# 13TH ANNUAL TECHNICAL SYMPOSIUM

# 1976



## Asbestos - A Case Study of the Navy's Response to Updated Safety and Health Requirements

W. D. Holtgren, NAVSEA Safety Division (SEA 04H) and
A. Winer, Engineering Materials and Services Office (SEC 6101E)



ASSOCIATION OF SCIENTISTS AND ENGINEERS
OF THE NAVAL AIR AND SEA SYSTEMS COMMANDS
DEPARTMENT OF THE NAVY - WASHINGTON D C. 20360

(6)

# ASBESTOS - A CASE STUDY OF THE U.S. NAVY'S RESPONSE TO UPGRADED SAFETY AND HEALTH REQUIREMENTS


by

(10) Allen Winer

Engineering Materials and Services Office
Naval Ship Engineering Center

and

by

Wallin D. Holtgren

Safety Division
Naval Sea Systems Command


(11) Mar[redacted]76



(12) 24p.



THE VIEWS EXPRESSED HEREIN ARE THE PERSONAL OPINIONS
OF THE AUTHORS AND ARE NOT NECESSARILY THE OFFICIAL VIEWS
OF THE DEPARTMENT OF DEFENSE OR A MILITARY DEPARTMENT

ABOUT THE AUTHORS...

MR. WALLIN D. HOLTGREN

Mr. Wallin D. Holtgren, Occupational Safety Officer in the Naval Sea Systems Command, Safety Division (NAVSEA 04H4), a native of New Jersey, attended the U. S. Merchant Marine Academy, Kings Point, L.I., New York, and received his BS in Marine Engineering in December 1951.

Mr. Holtgren served from January 1955 through May 1959 in the U.S. Navy, two years on USS HYADES (AF-28) as Damage Control Officer and Engineer Officer, and two years as Ship Superintendent at Long Beach Naval Shipyard, Long Beach, California.

After serving with the Navy Mr. Holtgren worked at the Department of Labor in Washington where he bacame Assistant Chief, Shipyard Branch in the Office of Maritime Safety. In January 1967 he went to the Naval Ship Engineering Center, Hyattsville, Maryland, where he served as Naval Architect in the Ship Specification Branch. In June 1972 he came to Naval Ship Systems Command (presently Naval Sea Systems Command) where he has served as Safety, Fire Protection and Damage Control Coordinator and Occupational Safety Officer.

Mr. Holtgren is active in the U. S. Naval Reserve, holds the rank of Commander, USNR-R Engineering Duty Officer (EDO). He is the Navy member of the National Fire Protection Association (NFPA) Sectional Committee on Gas Hazards; a licensed Commercial Captain and Marine Engineer.

Mr. Allen Winer received his M.S. degree in chemistry from Tufts University. After Working for a number of rubber companies in development and quality control, he joined the U.S. Army Biomechanical Research Laboratory as an organic chemist. In 1963 he joined the Bureau of Ships and subsequently the Naval Ship Engineering Center where he is now employed as a materials engineer. He is the holder of two U.S. patents, has published articles on cellular plastics for NAVAL applications, synthetic flotation materials for deep submergence vehicles, plastic foams for marine salvage and passive fire protection for Aluminum Structures. He is a member of the American Chemical Society, American Society for Testing and Materials and the Association of Scientists and Engineers of the Naval Air and Sea Systems Command. His present responsibilities now include technical cognizance for thermal insulation for piping and machinery. Currently he has the responsibility for implementing NAVSEA's asbestos elemination/substitution/personnel protection program.

TABLE OF CONTENTS

## ABSTRACT

The U.S. Navy is becoming increasingly involved with more rigorous national safety and health requirements. The U.S. Department of Labor's Occupational Safety and Health Administration (OSHA) has established low tolerance limits for airborne asbestos particles. The Navy's response to this restriction is reflected by the decrease in exposure of personnel to this hazard. Control has been accomplished by various means, such as wet processes, ventilation, vacuuming, use of respirators and proper procedures, as well as through training, education and modernization. Most recently, exposure is being further decreased by prohibiting the use of asbestos-containing materials where suitable substitutes have been designated and by revising applicable documentation. Asbestos exposure conditions will however, be present in the Navy for the next 20 to 30 years due to the need for periodic rip-out of existing asbestos installations, for maintenance and repair purposes and for those asbestos installations for which substitutes are not yet available. The Navy's near-term objective will be to develop improved procedures during rip-out operations, to provide even greater protection to personnel working with asbestos and to identify remaining asbestos end items that must be replaced. The Appendix to this paper lists the asbestos-free end items now specified for thermal insulation systems.

ASBESTOS - A CASE STUDY OF THE U.S. NAVY'S
RESPONSE TO UPGRADED SAFETY AND HEALTH REQUIREMENTS

## INTRODUCTION

It is ircnic that asbestos, a material which has been clearly associated in the past with safety and protection, and which has been used universally in a multitude of useful applications, is known to pose a serious health hazard to all of us.

The magnitude of this problem is evident from the partial list of naval applications for asbestos as shown in the following listing:

| | |
|---|---|
| INSULATION | PACKING |
| EXPANSION JOINTS | FLOORING |
| GASKETS | FIRE-FIGHTERS' CLOTHING |
| WELDERS" CURTAINS/GLOVES | PIPE HANGER COVERS |
| ELECTRICAL CABLE | TABLE TOPS |
| STRESS RELIEF PADS | INTUMESCENT COATINGS |
| SHEATHING | CEMENTS |

Lest one believe that asbestos is a problem which affects only the Navy, consider the many additional uses for asbestos in homes, offices, factories, trains, space and motor vehicles, as indicated in the following listing:

| | |
|---|---|
| SPRAY-ON COATINGS | SIDING |
| ROOFING | FILTER CLOTHS |
| TILE | BRAKE LININGS |
| CLUTCH FACINGS | SPACKLING COMPOUNDS |
| SAFETY CURTAINS | MASTICS |
| HEAT SHIELDS | CONVEYOR BELTS |

Moreover, according to recent reports, asbestos dust concentration in many new office buildings have been found to be as high as in areas near asbestos plants or where asbestos spraying was being done. The news media have also referred to air-borne asbestos dust generated in the course of new building construction and during demolition of old buildings. It is further estimated that asbestos may have as many as 3,000 different industrial applications.

Consequently, the magnitude, the pervasiveness, and the most recent medical observations regarding asbestos exposure, have, understandably, caused considerable apprehension in the medical community.

What is the U.S. Navy doing about this problem?

This paper will describe both the near term and long term actions underway to eliminate this health hazard from Navy ships and will further describe the Navy's on-going asbestos removal, substitution and personnel protection program.

## BACKGROUND

What is asbestos?

Chemically, asbestos is a crystalline, hydrated, mineral silicate material. Asbestos fibers are generally characterized by high tensile strength, good flexibility, superior heat and chemical resistance, dimensional stability and durability, which, of course, explains its use in a myriad of applications.

Asbestos is a familiar material to those who design, repair, build, sail, or are otherwise involved with ships or vessels. In fact, it is a term familiar to almost everyone since it is used so universally.

Because of its well known fire and heat resistance characteristics, asbestos has been used extensively and effectively in thermal insulation systems to reduce energy loss, to reduce heat stress of workers in engine rooms and power plants, and to afford protection from hot spots or areas which could cause severe burns to personnel.

Asbestos is mined in rock form, principally in Canada, Russia, the United States and Africa, it is also found in Brazil, India, Finland and Italy. The product is also known by less familiar if more crudite names as crocidolite, chrysotile, amosite, tremolite, anthophyllite and doctinolite. Each geographic area has a certain type. For example, Canadian mines produce a type known as chrysotile asbestos, while South African mines produce the crocidolite type. Finland produces anthophyllite, which is the rarest type of asbestos. In its original state, where it is mined, it seems to be part of the rock itself (see Figure 1). It is hard and compact, but its fibrous structure can readily be seen in Figure 2.

Asbestos is hardly a new material. Historians relate that Marco Polo was impressed with Chinese fireproof cloth, an asbestos textile, and that centuries ago potters in Finland used asbestos fibers to strengthen the clay in their cooking pots which were sold not only in Finland but throughout ancient Europe.

Actually, the hazard of asbestos has been known to man for many years. Even as early as the first century, the adverse biological effects of asbestos were casually observed by the Greek geographer Strabo and by the Roman naturalist Pliny the Elder, both of whom in their writings mentioned a sickness of the lungs in slaves whose occupation was to weave asbestos into cloth. This disease was later to become known as asbestosis. However, the biological effects of asbestos were apparently not fully recognized until the beginning of the present century.

## HEALTH HAZARDS

What are the health hazards of asbestos?

Breathing asbestos dust over a period of many years makes one susceptible to one or more of the diseases that have a direct relationship with exposure to asbestos. It appears that disease may occur even with limited exposure. Of course, prolonged exposure increases the possibility of disease. Exposure occurs by inhaling the respirable fibers (invisible to the naked eye) that become airborne when asbestos is woven, milled, cut, laminated, processed, etc. Asbestosis is a scarring of the lung tissue resulting in impaired breathing which can eventually cause death. Normally, asbestosis is not noticeable until 10 to 20 years following initial exposure, although there are some cases on record showing an exposure time of only seven years. Scarring of the lung tissues decreases the ability of oxygen to pass from the air inhaled to the blood in the system.

In the 1960's, a cancer of the lining of the chest and abdominal cavities known as mesothelioma was recognized with studies indicating a direct relationship to inhalation of asbestos fibers. While studies indicate that smoking has no appreciable effect on producing mesothelioma, smoking is believed to have a pronounced, accelerating effect on the development of asbestosis and massive effects on development of various types of lung cancer, especially bronchogenic cancer.

Medical reports refer to mesothelioma as being rare and more closely associated with exposure to the crocidolite type of asbestos rather than the amosite or chrysotile.

The major hazards of asbestos relate to inhalation, which results in damage to the lungs, stomach, rectum, and colon. Table I shows the general time relationship between initial exposure and onset of disease:

TABLE I

TIME RELATIONSHIP BETWEEN INITIAL EXPOSURE

TO ASBESTOS DUST AND ONSET OF DISEASE

| Disease | Time Period |
|---|---|
| Asbestosis | 10 - 20 years |
| Bronchogenic Cancer | 15 - 25 years |
| Mesothelioma | 20 - 45 years |

Another problem affecting asbestos workers is asbestos warts or corns that form on their fingers and hands. Since it is very difficult to remove all of the asbestos fibers that have penetrated the skin, the imbedded fibers can cause tumors at these locations.

It is interesting to note that the largest proportion, or 90% of all medical information currently known about asbestos, has been learned or published only within the past 15 years. Asbestos dust is, however, but one of many thousands of pollutants released in modern times by industrial processes or equipment. For example, carbon monoxide, carbon dioxide, oxides of nitrogen and sulfur compounds are released by internal combustion engines, while acid fumes, beryllium, lead, cadmium, zinc, cotton dust, pesticides, vinyl chloride monomer (VCM), etc., are some of the pollutants released in industrial processes.

Actually, medical studies are needed in many other areas and, of course, a number are already in progress. In particular, it is important that increased attention be given to the potential hazards and effective means to control the hazards of substitute materials already known or developed, as well as for those materials under current development or to be used in the near future.

Asbestos has been used extensively on shipboard as cloth lagging and felt, in boiler and pipe insulation, and in general where the need for thermal insulation exists. Exposure to asbestos dust, especially during rip-out operations, is considered to be the most hazardous. The Navy has been aware of the asbestosis hazard for years, and has utilized means to minimize the exposure of their personnel to airborne asbestos fibers. As far back as the 1940s, during construction of vessels in World War II, medical studies were made of over 1000 workers, where the exposure hazard was limited to a few years. However, these studies revealed only three cases of any abnormalities. Since the latent feature of this disease was not well recognized at that time, the correlation between time and onset of disease did not cause alarm, even though these three cases involved persons who had worked with asbestos for 20 years or more.

## CONTROL MEASURES

Measures that were deemed appropriate were taken in the naval shipyards many years ago. As more information unfolded regarding the hazards of exposure to asbestos dust, even more emphasis was given to controlling the exposure. Control consisted of limiting exposure by means of wet processes, exhaust ventilation, protective clothing, vacuuming, development of proper procedures and respiratory protection. Military construction (MILCON) projects for modernizing the naval shipyards include designing and installing asbestos facilities with proper layout, ventilation and air filtration systems to further reduce the hazard. It is anticipated, however, that with the substitution of asbestos-free materials, the asbestos hazard will eventually be eliminated. Figure 3 shows an artist's concept for the MILCON which was completed at Pearl Harbor Naval Shipyard in 1975. A MILCON was completed earlier at Norfolk Naval Shipyard in 1974, which resulted in modernization of their asbestos facilities. It is anticipated that the Charleston Naval Shipyard MILCON will be completed in June of 1976. Efforts to eliminate the uses of asbestos on Navy vessels is continuing. Progress to date will be described later in this paper, and will refer to specification changes, instructions, Qualified Products Lists (QPLs) and stock numbers for asbestos-free thermal insulation end items.

The Williams Steiger Occupational Safety and Health Act, commonly known as the Williams Steiger Act or OSH Act, was approved on 29 December 1970. In general, this regulation gave added emphasis to safety and health throughout the country, and included strict requirements regarding occupational exposure to harmful substances. Executive Order 11612, signed by President Nixon on 26 July 1971, was subsequently revised and signed by President Ford, and was issued as Executive Order 11807 on 28 September 1974, and 29 CFR (Code of Federal Regulations) 1960 of 9 October 1974, which incorporate occupational safety and health requirements which Federal agencies must meet. These requirements are based on Section 19 of the OSH Act, regarding responsibility of the federal agencies to establish and maintain an effective and comprehensive occupational safety and health program consistent with the standards promulgated by the Secretary of Labor for businesses affecting interstate commerce. This Executive Order basically orders federal agencies to comply with the OSH Act. Section 1910.93A in the 29 CFR Part 1910, Occupational Safety and Health Standards published in the 18 October 1972 Federal Register, specifies safety requirements for work involving asbestos dust and exposure. This standard on asbestos became effective 1 July 1972, and is quite detailed. It has been recodified as 29 CFR 1910.1001, and in October 1975, a new even more stringent proposal was published for comment. Some of the highlights of the current and proposed standards follow:

The eight hour time-weighted average (TWA) airborne concentrations of asbestos fibers to which any employee may be exposed shall not exceed five fibers longer than five micrometers per cubic centimeter of air and prescribes the method for measuring. (Note: One micrometer is equal to one-millionth of a meter, or 1/2540 inch). The standard which will be effective 1 July 1976 will limit the exposure to not to exceed two fibers longer than five micrometers per cubic centimeter of air. Therefore, a change of from five to two fibers is noted. A ceiling limit is also specified.

As pointed out in the November/December 1973 issue of LIFELINE, the Naval Safety Journal, "a fiber is defined as a particle at least three times longer than it is wide. A five micrometer particle will sit nicely on the average red blood cell with a couple of micrometers to spare. So the particles we're talking about are invisible to the naked eye. So much for those people who tell you they know that they do a clean job with asbestos, because they can never see any dust." Although there is no positive evidence that five or even two fibers limitation will totally eliminate the hazard, statistical studies indicate an increase in protection to those exposed. A decision was made that is now law. The October 1975 proposal reflects a more stringent requirement. The status of this proposal should be well known by March 1976, at which time much or all of the proposal may be law. The intent of the proposed standard as revised is to continue to apply requirements to all work places where occupational exposure is present, but would exclude the construction industry. OSHA intends to develop and subsequently propose a separate revision to the existing asbestos standard for the construction industry. The major impact of the proposal would be in the limitations on permissible exposure. The proposed standard was published in Part II of the Federal Register Vol. 40, No. 197-October 9, 1975.

The proposed standard would, among other things, lower the permissible exposure to 500,000 fibers per cubic meter (0.5 asbestos fibers per cubic centimeter) for an eight hour time-weighted average (TWA) exposure and would reduce the permissible ceiling exposure to five million asbestos fibers per cubic meter (5 asbestos fibers per cubic centimeter) for any period not exceeding 15 minutes, and would extend the retention period for medical and monitoring records to 40 years, or for the duration of employment plus 20 years, whichever is longer. In any event, the status of the proposal will not affect the U.S. Navy's current program to eliminate the use of asbestos materials where appropriate substitute materials are available and authorized by the Naval Sea Systems Command (NAVSEA). NAVSEA has, however, taken the approach to eliminate the use of asbestos in thermal insulation systems as evidenced by changes to applicable pipe and block insulation specifications initially modified in January of 1973. Asbestos end items, other than thermal insulation systems, will be tested to determine which ones represent a health hazard either during installation, while in service, or during rip-out in order to determine the future need for finding or developing substitute materials. In general, the basic material substituted for asbestos thus far in thermal insulation systems are fibrous glass cloth and felt, refractory felt, and calcium silicate with a non-asbestos filler.

Methods of compliance are specified by the current OSHA promulgated asbestos standard, which requires the use of engineering controls, including isolation, enclosure, ventilation and dust collection. All hand operated and power operated tools which may produce or release asbestos fibers in excess of the exposure limits, such as, but not limited to saws, scorers, abrasive wheels and drills, are required to be provided with local exhaust ventilation systems. Practices such as wet methods, Section 1910.1001 require the use of type "C" supplied air respirators, continuous flow or pressure demand class when the employees are engaged in the spraying, removal or demolition of pipes, structures or equipment covered or insulated with asbestos. This is similar to rip-out work on ships where engineering controls are not practical, but protection must nevertheless be provided. In England, self-contained air supply suits are used in work of this type. The asbestos standard has additional requirements which include supplying special work clothing, change rooms, clothes lockers, laundering, methods of measurement, caution signs, monitoring and sampling, frequency and sampling patterns, waste disposal, medical examinations, record keeping and others. When it is not feasible to obtain full compliance, the standard requires that protective equipment or other protective measures shall be used to keep the exposure of employees within the allowable limits. Any equipment and/or technical measures used for this purpose should be approved for each particular use by trained personnel, such as an industrial hygienist.

## PROGRESS TO DATE

In the past, the Navy attempted to minimize the use of asbestos by utilizing low-content asbestos for reinforcing pipe and block insulation materials. Accordingly, Military Standard MIL-STD-769, Thermal Insulation for Machinery and Piping, was changed on 1 April 1971 to eliminate the use of high-content (85 to 95%) asbestos, by specifying only low-content (5% to 15%) asbestos, for pipe and block insulation, and by totally eliminating the use of asbestos felt. Currently, all specifications referred to in MIL-STD-769 which specify thermal insulation to be used for piping and machinery, prohibit the use of asbestos. The first material specifications changed were the pipe and block insulation, Military Specifications MIL-I-2781 and MIL-I-2819, respectively, which were so amended on 9 January 1973. Since that time, other material specifications referred to in MIL-STD-769 have had similar changes. For convenience to the reader, the appendices of this paper contain a listing of asbestos free thermal insulation end items, as well as applicable procurement information. The General Shipbuilding Specifications, overhaul specifications for submarines, and Chapter 9390 of the Naval Ships Technical Manual (NSTM) have been modified to reflect the latest available asbestos free materials, and to provide detailed guidance regarding personnel protection when working with asbestos.

OPNAV Instruction 6260.1 of 9 April 1974 is the basic Navy policy document on controlling asbestos exposure and is in accord with current OSHA standards.

A subsequent NAVSEA Instruction issued on 24 October 1975 prohibits the use of asbestos items where suitable substitutes have been specified by NAVSEA.

In 1969, the Bureau of Medicine and Surgery (BUMED) established a four-point program for control, which included the following tasks:

1. Examine work practices, to identify the most hazardous operations, and to suggest alternative measures, such as wetting down.

2. Conduct an educational program to help workers and management to understand the potential hazards as well as to understand why a change in work procedures was made. (Everyone is familiar with the statement, "We've always done it that way," and it is natural to resist change. Therefore, it is important to explain the need for change.)

3. Provide engineering controls.

4. Provide a respirator program.

This 4-point program was established because the hazards of exposure to asbestos dust were seen as a continuing serious problem. In spite of a mandatory requirement to wear dust respirators, many workers chose to ignore this regulation. Poor face fit, breathing resistance and discomfort were the reasons offered for non-compliance. It was also difficult for personnel to understand that there actually was a hazard, which is typical of problems encountered with the required use of respirators. Consequently, a respirator should only be used as a last resort. Alternately, and unquestionably, the best protection is to eliminate the hazard altogether by substituting less hazardous materials for asbestos. Thanks to industry cooperation, many asbestos substitutes are already available and are currently being used. Elimination of a material as widely used as asbestos insulation from an organization as large as the Navy is not a simple task, nor can one expect this task to be accomplished overnight. But as of late 1975, it is believed that very little asbestos thermal insulation is being placed on board U.S. Naval vessels either in new construction, or in repair operations. Nevertheless, it is also realized that for the next 20 to 30 years, asbestos exposure must still be dealt with due to removal operations (rip-out) of asbestos thermal insulation that was installed in earlier years.

For these (rip-out) operations, signs (as shown in Figures 4 and 5) have been used and will continue to be used in Naval shipyards as well as by Forces Afloat, but for the latter under emergency conditions only. Ordinarily, removal of asbestos is left to shore activities which are better able to provide the proper safeguards. Asbestos exposure conditions can be measured. Rip-out work is automatically considered to be above permissible limits, and air line respirators or self-contained respirators are required use for U.S. Navy civilian and military personnel engaged in doing such work.

In order to measure the extent of exposure, units consisting of a battery operated pump, hose and filter paper are utilized. These are commonly referred to as personnel monitors. A count is made of fibers on filter paper by qualified persons, such as an industrial hygienist or a laboratory technician. A 450 magnification Phase Contrast Microscope is used.

## CONCLUSION

Only through the slow process of past history were the hazards of inhaling asbestos learned. Even after the hazards became known, it was still a slow process to impress the people who should be most concerned, the shipyard workers or construction workers and management, that employees should work only when proper precautions have been taken. Engineering methods take time and money. All too often in the past, the tendency was to provide the most immediate, and presumably, the most economical means of protection, i.e., respirators, rather than engineering controls. This is just as true in Government as it is in industry. The Navy has accomplished a great deal in reducing the asbestos hazard, but more effort is needed. Providing a safe place to work is paramount.

The expense and effort is large, but the effort must be sustained, to reduce and ultimately eliminate the hazard from inhalation of asbestos dust. There is presently a high concern, as evidenced by the increased attention being given to this problem in recent years. This attention includes initiating and developing engineering controls and remodeling of shops in the Naval modernization program. Amendments and modifications of technical manuals, standards, shipbuilding specifications and material specifications have also been made. The Navy's ultimate goal is to eliminate the disease associated with asbestos. Accordingly, the search is continuing for asbestos free materials suitable for use as substitutes for all remaining shipboard applications.

## FUTURE WORK

All asbestos end items used by the Navy in new construction, overhaul and repair will be identified. Subsequently, an analysis will be conducted to determine which of these items represent a health hazard while handling, while in service, or during eventual rip-out operations. Subsequent action will be taken to obtain suitable commercially available substitutes for those items that are declared to be a health hazard under any of the above stated conditions. If no adequate substitute is commercially available for any of the end items declared to be a health hazard, industry will be encouraged to conduct an R&D program to accelerate development of commercial substitutes.

In the interim, as a final reminder, when working with asbestos, keep in mind that a potentially hazardous condition exists, and ensure that all personnel in the area of exposure understand the hazard involved and are protected by the best means available.

# APPENDIX A

## ASBESTOS-FREE REPLACEMENT END-ITEMS FOR THERMAL INSULATION SYSTEMS

| ASBESTOS END ITEMS | CURRENT NON-ASBESTOS SUBSTITUTE |
|---|---|
| 1. ASBESTOS CLOTH (Regular Weight)<br>Applicable Spec: SS-C-466 Form I | 1. GLASS CLOTH (18 oz./sq. yd.)<br>Applicable Spec: MIL-C-20079, Type I,Class 9<br>NSN: 1H-4730-00-148-7364 |
| 2. ASBESTOS CLOTH (Light Weight)<br>Applicable Spec: SS-C-466 Form I | 2. GLASS CLOTH (8.5 oz./sq. yd.)<br>Applicable Spec: MIL-C-20079 Type I, Class 3<br>NSN: 1H-4730-00-148-7363 |
| 3. ASBESTOS FELT<br>Applicable Spec: (spec. canceled) | 3. GLASS FELT<br>Applicable Spec: MIL-I-16411, Type II<br>NSN: 5640-00-768-2229(1/2 in. thick)<br>NSN: 5640-00-173-6591(1 in. thick) |
| 4. ASBESTOS THREAD<br>Applicable Spec: SS-C-466(Form III) | 4. GLASS THREAD (machine sewing)<br>Applicable Spec: MIL-C-20079, Type III,Class 3<br>NSN: 4730-00-085-1711 |
| 5. HIGH TEMPERATURE INSULATION CEMENT (Asbestos filler) | 5. HIGH TEMPERATURE CEMENT<br>Applicable Spec: MIL-C-2861<br>NSN: 5640-00-272-2995 |
| 6. FINISHING CEMENT | 6. FINISHING CEMENT<br>Applicable Spec: SS-C-160 Type III, Grade F<br>NSN: 5640-00-226-4540 |
| 7. HIGH TEMP. PIPE INSULATION (with asbestos filler) | 7. HIGH TEMP. PIPE INSULATION<br>Applicable Spec: MIL-I-2781<br>New stock numbers in preparation by SPCC and GSA for all sizes listed in MIL-STD-769. In the interim, only products listed in Appendix B should be procured. |

APPENDIX A (CONTINUED)

| | |
|---|---|
| 8. <u>HIGH TEMP. BLOCK INSULATION (with asbestos filler)</u> | 8. <u>HIGH TEMP PIPE INSULATION</u><br>Applicable Spec: MIL-I-2819<br>Stock numbers available from SPCC and GSA for all sizes listed in MIL-STD-769. |
| 9. <u>ALUMINIZED ASBESTOS CLOTH</u> | 9. <u>ALUMINIZED GLASS CLOTH</u><br>Applicable Spec: MIL-C-20079, Type I, Class 10<br>NSN: 1H 4730-00-085-1715 |

## APPENDIX B

## LISTING OF QUALIFIED SUPPLIERS AND PRODUCTS OF ASBESTOS-FREE PIPE AND BLOCK INSULATION

| Specification | Product | Supplier |
|---|---|---|
| MIL-I-2781 (pipe insulation) | 1. New Careytemp 1500 pipe insulation | CELOTEX Corp. Div. Jim Walter Corp. Tampa, FL 33622 |
| | 2. PABCO Super CALTEMP Type 1200 NA | Fibreboard Corp., PABCO Industrial Products Div. San Francisco, CA 94106 |
| | 3. THERMO-12 | Johns Manville Corp. Denver, CO 80217 |
| | 4. THERMASIL | Keene Insulation Princeton, NJ 08540 |
| | 5. KAYLO 10 AF | Owens-Corning Fiberglas Corp. Washington, DC 20006 |
| MIL-I-2819 (block insulation) (Class 2) | 1. New Careytemp 1500 Block Insulation | Celotex Corp. |
| | 2. THERMO-12 | Johns-Manville Corp. |
| (Class 3) | 1. New Careytemp 1500 | |
| | 2. PABCO Super Caltemp Type 1200 NA | |
| | 3. THERMO-12 | |
| | 4. THERMASIL | |
| | 5. KAYLO 10 | |

BIBLIOGRAPHY


1. W. T. Marr "Asbestos Exposure During Naval Vessel Overhaul", American Industrial Hygiene Association. J. 25:264 (May-June 1964)

2. Recent Developments in Asbestos Control Measures in United States Naval Shipyards presented by Samuel H. Barboo, Dr. P. H., Commander, Medical Service Corps, USN at the Symposium on Safety and Health in Shipbuilding and Ship Repairing International Labor Office (ILO) Helsinki, Finland, 30 Aug - 2 Sep 1971.

3. Edward Cherowbrier, Naval Ship Engineering Center, "Preventing Asbestos Inhalation", NAVSHIPS Technical News May 1969

4. CDR Samuel H. Barboo, MSC USN, "Asbestos Dust Control", Safety Review May 1972.

5. Wallin D. Holtgren "Who's Afraid of Asbestos?", NASHIPS Technical News November 1972

6. Wallin D. Holtgren "Asbestos Workplace - Controls and Substitutes" NAVSHIPS Technical New October 1973 (condensed from the paper of same title presented by Mr. Holtgren at the International System Safety Symposium, Denver, Colorado - 17 - 20 July 1973

7. Asbestos Exposure from Naval Safety Center "Lifeline" Nov-Dec 1973 issue

8. MIL-C-20079E - Military specification "Cloth, Glass; tape, textile glass; and thread, glass", 15 May 1975

9. Tech Report No 106 from Navy Clothing and Textile Research Unit, Natick, Mass. "Preliminary Studies on the Development and Testing of Low-temperature handwear with improved dexterity" (Report No. 1)

10. The Hazards of Asbestos for Brake Mechanics by Barry Castleman, Lucille A. Camarota, Albert J. Fritsch, Susan Mazzocchi and Robert G. Crawley

11. The Washington Post 10 December 1975 and 18 December 1975.

12. Asbestos and Enzymes, Paul Brodeur, Ballantine Books, January 1972

13. MIL-STD-769F, Military Standard, Thermal Insulation Requirements for Piping and Machinery, 7 Oct 1975

14. Control Techniques for Asbestos Air Pollutants U.S. Environmental Protection Agency, Research Triangle Park, North Carolina, February 1973

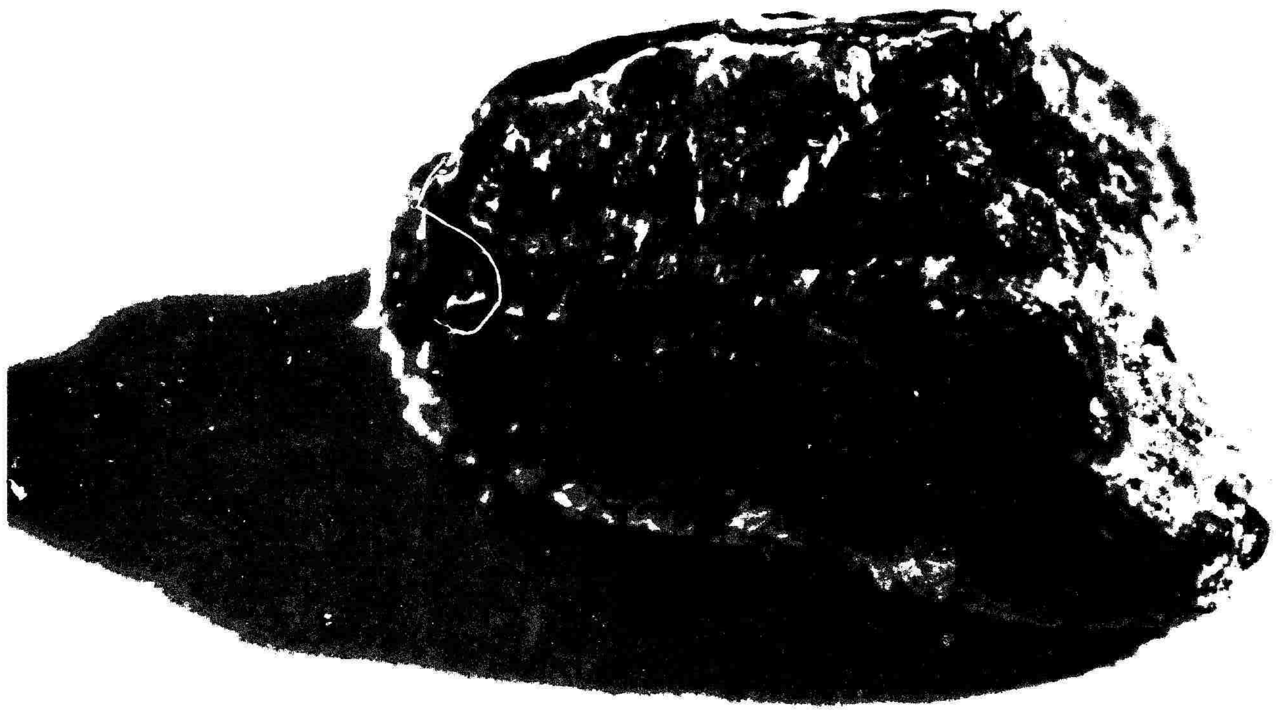

FIGURE 1   ASBESTOS ROCK

FIGURE 2 ASBESTOS FIBERS

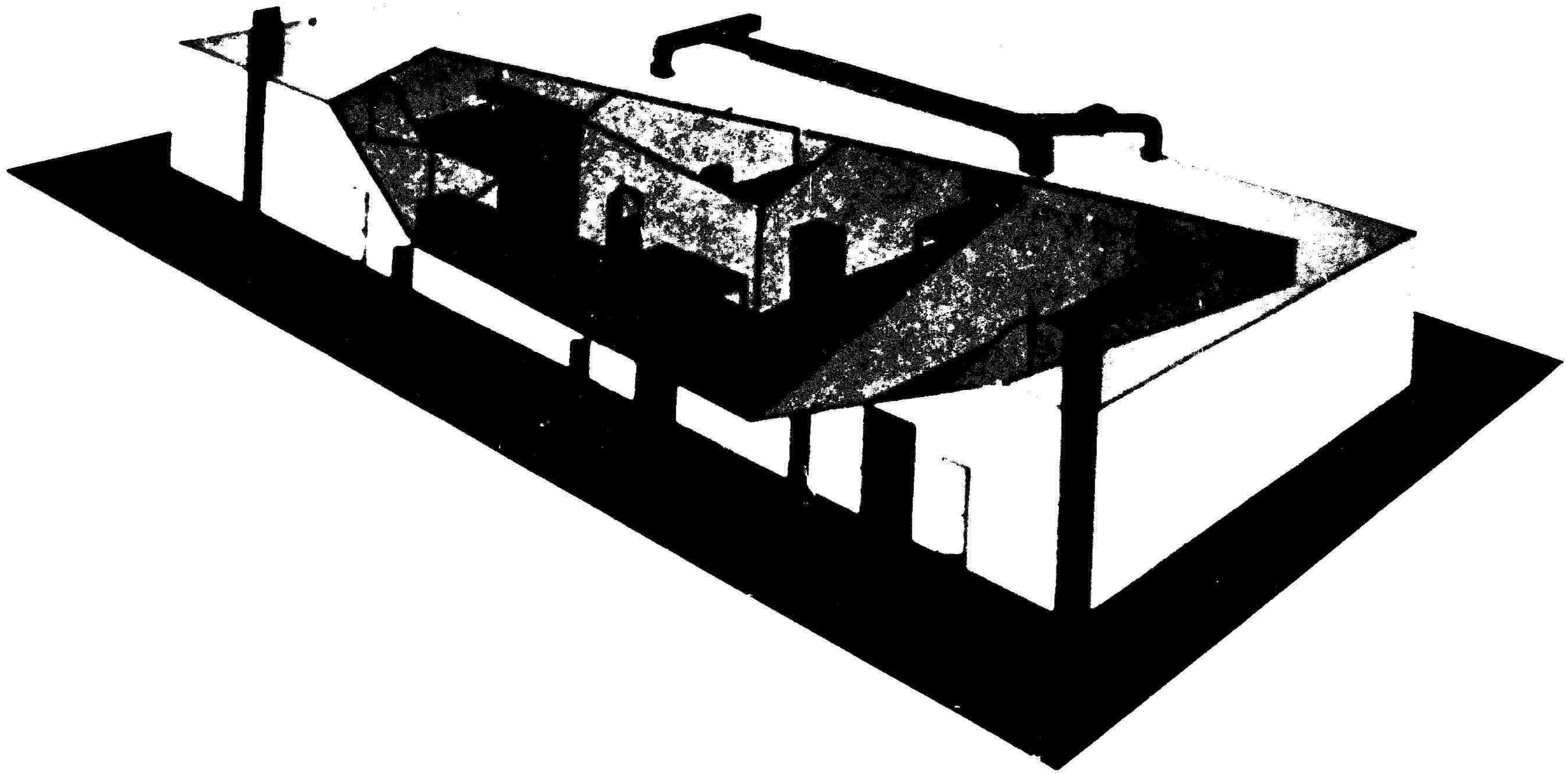

FIGURE 3 PEARL HARBOR NAVAL SHIPYARD P-086-LAGGING FACILITY ALTERATIONS BLDG 4

RESTRICTED ACCESS

ASBESTOS

FABRICATION AREA

FIGURE 4

**RESTRICTED ACCESS**

**ASBESTOS**

**INSTALLATION/RIP OUT**

**WEARING OF**

**RESPIRATORS REQUIRED**

FIGURE 5