for assessment of friable asbestos insulating material, by E. E. Lory and D. S. Coin, of VSE Corp. Port Hueneme, Calif., Feb 1981.

- The asbestos-containing insulation is generally undamaged.

- Water damage (plumbing or roof leaks) has not occurred and is not likely to occur in the future.

- Mechanical damage due to accidental contact or vandalism is not likely to occur.

- Frequent maintenance or repair of building components buried or covered by the insulation is not required.

If all of the aforementioned conditions permit the installation of an encapsulant, the ramifications and possible deleterious effects of its application must be considered:

- Since most encapsulants have a very low coverage rate, i.e. between 10 and 50 square feet per gallon, a great weight is initially applied to the insulation until the vehicle of the encapsulant evaporates. This added load could pull the fiber matrix apart or cause it to delaminate from the substrate.

- Most encapsulants are water-based. They could possibly dissolve certain water-soluble binders originally used in the insulation and cause the system to fail.

- Most encapsulants make the insulation impervious to water. If some or all of the insulation will have to be removed at a later date, it will be impossible to employ a "wet method," as recommended by the Environmental Protection Agency (EPA). Therefore, it will make efficient fiber control more difficult and more expensive.

- If the asbestos-containing insulation has been installed as fireproofing, the application of an encapsulant could derate it by lowering its fire retarding value.

- Insulation installed for acoustical control, like the acoustical plasters, could be affected. Coating these surfaces with an encapsulant will lower their sound-absorptive quality and necessitate additional and remedial work.

To take the guesswork out of making the right assessment, two guidelines are established.

- The softer, thicker, and more fibrous an insulation material appears, the less suitable it is for an encapsulant. A rule of thumb is not to encapsulate highly fibrous insulation over 1 inch thick. Hard insulations like granular/cementitious material, fireproofing, and acoustical plasters lend themselves more to encapsulation.

- If a Naval facility with asbestos-containing insulation has a history of being renovated and modified because of changing mission requirements, an encapsulation project should not be considered. Removing the insulation completely in conjunction with such renovation is recommended.

Table 1 lists a simplified decision tree that encompasses the criteria to be considered before the encapsulation abatement method is selected.

It is evident that the encapsulation method has only limited application in Navy facilities, particularly since some parameters in the evaluation are unknown and only educated guesses are possible. The overriding fact is that the source of asbestos-fiber pollution will still remain and is only sealed off from the breathing air environment.

Research conducted during well-documented encapsulation work on fibrous asbestos insulation has shown that fiber contamination can exceed the permissible Threshhold Limit Value (TLV) of 2 fibers per cubic centimeter (2 f/cc). Therefore, a project of this nature will have to comply with all safety precautions promulgated by EPA and the Occupational Safety and Health Act (OSHA), as stated in Reference 1 and work procedures described in the Appendix* of this report.

In those cases in which encapsulation meets the OSHA standards, it is the least costly alternative among the asbestos hazard abatement measures. It is prudent, therefore, to consider its value and when its application is suitable, to prepare cost estimates for all alternatives and compare the cost and benefits of each.

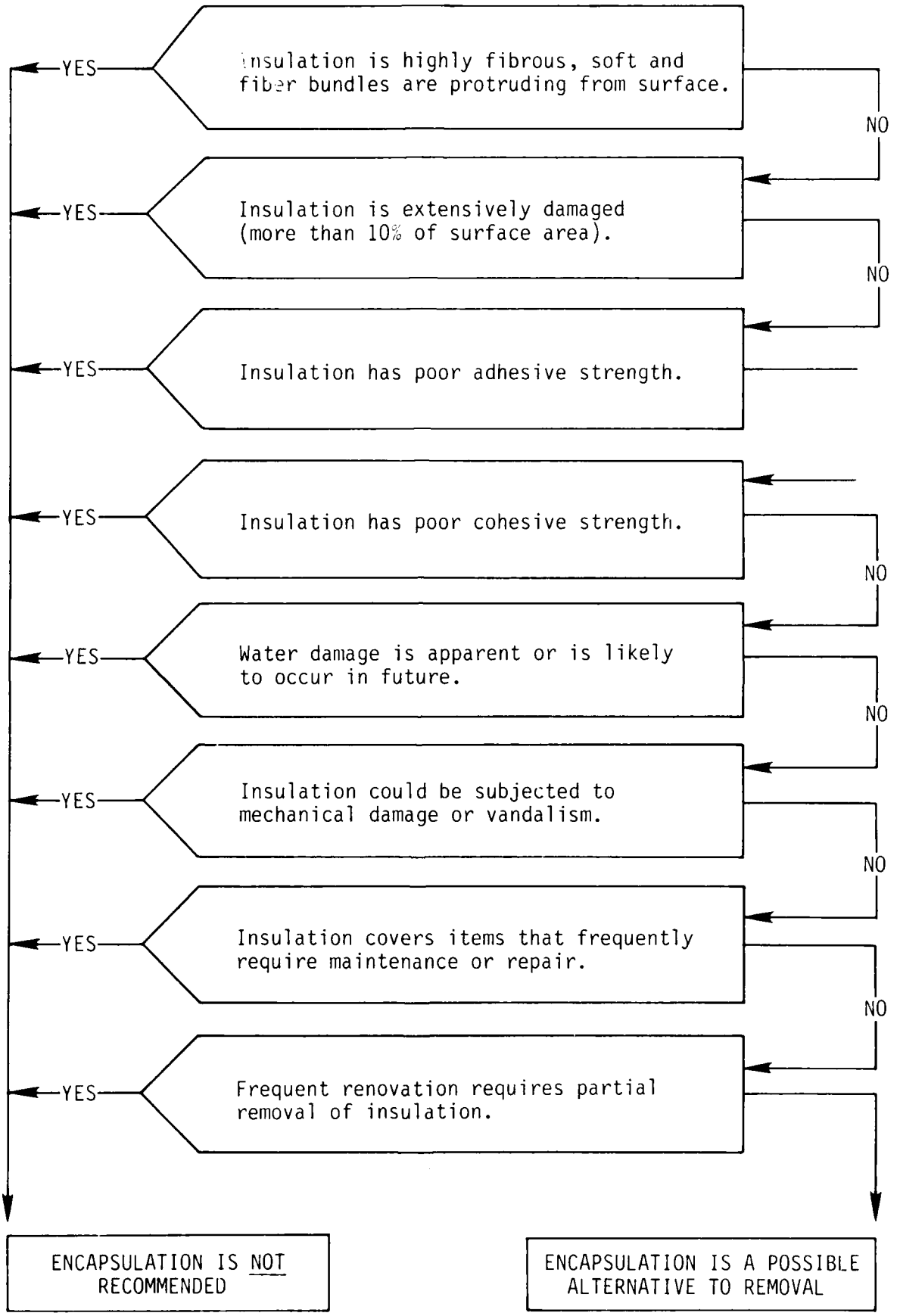
WHAT ENCAPSULANT MATERIALS ARE AVAILABLE?

Encapsulant Composition

Encapsulants have three basic component parts: (1) the volatile vehicle (solvent or dispersant), (2) the non-volatile vehicle (resin), and (3) the pigment. The resin component is dissolved or dispersed in the solvent so that the finely ground pigment dispersed in the mixed vehicle is the only solid material present in the coating. The solvent evaporates into the atmosphere as the coating cures and, therefore, is not present in the cured film. The resin (sometimes called binder) is composed of one or more polymers or prepolymers that form a continuous film upon curing. Accordingly, coatings are classified generically by the type of resins used in their formulations. Common types of encapsulating agent resins include: butyl-rubber emulsion, acrylic, acrylic-epoxy, polyvinyl acetate copolymer, silicate hydrate, and potassium silicate.

*NAVFAC Guide Specification (NFGS-09876) entitled, "Encapsulation of Asbestos Materials."

Table 1. Decision Tree For/Against Encapsulation



The primary pigments used in coatings are opaque and, thus, impart hiding as well as color. Because titanium dioxide has more opacity than other primary pigments, it is used extensively in both white and colored coatings. Secondary pigments include: (1) fillers, such as talc to regulate flow, brushability, etc.; (2) fibers to increase reinforcement; and (3) flakes to reduce water permeability or increase abrasion resistance.

Other materials, such as driers, plasticizers, and emulsifiers are added to coatings to create special properties. For laboratory purposes, they are considered to be part of the resin or pigment, depending upon their solubility.

While all solvent is lost after the coating has cured, the proportions of resin and pigment remain the same.

Types of Encapsulant

Encapsulants are classified into two categories by the nature of their performance: bridging and penetrating.

Bridging encapsulants are designed to form an impervious coating (membrane) over the asbestos-containing insulation material to prevent any fibers from becoming dislodged and airborne. Ideally, this coating should be tough, continuous, have vapor permeability only in one direction (from the insulation side) and be aesthetically acceptable since it is usually visible. Encapsulants in this group are above 35% solid content and have high viscosities (greater than 1,000 centipoises). Figure 1 is a surface detail of an installed bridging encapsulant enlarged by a scanning electron microscope (SEM) and shows a relatively continuous membrane.

Penetrating encapsulants are designed to be absorbed, to the saturation point, into the asbestos-containing insulation material. Upon curing, the fiber matrix of the insulation system should be locked or "glued" together, thus preventing fibers from becoming airborne. The penetrating encapsulants are low in solids (maximum 35%) and have low viscosities (usually less than 100 centipoises). Figure 2 is a detailed SEM photograph of an installed penetrating encapsulant in which the globules of sealant can be seen spanning some fibers and only coating the surface of others.

Choosing the Correct Encapsulant

Since bridging encapsulants only treat the surface and do not enhance the cohesive properties of the insulation matrix, they should be selected as a coating for insulations that are strong and cohesive due to the nature and proportions of their ingredients. These are generally of the granular/cementitious (acoustical plasters) and the fireproofing variety. Because these insulations are denser, their surface pores can be more easily bridged by the coating. Also, because of their hard, rubber-like compressibility, the encapsulants need not have a great amount of elasticity or resilience to impact.

Figure 1. Installed bridging encapsulant enlarged by a scanning electron microscope.

Figure 2. Installed penetrating encapsulant. Notice the globules of sealant spanning some fibers and only coating the surface of others.

Penetrating encapsulants are more appropriate for use on softer insulations with a high-fiber content. If the asbestos-containing material has a spongy resilience, a penetrating sealant should be used. If the insulation is thin enough, the encapsulant will penetrate to the substrate and increase the adhesive bond.

Published Material Specifications and Performance Criteria for Encapsulants

To date performance standards and test criteria for encapsulants have not been established. It is, therefore, difficult for the specifier and designer to choose an encapsulant that can be expected to perform well on an existing insulation.

The EPA recently completed a study that evaluated 100 sealants. The sealants were categorized into bridging and penetrating encapsulants and were tested for toxic gas release, impact strength, flexibility, abrasion resistance, and adhesive and cohesive strength. The results from these tests were used to collectively rank the encapsulants in order of their quality of performance. A small number of sealants with the highest quality scores was selected and subjected to further testing for surface flammability by the ASTM E-162 method. This test has been the only one to yield a hard pass/fail grade that is recognized by industry and code officials. This should be kept in mind when studying the current sales and promotional literature of encapsulant manufacturers.

Because of the lack of standard performance criteria for a singular-use material such as an encapsulant, Government and industry have asked the American Society for Testing and Materials (ASTM) to develop a standard specification. An ASTM task group is currently working on such a standard and is expected to have it published in 1983 under the title: "Standard Specification for Encapsulating Agents for Friable Asbestos-Containing Building Materials." This new standard will cover both laboratory and field tests, will incorporate existing test methods, and will specify new procedures particularly applicable to the expected performance of encapsulants.

APPLICATION METHODS FOR ENCAPSULANTS

Application methods are almost as numerous as there are types of sealants. The application process should minimize the dislodging and dispersing of the asbestos fibers. Therefore, the specific instructions accompanying the encapsulating product should be closely followed. It is advisable that, for more extensive projects, the sealant manufacturer's representative be on site to assist the contractor in determining the correct application techniques.

Airless spray is the most common method employed in sealant application. To minimize fiber disturbance, the pump and nozzle pressures should be adjusted as low as possible and still be compatible with the product being sprayed. In order to apply the maximum amount of sealant that the insulation will accept, various misting and saturation techniques are used during the application process. The purpose of the

light mist is to seal loose fibers into the surface. Each succeeding coat should be applied at right angles to the preceding application insofar as practicable. This application technique for bridging encapsulants should prevent any holes or voids from being formed in the membrane.

A less frequently used method is roller application. Since some amount of pressure on the roller is needed to work the sealant in (squeezing the coating into all holes and voids), mechanical disturbance of the insulation is likely to occur. This method should be employed with bridging encapsulants on hard, dense asbestos-containing insulation only.

Before the sealant application begins, all loose insulation material from isolated, damaged areas should be cut off. Adjacent surfaces not being sealed should be protected from overspray.

The rate of coverage depends primarily on the individual insulation matrix. The higher the density or the thinner the insulation, the less sealant will be needed. Coverage rates may range from 10 square feet per gallon to 60 square feet per gallon for penetrating sealants, to from 40 square feet per gallon to 120 square feet per gallon for bridging sealants. The amount needed will not be known until a significant portion of insulation has been encapsulated. This poses a problem for contractors estimating on a lump-sum bid and estimators preparing a Government cost estimate, particularly for projects where penetrating sealants are specified. It is, however, feasible to specify an average minimum coverage rate based on an educated guess and to negotiate with the contractor if more encapsulant is needed.

SIGNIFICANCE OF FIELD TESTING AND INSPECTION

If an encapsulation project is contemplated for more than 10,000 square feet of asbestos-containing insulation, the preparation of test patches is recommended. This will eliminate much of the guessing that is unique to encapsulation. A small contract should be awarded to encapsulate three test patches, each 50 square feet in size, using three sealants thought to be most suitable for the existing insulation matrix. Manufacturers' representatives should be on site with the contractor and Government representatives to monitor the application techniques and ensure that the desired results will be duplicated in subsequent major construction contracts. After the three test patches have cured, a field test should be done in accordance with the ASTM method. The test results should be documented. A sole source authority may have to be obtained to specify the sealant that gives the best performance.

The importance of test patches cannot be overemphasized. There have been many projects where the entire insulation had been sealed, only to fail soon thereafter. Of equal importance is to have the manufacturer represented, since he knows his product best and has probably had valuable experience with similar encapsulation projects.

The preparation of test patches provides a further indication of whether encapsulation is a suitable solution at all. Figure 3 shows a bridging encapsulant that did not completely bridge. Although this photograph was taken with an SEM, the voids were noticeable to the naked

eye upon close scrutiny or with the aid of a magnifying glass. When using the ASTM field test method, a plug must be cut from the encapsulated insulation matrix. A plug sample will indicate, as in Figure 4, how deep the sealant has penetrated the insulation matrix. A plug sample can clearly indicate if good penetration to the substrate was achieved.

SPECIFICATION PREPARATION AND CONTRACT INSPECTION

The specifications for major projects should call for an encapsulation system that will provide the best performance of the three products tested. For projects of limited areas, i.e., less than 10,000 square feet, three products having the greatest promise can be listed. Despite some manufacturer's claims, airborne asbestos fiber concentrations can rise quite significantly during encapsulation. Therefore, all precautions such as separation barriers, filtered exhaust ventilation, worker protection, and environmental air monitoring must be observed.

The sealant application requires close inspection by the Government. The contractor should be held to the same quality of installation as the test patch demonstrated. The coverage rate is the best indicator of acceptable contractor performance and full depth of dry-film coverage; thus, the inspector should assure that a consistent rate (xx square feet per yy gallon) is applied. Many contractors, painters in particular, use coverage rates as high as 250 square feet per gallon and have difficulty understanding why the desired rate is usually specified as 10 square feet per gallon.

SUMMARY

The encapsulation of asbestos-containing materials is a new field in the construction industry as well as for architects and engineers involved in such projects. Many variables involved in encapsulation of FIM containing asbestos should be considered before selecting and specifying encapsulation systems. Hasty decisions can be very costly.

Field tests should be performed to form the basis for these specifications. Standard methods and textbook procedures for coating systems in general cannot be adapted because the existing building material being encapsulated is usually different for each installation. For example, the building can be between 15 and 45 years old, in various stages of repair, or contain several unknown ingredients. Although RDT&E of encapsulant materials and their applications can provide some degree of standardization and design guidance, architects, engineers, and specifiers should thoroughly evaluate the existing conditions and use the best engineering judgment in selecting suitable materials and systems to properly abate the asbestos hazard.

Figure 3. A failed bridging encapsulant taken with an SEM.

Figure 4. Plug samples were cut to determine how deep the sealant penetrated.

Appendix

NAVFAC GUIDE SPECIFICATION (NFGS-09876)

DEPARTMENT OF THE NAVY
NAVAL FACILITIES
ENGINEERING COMMAND
GUIDE SPECIFICATION

SECTION 09876

ENCAPSULATION OF ASBESTOS MATERIALS

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Division Director:_____ _____ _____ _____

Approval for NAVFAC:_____ _____

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DEPARTMENT OF THE NAVY
NAVAL FACILITIES
ENGINEERING COMMAND
GUIDE SPECIFICATION

SECTION 09876

ENCAPSULATION OF ASBESTOS MATERIALS (A)

PART 1 - GENERAL

1.1 APPLICABLE PUBLICATIONS: The publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by the basic designation only. (C)

1.1.1 Code of Federal Regulations (CFR) Publications:

29 CFR 1910.1001	Asbestos
29 CFR 1910.134	Respiratory Protection
29 CFR 1910.145	Specifications for Accident Prevention Signs and Tags
40 CFR 61, Subpart A	General Provisions
40 CFR 61, Subpart B	National Emission Standard for Asbestos

1.1.2 American National Standard Institute (ANSI) Publications:

Z9.279	Fundamentals Governing the Design and Operation of Local Exhaust Systems
Z88.280	Practices for Respiratory Protection

1.1.3 American Society for Testing and Materials (ASTM)

ASTM Standard (future) will be issued in near future.

1.1.4 National Institutes for Occupational Safety and Health (NIOSH)

77-173 NIOSH Occupational Exposure Sampling Strategy Manual.

1.2 ENCAPSULATION AND DISPOSAL:

1.2.1 Description of Work: The work covered by this section includes the encapsulation of friable materials containing asbestos and procedures and equipment required to protect workers and occupants of the building or areas, or both, from contact with airborne asbestos fibers.

The work also includes the disposal of asbestos-containing and contaminated materials. The asbestos work involves the encapsulation of _____ located _____. The asbestos control area for the encapsulation project is defined as _____. (E) (F)

1.2.2 Definitions:

1.2.2.1 Encapsulant: The term encapsulant is used synonymously with sealant or coating. Encapsulants are of two kinds: those that penetrate the sprayed material and those that cover or bridge the material with a protective coating.

1.2.2.2 Asbestos: The term asbestos includes chrysotile, amosite, crocidolite, tremolite, anthophyllite, and actinolite.

1.2.2.3 Asbestos Control Area: An area where asbestos encapsulation operations are performed which is isolated by physical boundaries to prevent the spread of asbestos dust, fibers, or debris.

1.2.2.4 Asbestos Fibers: This expression refers to asbestos fibers having an aspect ratio of 3:1 and longer than 5 micrometers.

1.2.2.5 Ceiling Concentration: A concentration of airborne asbestos fibers at any time in excess of 10 fibers, longer than 5 micrometers, per cubic centimeter of air.

1.2.2.6 Area Monitoring: Sampling of asbestos fiber concentrations within the asbestos control area and outside the asbestos control area which is representative of the airborne concentrations of asbestos fibers which may reach the breathing zone. Sampling is to be conducted under NIOSH procedures and guidelines.

1.2.2.7 Friable Asbestos Material: Material that contains more than one percent asbestos by weight and that can be crumbled, pulverized, or reduced to powder by hand pressure when dry.

1.2.2.8 HEPA Filtered Equipment: High Efficiency Particulate air filtered equipment with a filter system capable of collecting and retaining asbestos fibers. Filters shall be at least 99.97 percent efficient for retaining fibers of 0.3 microns or larger.

1.2.2.9 Personal Monitoring: Sampling of asbestos fiber concentrations within the breathing zone of an employee. Sampling performed to NIOSH Standards.

1.2.2.10 Time Weighted Average (TWA): A minimum of three samples are required to establish the 8-hour time weighted average. The TWA is an 8-hour time weighted average airborne concentration of fibers, longer than 5 micrometers, per cubic centimeter of air.

1.2.3 Title to Materials: All work resulting from encapsulation work, except as specified otherwise, shall become the property of the Contractor and shall be disposed of as specified herein.

1.2.4 Protection of Existing Work to Remain: Perform encapsulation without damage or contamination of adjacent work. Where such work is damaged or contaminated, it shall be restored to its original condition.

1.2.5 Medical Requirements: 29 CFR 1910.1001.

1.2.5.1 Medical Examinations: Before exposure to airborne asbestos fibers, provide workers with a comprehensive medical examination as required by 29 CFR 1910.1001. This examination is not required if adequate records show the employee has been examined as required by 29 CFR 1910.1001 requirements within the past year. The same medical examination shall be given on an annual basis to employees engaged in an occupation involving asbestos fibers and within 30 calendar days before or after the termination of employment in such occupation. Specifically identify x-ray films of asbestos works to the consulting radiologist and mark medical record jackets with the word "ASBESTOS."

1.2.5.2 Medical Records: Maintain complete an accurate records of employees' medical examinations for a period of [40] [20] [__] years after termination of employment and make records of the required medical examinations available for inspection and copying to: The Assistant Secretary of Labor for Occupational Safety and Health, The Director of The National Institute for Occupational Safety and Health (NIOSH), authorized representatives of either of them, and an employee's physician upon the request of the employee or former employee. (G)

1.2.6 Training: Within 3 months prior to assignment to asbestos work, instruct each employee with regard to the hazards of asbestos, safety and health precautions, and the use and requirements for protective clothing and equipment including respirators. Fully explain and demonstrate engineering and work practice techniques and procedures.

1.2.7 Permits and Notifications: Secure necessary permits in conjunction with the asbestos encapsulation, hauling, and disposition and provide timely notification of such actions as may be required by federal, state, regional, and local authorities. Notify the Regional Office of the United States Environmental Protection Agency (USEPA) in accordance with 40 CFR 61.22 (d)(1) and provide copies of the notification to the Contracting Officer and the State Environmental Regulatory Agency 20 days prior to commencement of the work. (H)

1.2.8 Safety Compliance: In addition to detailed requirements of this specification, comply with laws, ordinances, rules, and regulations of federal, state, regional, and local authorities regarding handling, storing, transporting, and disposing of asbestos waste materials. Comply

with the applicable requirements of the current issue of 29 CFR 1910.1001 and 40 CFR 61, Subparts A and B. Submit matters of interpretation of standards to the appropriate administrative agency for resolution before starting the work. Where the requirements of this specification and referenced documents vary, the most stringent requirement shall apply.

1.2.9 Respirator Program: Establish a respirator program as required by ANSI Z88.2 and 29 CFR 1910.134.

1.2.10 Industrial Hygienist: Conduct air monitoring and training by or under the direction of an industrial hygienist certified by the American Board of Industrial Hygiene in the Comprehensive Practice of Industrial Hygiene.

1.3 SUBMITTALS: The following items shall be submitted to and approved by the Contracting Officer prior to commencing encapsulating material involving asbestos materials.

1.3.1 Encapsulant: Submit 3 quarts of encapsulating material in manufacturer's unopened containers with certificate of compliance with ASTM _____. Encapsulant shall be water based.

1.3.2 Certificates of Compliance: Submit manufacturers' certification that vacuums, ventilation equipment, and other equipment required to contain airborne asbestos fibers conform to ANSI Z9.2.

1.3.3 Asbestos Plan: Submit a detailed plan of the work procedures to be used in the encapsulation of materials containing asbestos. Such plan shall include the location of asbestos control areas, change rooms, layout of change rooms, interface of trades involved in the construction, sequencing of asbestos related work, disposal plan, asbestos encapsulant to be used, air monitoring procedures, and a detailed description of the method to be employed to control pollution. This plan must be approved prior to the start of any asbestos work.

1.3.4 Testing Laboratory: Submit the name, address, and telephone number of the testing laboratory selected for the monitoring of airborne concentrations of asbestos fibers along with certification that persons counting the samples have been judged proficient by successful participation in the National Institute for Occupational Safety and Health (NIOSH) Proficiency Analytical Testing (PAT) Program.

1.3.5 Industrial Hygienist: Submit the name, address, and telephone number of the industrial hygienist selected to direct monitoring and training, and certification of the industrial hygienist by the American Board of Industrial Hygiene.

1.3.6 Monitoring Results: Fiber counting shall be completed and results reviewed by the industrial hygienist within 16 hours. The industrial hygienist shall notify the Contractor and the Contracting Officer immediately of any exposures to asbestos fibers in excess of the acceptable limits. Submit all monitoring results to the Contracting Officer within 3 working days.

1.3.7 Notification: Notify the Contracting Officer 3 working days prior to the start of asbestos work.

1.3.8 Landfill: Submit written evidence that the landfill for disposal is approved for asbestos disposal by the USEPA and state or local regulatory agency(s). (I)

1.3.9 Local Exhaust System: Pressure differential recordings for each work day shall be monitored and reviewed by the contractor and submitted to the Contracting Officer within 24 hours from the end of each work day. The Contractor shall immediately remedy any variance in the pressure differential which could cause exposure of adjacent unsealed areas to asbestos fiber concentrations in excess of the TWA. (J)

1.3.10 Training: Submit certificates signed by each employee that the employee has received training in the proper handling of materials that contain asbestos; understands the health implications and risks involved, including the illnesses possible from exposure to airborne asbestos fibers; understands the use and limits of the respiratory equipment to be used and understands the results of monitoring of airborne quantities of asbestos as related to health and respiratory equipment.

PART 2 - EXECUTION

2.1 MATERIAL: Conform to ASTM _____. The encapsulant shall be [penetrating] [bridging] type [a combination of bridging and penetrating].

2.2 EQUIPMENT: At all times, make available to the Contracting Officer for personal use two complete sets of protective equipment as required herein for entry to the asbestos control areas for inspection of the asbestos control areas. (K)

2.2.1 Respirators: Select respirators from those certified by the Mine Safety and Health Administration (MSHA), Department of Labor, or the National Institute for Occupational Safety and Health (NIOSH), Department of Health and Human Services.

2.2.1.1 Respirators for Handling Asbestos: Provide personnel engaged in the application of encapsulants on asbestos materials with Type C supplied-air respirators, continuous flow or pressure demand class.

2.2.1.2 Optional Respirators for Encapsulant Application: Use Type C continuous flow or pressure-demand, supplied-air respirators until the Contractor establishes that the average airborne concentrations of asbestos the employees will confront will not exceed 100 times the permissible exposure limits; i.e., 8-hour time-weighted average (TWA) and ceiling limit. When the exposure limits are established, the respirators presented in 29 CFR 1910.1001 that afford adequate protection at such upper concentrations of airborne asbestos may be used. If the Contractor decides to provide respirators other than a Type C continuous flow or pressure-demand, supplied-air respirator, the Contractor shall determine the exposure of each employee to airborne asbestos during each type of encapsulation operation. Determine both the ceiling limit and the 8-hour, time-weighted average concentration of asbestos to which each of the employees is exposed during each type of encapsulant operation.

2.2.2 Special Clothing:

2.2.2.1 Protective Clothing: Provide personnel exposed to airborne concentrations of asbestos fibers with fire retardant disposable protective whole body clothing and headcoverings, gloves, and foot coverings. Provide disposable plastic or rubber gloves to protect hands. Cloth gloves may be worn inside the plastic or rubber gloves for comfort, but shall not be used alone. Make sleeves secure at wrists and make foot coverings secure at the ankle by the use of tape.

2.2.2.2. Work Clothing: Provide cloth work clothes for wear under the disposable protective coveralls and foot coverings.

2.2.3 Change and Decontamination Rooms: Provide a temporary unit with a separate decontamination locker room and a clean locker room for personnel required to wear whole body protective clothing. Provide two separate lockers for each asbestos worker, one in each locker room. Keep street clothing and street shoes in the clean locker. Vacuum and remove asbestos contaminated disposable protective clothing while still wearing respirators at the boundary of the asbestos work area and seal in impermeable bags or containers for disposal. Do not remove disposable protective clothing in the decontamination locker room. Remove cloth work clothing in the decontamination room. Tag and bag cloth work clothes for laundering and keep work shoes in the decontamination locker. Do not wear work clothing between home and work. Locate showers between the decontamination locker room and the clean locker room and require that all employees shower before changing into street clothes. Clean asbestos-contaminated work clothing in accordance with 29 CFR 1910.1001.

2.2.4 Eye Protection: Provide goggles to personnel engaged in asbestos operations when the use of a full face respirator is not required.

2.2.5 Caution Signs and Labels. Provide [bilingual] caution signs at all approaches to asbestos control areas containing concentrations of airborne asbestos fibers. Locate signs at such a distance that personnel may read the sign and take the necessary protective steps required before entering the area. Provide labels and affix to all asbestos materials, scrap, waste, debris, and other products contaminated with asbestos.

2.2.5.1 Caution Sign: Vertical format conforming to 29 CFR 1910.145(d)(4), minimum 20 by 14 inches.

2.2.6 Tools and Local Exhaust System: Provide a local exhaust system in the asbestos control area. The local exhaust system shall be in accordance with ANSI Z9.2. Equip exhaust with absolute (HEPA) filters. Local exhaust equipment must be sufficient to maintain a minimum pressure differential of minus 0.02 inch of water column relative to adjacent unsealed areas. Provide continuous 24-hour per day monitoring of the pressure differential with an automatic recording instrument. In no case shall the building ventilation system be used as the local exhaust system for the asbestos control area. (J)

2.3 WORK PROCEDURE: Perform asbestos related work in accordance with 29 CFR 1910.1001 and as specified herein. Personnel shall wear and utilize protective clothing and equipment as specified herein. Eating, smoking, or drinking shall not be permitted in the asbestos control area. Personnel of other trades not engaged in the encapsulation of asbestos shall not be exposed at any time to airborne concentrations of asbestos unless all the personnel protection provisions of this specification are complied with by the trade personnel. Shut down the building heating, ventilating, and air conditioning system (and provide temporary heating, ventilation, and air conditioning).

2.3.1 Furnishings: Furniture (_____) and equipment will be removed from the area of work by the Government before asbestos work begins. (L)

OR

2.3.1 Furnishings: Furniture (_____) and equipment will remain in the building. Cover all furnishings with 6-mil plastic sheet and seal with tape. (L)

OR

2.3.1 Furnishings: (Furniture,) (books,) (equipment,) (carpeting,) (draperies,) (venetian blinds,) and (____) in the work area (is) (are) contaminated with asbestos fibers. Transfer these items to an area on site approved by the Contracting Officer set aside for cleaning (wet cleaning where possible or HEPA filter vacuuming) and then store until the room from which they came is declared clean and safe for entry. (L)

(Carpets, draperies, and other items which may not be suitable for on-site wet cleaning methods shall be laundered in accordance with 29 CFR 1910.1001.) At the conclusion of the asbestos encapsulation work and cleanup operations, transfer all objects so removed and cleaned back to the area from which they came and re-install them.

2.3.2 Masking and Sealing:

2.3.2.1 Asbestos Control Area Requirements: Seal openings in areas where the release of airborne asbestos fibers is expected. Establish an asbestos control area with the use of curtains, portable partitions, or other enclosures in order to prevent the escape of asbestos fibers from the contaminated asbestos control area. In all possible instances, control area development shall include protective covering of walls and ceilings with a continuous membrane of one layer of minimum 4-mil plastic sheet sealed with tape to prevent water or other damage. Provide two layers of 6-mil plastic sheet over floors and extend a minimum of 12 inches up walls. Seal all joints with tape. Provide a local exhaust system in the asbestos control area. Openings will be allowed in enclosures of asbestos control areas for the supply and exhaust of air for the local exhaust system. Replace filters as required to maintain the efficiency of the system. (M)

(2.3.2.2 Asbestos Control Area Requirements: The construction of an enclosed asbestos control area is impractical for the encapsulation of ____ located ____. Establish designated limits for the asbestos work area. With the use of rope or other continuous barriers maintain all other requirements for asbestos control areas. Conduct area monitoring of airborne asbestos fibers during the work shift at the designated limits downwind of the asbestos work area at such frequency as recommended by the Industrial Hygienist. If the quantity of airborne asbestos fibers monitored at the designated limits at any time reaches the time-weighted average specified, evacuate personnel in adjacent areas or provide personnel with approved protective equipment. If adjacent areas are contaminated, clean the contaminated areas, monitor, and visually inspect the area as specified herein.)

2.3.3 General Procedures: Before the application of encapsulant material, selectively remove by cutting all loose and surface-damaged portions of the insulation. Pretreat hose areas with amended water.

2.3.4 Application of Encapsulant: Apply the encapsulant in accordance with the manufacturer's recommended application instructions. Prepare three test patches, size 3 feet by 3 feet minimum, in different, yet typical, areas of the building. Fully cure the test patches and take samples. For bridging types, cut a sample to measure dry film thickness. For the combination per/bridging and penetrating type, cut a plug sample to measure depth of penetration. In the presence of the Contracting Officer, determine if the encapsulation material and application technique are acceptable in accordance with ASTM _____.

2.3.5 Monitoring: Monitoring of airborne concentrations of asbestos fibers shall be in accordance with 29 CFR 1910.1001 and as specified herein.

2.3.5.1 Monitoring Prior to Asbestos Work: Provide area monitoring and establish the Reference TWA one day prior to the masking and sealing operations for each asbestos control area.

2.3.5.2 Monitoring During Asbestos Work: Provide personal and area monitoring and establish the TWA during the first exposure to airborne concentrations of asbestos. Thereafter, provided the same type of work is being performed, provide area monitoring once every 4 hours during the work shift inside the asbestos control area, outside the entrance to asbestos control area, and at the exhaust opening of the local exhaust system. If monitoring outside the asbestos control area shows airborne concentrations have reached the specified TWA, stop all work, correct the condition(s) causing the increase, and notify the Contracting Officer immediately. (In areas where the construction of an asbestos control area is not required, establish initial (reference) TWA's and, provided the same type of work is being performed, conduct monitoring at the designated limits of the asbestos work area at such frequency as recommended by the Industrial Hygienist.) (N)

2.3.5.3 Monitoring After Final Clean-Up: Provide area monitoring of asbestos fibers and establish the TWA of less than 0.5 fibers/cc after final cleanup but before removal of the enclosure of the asbestos control area. Provide area monitoring and establish the TWA 5 days and 15 days, [and 30 days] after the enclosure of the asbestos control area is removed (or after final cleanup when an enclosure is not required.) The fiber counts from these samples shall be less than 0.5 fibers/cc or be not greater than the Reference TWA, whichever is less. Should any of the final samplings indicate a higher value, the Contractor shall take appropriate actions to reclean the area and shall repeat the monitoring. (N)

2.3.6 Government Inspection: While performing asbestos encapsulation work, the Contractor shall be subject to onsite inspection by the Contracting Officer who may be assisted by safety or health personnel. If the work is found to be in violation of this specification, the Contracting Officer will issue a stop work order to be in effect immediately and until the v ation is resolved. Standby time, required to resolve the violation, shall be at the Contractor's expense.

2.4 CLEAN-UP AND DISPOSAL:

2.4.1 Housekeeping: Essential parts of asbestos dust control are housekeeping and clean-up procedures. Maintain surfaces of the asbestos control area free of accumulations of asbestos fibers. Give meticulous attention to restricting the spread of dust and debris; keep waste from being distributed over the general area. Do not blow down the space with compressed air. When asbestos encapsulation is complete, all

asbestos debris is removed from the worksite, and final cleanup is completed, certify the area as safe before the signs are removed. After final cleanup, remove all filters on the building HVAC system and provide new filters. Dispose of filters as asbestos-contaminated materials. Reestablish HVAC, mechanical, and electrical systems in proper working order. The Contracting Officer will visually inspect for accumulated dust and the Contractor shall re-clean all areas showing dust. If re-cleaning is required, monitor the asbestos airborne concentration after re-cleaning. Notify the Contracting Officer before unrestricted entry is permitted. The Government shall have the option to perform monitoring to certify the areas are safe before entry is permitted.

2.4.2 Disposal of Asbestos: (O)

2.4.2.1 Procedure for Disposal: Collect asbestos waste, masking debris, and asbestos-contaminated clothing which may produce airborne asbestos fibers and place in sealed impermeable bags. Affix a caution label to each bag.

Dispose of waste asbestos material (by burial under at least 6 inches of daily compacted cover of nonasbestos materials and by final cover of at least 2 feet of compacted earth.) (at an Environmental Protection Agency (EPA) or state-approved sanitary landfill off Government property.) For temporary storage, store sealed impermeable bags in asbestos waste drums or skips. An area for interim storage of asbestos waste-containing drums or skips will be assigned by the Contracting Officer or his authorized representative. Procedure for hauling and disposal shall comply with 40 CFR 61 (Subpart B), state, regional, and local standards. Sealed plastic bags may be dumped from drums into the burial site unless the bags have been broken or damaged. Damaged bags shall remain in the drum and the entire contaminated drum shall be buried. Uncontaminated drums may be recycled. Workers unloading the sealed drums shall wear appropriate respirators and personal protective equipment when handling asbestos materials at the disposal site. (P)

*** END OF SECTION ***

GENERAL NOTES

1. This guide specification shall not be referenced but is to be used as a manuscript in preparing project specifications. APPROPRIATE CHANGES AND ADDITIONS AS MAY BE NECESSARY AND AS REQUIRED BY THE NOTES MUST BE MADE. Where the phrase "unless indicated or specified otherwise", "as indicated", or words of similar import are used, appropriate requirements, as necessary, shall be included in the project drawings of specifications.

2. The capital letters in the right hand margins indicate that there is a technical note pertaining to that portion of the guide specification. It is intended that the letters in the margins be deleted before typing the project specifications.

3. Where numbers, symbols, words, phrases, clauses, or sentences in this specification are enclosed in brackets [ ], a choice or modification must be made; delete inapplicable portion(s) carefully. Where blank spaces occur in sentences, insert the appropriate data. Where more than one paragraph has the same number, delete those paragraphs that are not applicable. Where entire paragraphs are not applicable, they should be deleted completely.

4. CAUTION: Coordination of this section with other sections of the specification and with the drawings is mandatory. If materials or equipment are to be furnished under this section, but installed, connected, or placed in operation under other sections of the specification and/or the drawings, then state that fact clearly and concisely in this section and in all other sections involved. EACH DISCIPLINE SHALL REVIEW THE ENTIRE SPECIFICATION TO INSURE THAT LANGUAGE IS INCLUDED TO PROVIDE COMPLETE AND OPERABLE SYSTEMS AND EQUIPMENT.

5. DO NOT INCLUDE TABLE OF CONTENTS, GENERAL NOTES, AND TECHNICAL NOTES IN THIS SECTION IN FINAL MANUSCRIPT.

6. Suggestions for improvement of this specification will be welcomed and should be forwarded to:

COMMANDER
NAVAL FACILITIES ENGINEERING COMMAND
Code 0432
200 Stovall Street
Alexandria, VA 22332

REFERENCED NOTES

A. This guide specification covers the safety procedures and requirements for the encapsulation friable material containing asbestos. On small asbestos encapsulation operations an "enclosed" asbestos control area may not be required. The location of the area, type of material, and potential hazard must be reviewed and a judgment made by the designer. In a case where an enclosed area is not provided, many of the requirements in this specification should be deleted (see Notes M and N). State type of asbestos as chrysotile, amosite, or crocidolite

B. Specification, section, and page numbers shall be centered at the bottom of each page of this section.

EXAMPLE:

00-00-XXXX
09876-1

C. Paragraph 1.1: The listed designations for publications are those that were in effect when this guide specification was being prepared. Designations that are known to be out of date when project specifications are prepared should be changed to those current at that time, and the nomenclature, type, grades, classes, etc., referenced in the guide should be checked for conformance to the latest revision or amendment. To minimize the possibility of error, the letter suffixes, amendments, and dates indicating specific issues should be retained here and omitted elsewhere in the project specification.

D. Paragraph 1.2.1: The most common material in this category is asbestos insulation. The limits of asbestos encapsulation must be indicated on the drawings or in the specification in sufficient detail for the Contractor to submit an accurate bid. Portions of the building where asbestos work will take place must be unoccupied during the encapsulation operation. It is highly recommended in order to reduce exposure risk to occupants of the building that the entire building be unoccupied during asbestos encapsulation operations. If portions of the building where asbestos encapsulation is not taking place must remain occupied, additional requirements must be added for temporary heating/cooling and other utilities to the occupied portions of the building. The building heating/cooling system for example cannot be operated in the asbestos control area.

E. Paragraph 1.2.1: Insert the asbestos material to be encapsulated in the first blank and the location of the material in the second blank. Example: "The asbestos work includes the encapsulation of asbestos insulation located on ceiling in the boiler room."

F. Paragraph 1.2.1: Insert the location of the asbestos control area in the blank. The asbestos control area is the area where asbestos operations are performed and is isolated by physical boundaries to prevent the spread of asbestos dust, fibers, or debris (see paragraph 2.2.2.1). Example: "The asbestos control area for the encapsulation project is defined as the boiler room." If an "enclosed" asbestos control area is impractical and therefore not required, specify a distance from the asbestos work for the establishment of boundaries of the asbestos control area (see Note M).

G. Paragraph 1.2.5.2: OSHA 29 CFR 1910.1001 requires that medical records be retained at least 20 years. Some states require longer retention periods, the maximum being 40 years. Check with the state in which the project is located for the required retention time.

H. Paragraph 1.2.7: This paragraph may not be applicable for some overseas locations due to local government requirements. Verify the need for this requirement with the station safety officer.

I. Paragraph 1.3.8: Use this paragraph for all projects except projects in overseas locations where local Government regulations do not require a USEPA approved landfill.

J. Paragraphs 1.3.9 and 2.2.6: When an enclosed asbestos control area is not required, delete the requirements for the local exhaust system and pressure differential recording (see Note M).

K. Paragraph 2.2: Modify the number of sets of protective equipment as required, depending on the size of the asbestos encapsulation project.

L. Paragraph 2.3.1: In most projects, the Government will remove furniture and equipment before the contractor begins work. In this case the 1st paragraph should be used. The third paragraph should only be used when existing furnishings have been contaminated with asbestos fibers and the contractor will be required to clean these items. State distances and quantities where appropriate.

M. Paragraph 2.3.2.1 and 2.3.2.2: When an "enclosed" asbestos control area is impractical, such as for the encapsulation of asbestos insulation on very small operations, use paragraph 2.3.2.2 and delete paragraph 2.3.2.1. If the project has both areas which can be enclosed and areas which cannot be enclosed, retain both paragraphs and identify the areas which must be enclosed and the areas which cannot be enclosed.

N. Paragraphs 2.3.5.2 and 2.3.5.3: When an "enclosed" asbestos control area is not required, retain the portion in brackets.

O. Paragraphs 2.4.2: Disposal procedures and sites for asbestos materials vary considerably with each location. Contact local station Public Works and the NAVFAC division hazardous waste manager or industrial hygienist for local procedures.

P. Paragraph 2.4.2.1: Use the first portion in brackets or insert host country procedures for projects in overseas locations where local Government regulations apply and EPA has no jurisdiction. Use the second portion in brackets for all projects where EPA has jurisdiction.

*** E N D ***

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NARF Code 612, Jax, FL; Code 640, Pensacola FL; SCE Norfolk, VA
NAS CO, Guantanamo Bay Cuba; Code 114, Alameda CA; Code 183 (Fac. Plan BR MGR); Code 18700, Brunswick ME; Code 6234 (G. Trask), Point Mugu CA; Code 70, Atlanta, Marietta GA; Code 8E, Patuxent Riv., MD; Dir of Engrng, PWD, Corpus Christi, TX; Dir. Maint. Control Div., Key West FL; Dir. Util. Div., Bermuda; Lakehurst, NJ; Lead. Chief, Petty Offr. PW Self Help Div, Beeville TX; OIC, CBU 417, Oak Harbor WA; PW (J. Maguire), Corpus Christi TX; PWD - Engr Div Dir, Millington, TN; PWD - Engr

Div, Gitmo, Cuba; PWD - Engr Div, Oak Harbor, WA; PWD - Maint. Control Dir, Millington, TN; PWD Maint. Cont. Dir., Fallon NV; PWD Maint. Div., New Orleans, Belle Chasse LA; PWD, Code 1821H (Pfankuch) Miramar, SD CA; PWD, Maintenance Control Dir., Bermuda; PWD, Willow Grove PA; PWO Belle Chasse, LA; PWO Chase Field Beeville, TX; PWO Key West FL; PWO Sigonella Sicily; PWO Whiting Fld, Milton FL; PWO, Dallas TX; PWO, Glenview IL; PWO, Kingsville TX; PWO, Millington TN; PWO, Miramar, San Diego CA; PWO., Moffett Field CA; SCE Norfolk, VA; SCE, Barbers Point HI; SCE, Cubi Point, R.P; Security Offr, Alameda CA; Weapons Offr, Alameda, CA; Weapons Offr, North Island

NATL BUREAU OF STANDARDS B-348 BR (Dr. Campbell), Washington DC

NATL RESEARCH COUNCIL Naval Studies Board, Washington DC

NAVACT PWO, London UK

NAVACTDET PWO, Holy Lock UK

NAVAEROSPREGMEDCEN SCE, Pensacola FL

NAVAIRDEVCEN Code 813, Warminster PA; PWD, Engr Div Mgr, Warminster, PA

NAVAIRPROPTESTCEN CO, Trenton, NJ

NAVAVIONICFAC PW Div Indianapolis, IN; PWD Deputy Dir, D 701, Indianapolis, IN

NAVAVNWPNSFAC Wpns Offr, St. Mawgan, England

NAVCHAPGRU Engineering Officer, Code 60 Williamsburg, VA

NAVCOASTSYSCEN Code 423 Panama City, FL; Library Panama City, FL; PWO Panama City, FL

NAVCOMMAREAMSTRSTA Code W-60, Elec Engr, Wahiawa, HI; Maint Control Div., Wahiawa, HI; PWO, Norfolk VA; SCE Unit 1 Naples Italy; SCE, Wahiawa HI

NAVCOMMSTA Code 401 Nea Makri, Greece; PWD - Maint Control Div, Diego Garcia Is.; PWO, Exmouth, Australia; SCE, Balboa, CZ; Security Offr, Stockton CA

NAVEDTRAPRODEVCEN Technical Library, Pensacola, FL

NAVEDUTRACEN Engr Dept (Code 42) Newport, RI

NAVENVIRHLTHCEN CO, NAVSTA Norfolk, VA

NAVEODTECHCEN Code 605, Indian Head MD

NAVFAC PWO, Brawdy Wales UK; PWO, Centerville Bch, Ferndale CA; PWO, Point Sur, Big Sur CA

NAVFACENGCOM Code 043 Alexandria, VA; Code 044 Alexandria, VA; Code 0451 (P W Brewer) Alexandria, Va; Code 0453 (D. Potter) Alexandria, VA; Code 0454B Alexandria, Va; Code 046; Code 0461D (V M Spaulding) Alexandria, VA; Code 04A1 Alexandria, VA; Code 04B3 Alexandria, VA; Code 051A Alexandria, VA; Code 09M54, Tech Lib, Alexandria, VA; Code 100 Alexandria, VA; Code 1002B (J. Leimanis) Alexandria, VA; Code 1113, Alexandria, VA; Code 461D, Alexandria, VA; code 08T Alexandria, VA ; **Code 03 Alexandria, VA; Code 03T (Essoglou) Alexandria, VA**

NAVFACENGCOM - CHES DIV, Code 101 Wash, DC; Code 403 Washington DC; Code 405 Wash, DC; Code 407 (D Scheesele) Washington, DC; Code FPO-1C Washington DC; Contracts, ROICC, Annapolis MD; Library, Washington, D.C.

NAVFACENGCOM - LANT DIV, Code 403, Norfolk, VA; Code 405 Civil Engr BR Norfolk VA; Code 408, Norfolk, VA; Eur, BR Deputy Dir, Naples Italy; Library, Norfolk, VA; RDT&ELO 102A, Norfolk, VA

NAVFACENGCOM - NORTH DIV, CO; Code 04 Philadelphia, PA; Code 09P Philadelphia PA; Code 1028, RDT&ELO, Philadelphia PA; Code 111 Philadelphia, PA; Code 114 (A. Rhoads); Library, Philadelphia, PA; ROICC, Contracts, Crane IN

NAVFACENGCOM - PAC DIV, (Kyi) Code 101, Pearl Harbor, HI; CODE 09P PEARL HARBOR HI; Code 2011 Pearl Harbor, HI; Code 402, RDT&E, Pearl Harbor HI; Commander, Pearl Harbor, HI; Library, Pearl Harbor, HI

NAVFACENGCOM - SOUTH DIV, Code 405 Charleston, SC; Code 411 Soil Mech & Paving BR Charleston, SC; Code 90, RDT&ELO, Charleston SC; Library, Charleston, SC

NAVFACENGCOM - WEST DIV, 102; AROICC, Contracts, Twentynine Palms CA; Code 04B San Bruno, CA; Code 101.6 San Bruno, CA; Code 114C, San Diego CA; Library, San Bruno, CA; O9P 20 San Bruno, CA; RDT&ELO Code 2011 San Bruno, CA; Security Offr, Seattle WA

NAVFACENGCOM CONTRACTS ROICC MCAS El Toro; AROICC, NAVSTA Brooklyn, NY; ROICC, Point Mugu, CA; AROICC, Quantico, VA; Colts Neck, NJ; Contracts, AROICC, Lemoore CA; Dir, Eng, Div., Exmouth, Australia; Eng Div dir, Southwest Pac, Manila, PI; NAS, Jacksonville, FL; OICC, Southwest Pac, Manila, PI; OICC-ROICC, NAS Oceana, Virginia Beach, VA; OICC ROICC, Balboa Panama Canal; OICC ROICC, Norfolk, VA; ROICC AF Guam; ROICC Code 495 Portsmouth VA; ROICC Key West FL; ROICC Rota Spain; ROICC, Diego Garcia Island; ROICC, Keflavik, Iceland; ROICC, NAS, Corpus Christi, TX; ROICC, Pacific, San Bruno CA; ROICC, Yap; ROICC-OICC-SPA, Norfolk, VA

NAVFORCARIB Commander (N42), Puerto Rico

NAVMAG PWD - Engr Div, Guam; SCE, Guam; SCE, Subic Bay, R.P.

NAVOCEANSYSCEN Code 09 (Talkington), San Diego, CA; Code 4473 Bayside Library, San Diego, CA; Code 4473B (Tech Lib) San Diego, CA; Code 5221 (R.Jones) San Diego Ca; Code 6700, San Diego, CA

NAVORDMISTESTFAC PWD - Engr Dir, White Sands, NM

NAVORDSTA PWD - Dir, Engr Div, Indian Head, MD; PWO, Louisville KY; Security Offr, Indian Head MD; Security Offr, Indian Head MD

NAVPHIBASE CO, ACB 2 Norfolk, VA; Code S3T, Norfolk VA; SCE Coronado, SD,CA

NAVRADRECFAC PWO, Kami Seya Japan

NAVREGMEDCEN Code 29, Env Health Serv, CAI Bryson San Diego, CA; Code 3041, Memphis, Millington TN; PWD - Engr Div, Camp Lejeune, NC; PWO Portsmouth, VA; PWO, Camp Lejeune, NC
NAVREGMEDCEN PWO, Okinawa, Japan
NAVREGMEDCEN SCE; SCE San Diego, CA; SCE Camp Pendleton CA; SCE, Guam; SCE, Newport, RI; SCE, Oakland CA
NAVREGMEDCEN SCE, Yokosuka, Japan
NAVREGMEDCLINIC A. Watanabe, Pearl Harbor, HI
NAVSCOLCECOFF C35 Port Hueneme, CA; CO, Code C44A Port Hueneme, CA
NAVSECGRUACT Facil. Off., Galeta Is. Panama Canal; PWO, Adak AK; PWO, Edzell Scotland; PWO, Puerto Rico; PWO, Torri Sta, Okinawa; Security Offr, Winter Harbor MI
NAVSECSTA PWD - Engr Div, Wash., DC
NAVSHIPREPFAC SCE Subic Bay
NAVSHIPYD Bremerton, WA (Carr Inlet Acoustic Range); Code 134, Pearl Harbor, HI; Code 202.4, Long Beach CA; Code 202.5 (Library) Puget Sound, Bremerton WA; Code 380, Portsmouth, VA; Code 382.3, Pearl Harbor, HI; Code 400, Puget Sound; Code 410, Mare Is., Vallejo CA; Code 440 Portsmouth NH; Code 440, Norfolk; Code 440, Puget Sound, Bremerton WA; Commander, Philadelphia, PA; L.D. Vivian; Library, Portsmouth NH; PW Dept, Long Beach, CA; PWD (Code 420) Dir Portsmouth, VA; PWD (Code 450-HD) Portsmouth, VA; PWD (Code 457-HD) Shop 07, Portsmouth, VA; PWD (Code 460) Portsmouth, VA; PWO, Bremerton, WA; PWO, Mare Is.; PWO, Puget Sound; SCE, Pearl Harbor HI; Tech Library, Vallejo, CA
NAVSTA CO Roosevelt Roads P.R. Puerto Rico; CO, Brooklyn NY; Code 4, 12 Marine Corps Dist, Treasure Is., San Francisco CA; Dir Engr Div, PWD, Mayport FL; Dir Mech Engr 37WC93 Norfolk, VA; Engr. Dir., Rota Spain, Long Beach, CA; Maint. Cont. Div., Guantanamo Bay Cuba; Maint. Div. Dir Code 531, Rodman Panama Canal; PWD (LTJG P.M. Motolenich), Puerto Rico; PWD - Engr Dept, Adak, AK; PWD - Engr Div, Midway Is.; PWO, Guantanamo Bay Cuba; PWO, Keflavik Iceland; PWO, Mayport FL; SCE, Guam; SCE, Pearl Harbor HI; SCE, San Diego CA; SCE, Subic Bay, R.P.; Security Offr, San Francisco, CA; Utilities Engr Off, Rota Spain
NAVSUBASE Code 23 (Slowey) Bremerton, WA; SCE, Pearl Harbor HI
NAVSUPPACT PWO Naples Italy
NAVSUPPFAC PWD - Maint. Control Div, Thurmont, MD
NAVSURFWPNCEN PWO, White Oak, Silver Spring, MD
NAVTECHTRACEN SCE, Pensacola FL
NAVTELCOMMCOM Code 53, Washington, DC
NAVUSEAWC ENGSTA Security Spec (Code 01A) Keyport, WA
NAVWPNC , Code 24 (Dir Safe & Sec) China Lake, CA; Code 2636 China Lake; PWO (Code 266) China Lake, CA; ROICC (Code 702), China Lake CA
NAVWPNSTA Code 092, Colts Neck NJ; Code 092, Concord CA; Code 092A, Seal Beach, CA; Maint. Control Dir., Yorktown VA
NAVWPNSTA PW Office Yorktown, VA
NAVWPNSTA PWD - Maint Control Div, Charleston, SC; PWD - Maint. Control Div., Concord, CA; PWD - Supr Gen Engr, Seal Beach, CA; PWO, Charleston, SC; PWO, Seal Beach CA; Security Offr, Colts Neck NJ; Security Offr, Concord CA
NAVWPNSUPPCEN Code 09 Crane IN
NCBU 405 OIC, San Diego, CA
NCBC Code 10 Davisville, RI; Code 15, Port Hueneme CA; Code 155, Port Hueneme CA; Code 156, Port Hueneme, CA; Code 25111 Port Hueneme, CA; Code 400, Gulfport MS; Code 430 (PW Engrng) Gulfport, MS; Code 470.2, Gulfport, MS; NFESA Code 252 (P Winters) Port Hueneme, CA; PWO (Code 80) Port Hueneme, CA; PWO, Gulfport, MS
NCBU 411 OIC, Norfolk VA
NCR 20, Code R70; 20, Commander
NMCB 74, CO, FIVE, Operations Dept; Forty, CO; THREE, Operations Off.
NRL Code 5800 Washington, DC
NSC CO, Biomedical Rsch Lab, Oakland CA; Code 44 (Security Officer) Oakland, CA; Code 54.1 Norfolk, VA; Security Offr, Hawaii
NSD SCE, Subic Bay, R.P.
NSWSES Code 0150 Port Hueneme, CA
NTC OICC, CBU-401, Great Lakes IL
NUCLEAR REGULATORY COMMISSION T.C. Johnson, Washington, DC
NUSC Code 131 New London, CT; Code 5202 (S. Schady) New London, CT; Code EA123 (R.S. Munn), New London CT; Code TA131 (G. De la Cruz), New London CT
OFFICE SECRETARY OF DEFENSE OASD (MRA&L) Dir. of Energy, Pentagon, Washington, DC
ONR Central Regional Office, Boston, MA; Code 700F Arlington VA
PACMISRANFAC HI Area Bkg Sands, PWO Kekaha, Kauai, HI
PHIBCB 1 P&E, San Diego, CA
PWC ACE Office Norfolk, VA; CO Norfolk, VA; CO, (Code 10), Oakland, CA; CO, Great Lakes IL; CO, Pearl Harbor HI; Code 10, Great Lakes, IL; Code 105 Oakland, CA; Code 110, Oakland, CA; Code 120,

Oakland CA; Library, Code 1200, San Diego, CA; Code 128, Guam; Code 184 (Library), Great Lakes, IL; Code 200, Great Lakes IL; Code 200, Guam; Code 30V, Norfolk, VA; Code 400, Great Lakes, IL; Code 400, Oakland, CA; Code 400, Pearl Harbor, HI; Code 400, San Diego, CA; Code 420, Oakland, CA; Code 424, Norfolk, VA; Code 500 Norfolk, VA; Code 505A Oakland, CA; Code 600, Great Lakes, IL; Code 610, San Diego Ca; Code 700, San Diego, CA; Library, Pensacola, FL; Library, Guam; Library, Norfolk, VA; Library, Oakland, CA; Library, Pearl Harbor, HI; Library, Subic Bay, RP; Library, Yokosuka JA; Util Dept (R Pascua) Pearl Harbor, HI; Utilities Officer, Guam

SPCC PWO (Code 120) Mechanicsburg PA

SUPSHIP PWO, Williamsburg VA

U S MERCHANT MARINE ACADEMY Kings Point, NY (Reprint Custodian)

US GEOLOGICAL SURVEY Off. Marine Geology, Piteleki, Reston VA

US NATIONAL MARINE FISHERIES SERVICE Highlands NY (Sandy Hook Lab-Library)

USAF HOSPITAL Castle AFB, CA

USCG (Smith), Washington, DC; G-EOE-4 (T Dowd), Washington, DC

USCG R&D CENTER CO *Groton*, CT; D. Motherway, *Groton* CT

USDA Forest Service, Bowers, Atlanta, GA

USNA ENGRNG Div, PWD, Annapolis MD; Energy-Environ Study Grp, Annapolis, MD; Environ. Prot. R&D Prog. (J. Williams), Annapolis MD; PWO Annapolis MD; USNA Sys Eng Dept, Annapolis, MD

ARIZONA Kroelinger Tempe, AZ

CAHF MARITIME ACADEMY Vallejo, CA (Library)

CLEMSON UNIV, Col. Arch., Egan, Clemson, SC

UNIVERSITY OF DELAWARE (Dr. S. Dexter) Lewes, DE

GEORGIA INSTITUTE OF TECHNOLOGY Col. Arch, Benton, Atlanta, GA

IOWA STATE UNIVERSITY Dept. Arch, McKrown, Ames, IA

MAINE MARITIME ACADEMY CASTINE, ME (LIBRARY)

MIT Cambridge MA; Cambridge MA (Rm 10-500, Tech. Reports, Engr. Lib.)

NY CITY COMMUNITY COLLEGE BROOKLYN, NY (LIBRARY)

NYS ENERGY OFFICE Library, Albany NY

UNIVERSITY OF CALIFORNIA DAVIS, CA (CE DEPT, TAYLOR)

UNIVERSITY OF ILLINOIS URBANA, IL (LIBRARY)

UNIVERSITY OF PENNSYLVANIA PHILADELPHIA, PA (SCHOOL OF ENGR & APPLIED SCIENCE, ROLL)

UNIVERSITY OF WASHINGTON SEATTLE, WA (MERCHANT)

VENTURA COUNTY PWA (Brownie) Ventura, CA

BRITISH EMBASSY M A Wilkins (Sci & Tech Dept) Washington, DC

EVALUATION ASSOC, INC KING OF PRUSSIA, PA (FEDELE)

NUSC Library, Newport, RI

LOCKHEED MISSILES & SPACE CO, INC, Dept 57-22 (Rynewicz) Sunnyvale, CA

MATRECON Oakland, CA (Haxo)

MIDLAND-ROSS CORP, TOLEDO, OH (RINKER)

NEWPORT NEWS SHIPBLDG & DRYDOCK CO, Newport News VA (Tech. Lib.)

TECHNICAL COATINGS CO Oakmont PA (Library)

UNITED TECHNOLOGIES Windsor Locks CT (Hamilton Std Div., Library)

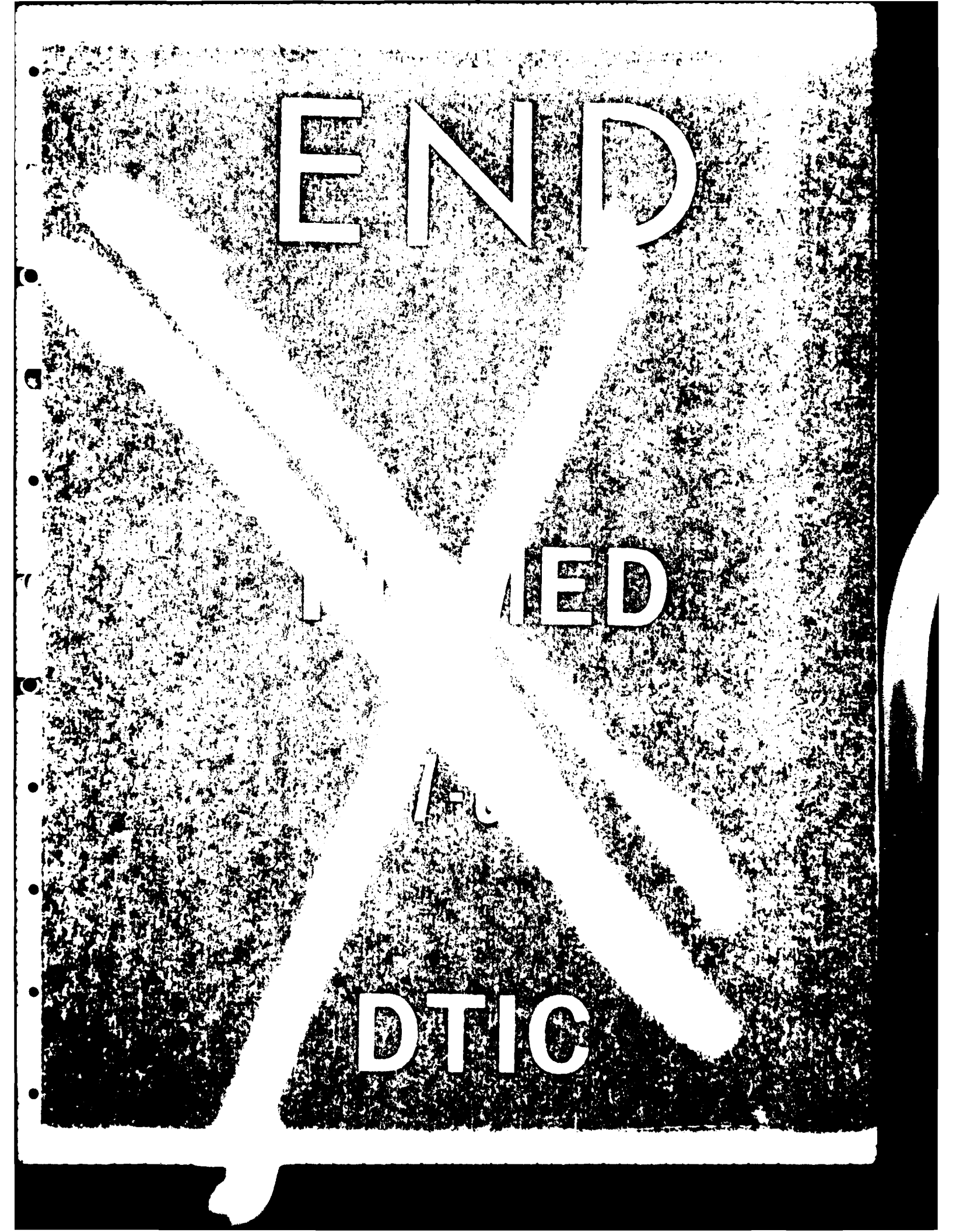
WESTINGHOUSE ELECTRIC CORP, Library, Pittsburgh PA

WM CLAPP LABS - BATTELLE DUXBURY, MA (LIBRARY)

WOODWARD-CLYDE CONSULTANTS PLYMOUTH MEETING PA (CROSS, III)

BROWN & CALDWELL Saunders, E.M. Oakland, CA

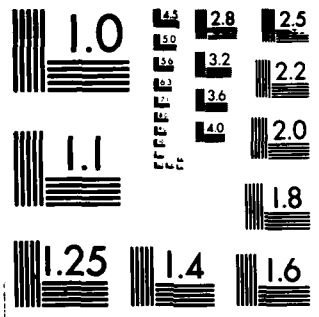
I.W. MERMEL Washington DC


END
ED
DTIC

AD A129 872 ENCAPSULATION OF FRIABLE INSULATION MATERIALS CONTAINING ASBESTOS(U) NAVAL CIVIL ENGINEERING LAB PORT HUENEME CA E E LORY ET AL. MAY 83 NCEL-TR-900

2/2

UNCLASSIFIED F/G 11/5 NL



SUPPLEMENTARY

INFORMATION

AD-A129872

DEPARTMENT OF THE NAVY
NAVAL CIVIL ENGINEERING LABORATORY
PORT HUENEME, CA 93043

IN REPLY REFER TO
5600
Ser L08/551
15 Apr 1985

From: Commanding Officer
To: Distribution

Subj: Errata Sheet for TR-900, "Encapsulation of Friable Insulation Materials Containing Asbestos," by E. E. Lory and M. J. Hienzsch.

1. Please make pen and ink change to first line of footnote on page 2 of TR-900: change Technical Report R-833 to Technical Report R-883.

P. D. Triem

P. D. TRIEM
By direction

END

DATE
FILMED
7-85