PROCEEDINGS
OF THE MARINE SAFETY COUNCIL

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Asbestos Dust Inhalation: Airborne Shipyard Hazard

U.S. Department of Transportation

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United States Coast Guard

PROCEEDINGS

OF THE MARINE SAFETY COUNCIL

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Contents

feature

Asbestos dust is an occupational hazard which is present at many construction sites, including shipyards. The authors present a general introduction to the biological effects of asbestos fiber inhalation, and recommend basic personnel protection measures which are available at reasonable cost. Current federal programs addressing the asbestos dust problem are summarized, including both Coast Guard and MARAD vessel survey projects currently underway.

departments

cover

Asbestos was used for many years before it was found to be a significant health hazard. The first studies linking asbestos dust exposure and lung disease included only those workers involved in asbestos mining and processing, as the man shown here, or others who were directly and heavily exposed. It was not suspected until the late sixties that indirectly exposed workers might be similarly affected. The specific dangers of asbestos dust inhalation, the development of personnel protection standards, and the precautions necessary in asbestos-contaminated areas are discussed on pages 144-151.

maritime sidelights

LT. HAAS PRESENTS TOXICOLOGY PAPER

Lieutenant Thomas Haas, Industrial Toxicologist of the Hazard Evaluation Branch at Coast Guard Headquarters, presented a paper on "Hazards Associated with Marine Cargo Tank Entries" before the 19th Annual American Industrial Hygiene Conference in Chicago, Illinois. Lt. Haas discussed the inherent hazards associated with entering enclosed spaces such as marine cargo tanks, including possible oxygen deficiency, flammable/explosive atmospheres and acute/chronic toxicity. Over 4,000 people attended the one-week conference.

Lt. Haas frequently contributes articles to the Proceedings. He and Commander John Lindak have co-authored an asbestos article for this month's issue, which begins on page 144.

FUSIBLE PLUGS

The regulations prescribed in 46 CFR, Subpart 162.014, Subchapter Q, Specification, require that manufacturers submit samples from each heat of fusible plugs for testing prior to their installation aboard vessels subject to Coast Guard inspection. The following approved heats should be added to the list of those that have been tested and found acceptable.

The Lunkenheimer Company
Cincinnati, Ohio 45214:

Heat Number	Size (Inches)	Type
832	3/8	Fireside
832	3/8	Fireside

SCBA ALERT

The National Institute for Occupational Safety and Health (NIOSH) advises users to check for split or punctured regulator diaphragms in Scott Air Pak II/IIA and Presur-Pak II/IIA self-contained breathing apparatus. NIOSH tests investigating the effect of such defects showed reduced respiratory protection on demand-mode apparatus. These tests showed no loss of protection when using the apparatus in the pressure demand mode, but did indicate a loss in service time. NOTE: The pressure demand unit is not approved while in the demand mode; the demand mode is to be used for donning purposes only.

NIOSH began this investigation following the recent death of three firefighters who were wearing this type of respirator. It has not been established that these deaths were due to damaged regulator diaphragms, but a sampling of the apparatus in the field has shown that at least 10 percent of the units examined have ruptured or punctured diaphragms.

Users should examine their apparatus for possible damaged diaphragms, in accordance with manufacturer's instructions. The diaphragm should be checked before each use by closing both the main line and bypass valves and blowing through the regulator outlet port. It should be possible to maintain a slight positive pressure in the regulator. The user should check the regulator diaphragm after each use and during monthly inspections of the complete apparatus. It is not known if failure occurs during assembly, storage, or use of the respirator regulator. Therefore, extreme caution must be employed when using the respirator. In checking the operation of the respirator, users are cautioned not to block the flow of air from the regulator when the bypass valve is open, because substantial obstruction may rupture or dislodge the diaphragm. If the regulator cover is loose or dislodged, it must be removed and the diaphragm inspected before reassembly of the regulator.

NIOSH has requested the manufacturer to stop all sales of the respirator pending determination of the reason for and necessary corrective action to prevent diaphragm failure. For further technical information contact:

Mr. Richard Ronk
NIOSH
944 Chestnut Ridge Road
Morgantown, WV 26505
(304)599-7337

NEW NFPA TRAINING MATERIALS

The National Fire Protection Association (NFPA) has released two new slide-tape training packages of interest to marine industry personnel.

The unusual circumstances presented by transportation BLEVES (boiling liquid expanding vapor explosions) are analyzed via three case studies in "Transportation BLEVES--Causes, Effects, Guidelines" (NFPA Catalog No. SL-36). This program identifies the hazards and examines options for controlling such incidents.

The second training package, "Fire Hazards Properties of Flammable and Combustible Liquids" (NFPA Catalog No. SL-34), details specific characteristics of these liquids and discusses extinguishing agents and methods.

Information presented in these programs should be useful to industry safety personnel and safety officers involved in refining, storing or transporting hazardous liquids.

Additional information is available from:

NFPA Publications Department
470 Atlantic Avenue
Boston, MA 02210
(617)482-8755

EXPO '79

The 1979 International Freight Containerization and Material Handling Exposition--EXPO '79--will be held at Jacksonville, Florida's Blount Island Terminal from October 2 through 4. This industry-wide, world-wide trade

Continued on next page.....

show boasts "something for everyone" in the freight, shipping and materials handling industry. Shipbuilders, ports, cargo handlers and a wide variety of maritime equipment and services will be included in the 3-day event.

Exhibitors from numerous countries will demonstrate the latest products, equipment and systems. More than 300 units of exhibit space will be available, including trade shows and "working" demonstrations. Ships of many nations will be docked at the terminal, loading and unloading freight from around the world.

In addition, the 1979 Containerization Institute Conference and Shipper's Dialogue will be held concurrently at the Jacksonville Hilton.

EXPO '79 is sponsored by the Jacksonville Area Chamber of Commerce. Endorsers include the Jacksonville Port Authority, Jacksonville Propeller Club, U.S. Maritime Administration, U.S. Department of Commerce, and other local, national and international organizations.

For further information call (904)353-9322, or write:

EXPO '79
P.O. Box 52444
Jacksonville, FL 32201

Two public hearings have been scheduled in September on the regulatory project concerning New Tank Barge Construction Standards (CGD 75-083) and the Upgrade of Existing Tank Barge Construction (CGD 75-083a). These hearings will be held in St. Louis and Washington, DC. The dates of the hearings are listed at the end of the Keynotes department.

Any questions regarding regulatory dockets or companies and individuals wishing to speak at public hearings should notify Captain P. J. Danahy **at our new address:** (G-CMC/TP24), U.S. Coast Guard Headquarters, 2100 Second St. SW, Washington, DC 20590; (202)426-1477.

* * *

Three significant new projects have been initiated during the past month. The first, Personnel Job Safety Requirements for Industrial Vessels (CGD 79-077), is concerned with health and safety requirements for installations and vessels engaged in oil field exploration and development. This action was mandated by pending Outer Continental Shelf legislation. It will provide more comprehensive protection for personnel employed in vessels and installations in the oil exploration trade. The work plan received by the Marine Safety Council (MSC) in early July calls for a Notice of Proposed Rulemaking (NPRM) to be published in October 1979.

The second new project, CGD 78-146, is a review of the Eight Hour Day, Voluntary Overtime regulation in 46 CFR 157.20-10, which states that no licensed officer should be required to be on duty more than eight hours per day except in extraordinary circumstances. Existing regulations, however, do not address overtime or consider any possible "fatigue factor." Recent Coast Guard studies have shown that the "fatigue factor" has a profound effect on reaction time and judgement, therefore the regulation is currently being reviewed and an Advanced Notice of Proposed Rulemaking (ANPRM) is expected this October.

The last new project, Personnel and Manning Standards for Foreign Vessels (CGD 79-081), would establish minimum manning levels for foreign tank vessels while operating in U.S. navigable waters. Procedures would also be established for the verification of training, qualification and watchkeeping standards of these vessels. This regulatory project was initiated to reduce the probability of oil spills in U.S. waters caused by foreign tankers. The work plan submitted to the MSC in July anticipates an NPRM in October 1979.

These three projects are the most recent significant projects submitted to the MSC. A complete listing of both the "significant" and "non-significant" regulations appeared in the August Federal Register as part of the Department of Transportation Regulatory Agenda.

QUALIFICATIONS OF THE PERSON IN CHARGE OF OIL TRANSFER OPERATIONS, TANKERMAN REQUIREMENTS CGD 74-44, 74-44a

These regulations will redefine and establish qualifying criteria for certifying individuals engaged in the carriage and transfer of dangerous cargoes in bulk.

It has been found that most pollution incidents are the result of personnel error; consequently, the minimum qualifications of persons involved in handling polluting substances should be specified.

As stated in the last issue, these projects have been withdrawn (44 FR 25243). New NPRM's which were anticipated in June have been delayed and are now scheduled for publication later this year.

REVISION OF ELECTRICAL REGULATIONS CGD 74-125

This regulation will constitute a general revision and updating of the electrical regulations to conform with latest technology. It will include steering requirements for vessels other than tank vessels.

This revision is occurring because industrial standards for electrical engineering have changed in the past few years, and the regulations must be brought up to date to reflect current industry practices.

Continued on next page.....

An initial NPRM was published on June 27, 1977 (42 FR 32700). A supplemental NPRM will be issued later in 1979.

STANDARDS FOR NEW SELF-PROPELLED VESSELS CARRYING BULK LIQUEFIED GASES CGD 74-289

These regulations adopt the Intergovernmental Maritime Consultative Organization (IMCO) Resolution, the Code for Construction and Equipment of Ships Carrying Liquefied Gas in Bulk.

The increased use of liquefied gases for energy sources has produced a dramatic increase in the manufacture and use of vessels designed for the cargo. Due to the unusual and unique hazards associated with liquefied gases, these vessels must be addressed in regulations specially tailored to their unique situation.

The final rule was published May 3, 1979 (44 FR 25986). Copies of this rule and its supporting documents may be obtained by writing or calling the Marine Safety Council at the address/telephone number given at the beginning of the Keynotes section.

NEW TANK BARGE CONSTRUCTION CGD 75-083 UPGRADE OF EXISTING TANK BARGE CONSTRUCTION CGD 75-083a

This action is comprised of two regulatory projects centered on tank barge construction standards. These projects were the result of a Presidential initiative of March 17, 1977, directing a study of the tank barge pollution problem. One project will address new barge construction while the other will pertain to existing barges. Regulatory documents for both will be published at the same time and joint public hearings will be held.

In July 1977, the Coast Guard began a reexamination of the tank barge construction standards. It was determined that new construction would be treated separately from existing barges. An advanced notice of proposed rulemaking (ANPRM) was then issued to gather additional data and assess impacts related to existing barges.

The new NPRM on tank barge construction, withdrawing the prior NPRM and the ANPRM for existing tank barges, was published as part VI of the June 14, 1979 Federal Register (44 FR 34440 and 44 FR 34443, respectively).

Public hearings were scheduled on the dockets as follows: August 2, 1979, Washington, DC; August 15, 1979, Seattle, WA; August 23, 1979, New Orleans, LA; September 5, 1979, Washington, DC; and September 7, 1979, St. Louis, MO. (For times and places of the meetings, see the meetings and public hearing schedules at the end of the Keynotes section.)

Anyone wishing to obtain copies of the rulemaking or desiring to be scheduled to speak at any of the public hearings may do so by contacting Capt. P. J. Danahy, Marine Safety Council **at our new address** (telephone number has not changed) which is given at the beginning of the Keynotes section.

POLLUTION PREVENTION, VESSELS AND OIL TRANSFER REGULATIONS CGD 75-124a

This regulation would reduce accidental or intentional discharge of oil or oily wastes during vessel operations.

The basis of this regulation is threefold. First, there is the need to reduce the number and incidence of oil spills. Second, this regulntion will help to clarify the existing rules. Finally, this regulation covers the additional requirement for oil-water separators under the 1973 International Convention for the Prevention of Pollution from Ships.

The NPRM was published on June 27, 1977 (42 FR 32670). A supplemental NPRM was published October 27, 1977 (42 FR 56625). As stated in the August issue, the draft of the final rule is under its legal review prior to publication.

OFFSHORE OIL POLLUTION FUND CGD 77-055

This document established procedural rules concerning administration and operation of the fund, including liability limits for certain facilities, financial responsibility factors, damage claim settlement procedures, et. al.

This regulation was passed to create procedures for prompt settlement of claims arising from damage caused by oil pollution.

The final rule of this docket was published March 19, 1979 (44 FR 16860).

TANK VESSEL OPERATIONS REGULATIONS, PUGET SOUND CGD 78-041

This regulation governs the operation of tank vessels in the Puget Sound area. It was initiated to reduce the possibility of environmental harm resulting from oil spills in Puget Sound. This is to be accomplished by governing the operation of tankers and reducing the risk of collision or grounding.

Former Secretary of Transportation Brock Adams signed a 180-day Interim Rule on March 14, 1978 prohibiting entry of oil tankers in excess of 125,000 deadweight tons in Puget Sound; this appeared in the Federal Register of March 23, 1978 (43 FR 12257). An ANPRM was published March 27, 1978 (43 FR 12840). An extension of the interim rule was published in the Federal Register in order to allow the Coast Guard adequate time to complete this rulemaking.

The public hearings scheduled June 11 and 12 in Seattle, Washington, June 13 in Mt. Vernon, Washington, and June 14 in Port Angeles, Washington have been completed and all the comments received have been entered in the docket files for consideration. The extension of the interim navigation rule was published June 21, 1979 (44 FR 36174). This extension was effective July 1 and will be in effect until the Coast Guard prints notice of its cancellation. Copies

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of documents or the transcripts of the hearings may be obtained by writing to the Marine Safety Council.

The following three regulations make up the Tanker Safety and Pollution Prevention (TSPP) Regulations. Public hearings have been held on the package, comments were requested and 541 have been received. Final rules on this package are currently being written. A notice of delay in publishing the final regulations was published in the June 7, 1979 Federal Register (43 FR 32713). Final rules are anticipated in the fall of 1979.

INERT GAS SYSTEM
CGD 77-057

This regulation would require certain oil tankers of 20,000 deadweight tons and over to be fitted with inert gas systems.

As part of the President's initiatives to reduce marine pollution, this regulation will reduce the possibility of in-tank explosions which have been the cause of some pollution incidents.

The Inflationary Impact Statement for this regulation was completed in May 1977. An NPRM was published May 16, 1977 (42 FR 24874). An ANPRM was published February 12, 1979 (44 FR 8984); 136 comments have been received on the docket.

SEGREGATED BALLAST AND TANK CLEANING REGULATIONS
GCD 77-058(b), (c) and (d)

This four-part regulation was initiated when President Carter directed the Secretary of Transportation to issue new rules for oil tanker standards, which were to include segregated ballast on all tankers and double bottoms on all new tankers which call at American ports. The provisions of these proposed regulations have been changed by the February 1978 Intergovernmental Maritime Consultative Organization (IMCO) Conference to include Crude Oil Washing (COW) and Clean Ballast Tanks (CBT).

The NPRM was published May 16, 1977 (42 FR 24868). As a result of the IMCO Tanker and Pollution Prevention Conference of February 1978, a new NPRM will be issued. This rulemaking was also mandated by the Port and Tanker Safety Act of 1978. An NPRM was published February 12, 1979 (44 FR 8984); 265 comments have been received on the docket.

STEERING GEAR DESIGN STANDARDS TO PROVIDE REDUNDANCY
CGD 77-063

As part of the President's initiatives to reduce pollution, this regulation is needed to help reduce the possibility of a marine collision due to a loss of steering.

An NPRM was published May 16, 1977 (42 FR 24869). As a result of the IMCO Tanker Safety and Pollution Prevention Conference of February 1978, a new NPRM was issued on February 12, 1979 (44 FR 8984); 138 comments have been received on the docket.

MEETINGS AND PUBLIC HEARINGS

SEPTEMBER 1979

5: Tank Barge Construction Standards (TBCS), 0900, room 2230 Nassif Building (old Coast Guard Headquarters) 400 7th St. SW, Washington, DC.

7: TBCS, 0900, Jefferson A and B Rooms, Stouffer's Riverfront Towers, 200 South 4th St., St. Louis, MO.

11: National Boating Safety Advisory Council's Visual Distress Signal Subcommittee, 0900, Dining Room C, Bldg. 101, National Engineering Laboratory, National Bureau of Standards, Gaithersburg, MD.

OCTOBER 1979

15-18: 67th Annual National Safety Congress and Exposition, Chicago, Illinois. Contact the National Safety Council, 444 N. Michigan Ave., Chicago, IL 60601.

Marine Safety Council Membership

Rear Admiral John D. Costello was born in Englewood, New Jersey on July 4, 1930. After graduating from Cardinal Hayes High School, Bronx, New York, he was appointed to the U.S. Coast Guard Academy in New London, Connecticut. He received his baccalaureate and was commissioned an Ensign in the U.S. Coast Guard in June 1952.

Rear Admiral Costello has held a variety of assignments, both ashore and afloat. During his early tours, he served as Deck Watch Officer and Engineering Watch Officer on board the USCG cutters SPENCER and HUMBOLDT. Field staff duty ashore included a Coast Guard Academy position, where he was a chemistry instructor, company officer and assistant football coach; Supply Officer and Assistant Comptroller on the staff of the Commander of the 12th Coast Guard District, San Francisco, California; and a second tour at the Academy as Comptroller. He has commanded the USCG LORAN-A transmitting station at Adak, Alaska, and the USCG cutters EWING, ACTIVE, and TRITON. More recently, he served at Coast Guard Headquarters in the Office of Personnel, the Budget Review Division, and the Programs Analysis Division. He subsequently served as Chief, Operations Division for the Commander of the First Coast Guard District in Boston, Massachusetts, then in July 1978 reported as Chief of Staff to the Commander, Third Coast Guard District, New York, New York. He is now back at Coast Guard Headquarters, having returned in June 1979 as Chief, Office of Operations. In the course of these assignments, Rear Admiral Costello has been recognized with three U.S. Coast Guard Commendation Medals, the U.S. Coast Guard Meritorious Service Medal, and by "deep selection" to the rank of Captain in 1972.

Rear Admiral Costello is a graduate of the U.S. Naval Postgraduate School in Monterey, California. Additionally, he attended graduate school at the University of California (Berkeley) and the George Washington University in Washington, DC from which he received a Master of Arts degree with a government major. He is active in the USCG Alumni Association.

The Rear Admiral and Mrs. Costello, formerly "Lynn" J. Marut of Thompsonville, Connecticut, have two sons.

The opinions or assertions claimed herein are the private ones of the writers and are not to be construed as official or reflecting the views of the Commandant or the Coast Guard at large.

ASBESTOS DUST INHALATION

By Commander John E. Lindak and Lieutenant Thomas J. Haas

Hazard Evaluation Branch, Cargo and Hazardous Materials Division
U.S. Coast Guard Headquarters, Washington, DC

This article was generated as a result of numerous queries received from Coast Guard marine inspectors, maritime union personnel, and shipping company officials. Their questions concerned the extent of hazard posed by asbestos dust inhalation in today's shipboard work environment, especially during repair of older vessels, and the nature of Coast Guard actions in response to this hazard. The Department of Health, Education and Welfare (DHEW) has made recent large-scale efforts to publicize the current medical problems of many former shipyard workers who were exposed to asbestos dust during the war years of the forties. In spite of these efforts, there appear to be many who are unfamiliar with the basic physical properties of asbestos and how it can adversely affect the human body.

Asbestos is the common name for a family of minerals which occur naturally in rock formations as masses of compact, relatively long, silky fibers. Six fibrous minerals, from the group called silicates, are recognized as asbestos:

Actinolite
Amosite (brown asbestos)
Anthophyllite
Chrysotile (white asbestos)
Crocidolite (blue asbestos)
Tremolite.

All of these forms tend to break up into extremely tiny fibers that can float in the air, stick to clothes and be easily inhaled or swallowed. Commercially, chrysotile is the most important form of asbestos. Most chrysotile is imported into the United States from the Quebec region of Canada. Amosite from South Africa has also been used in the U.S. in smaller quantities throughout the shipbuilding industry.

Asbestos has been used in small amounts for thousands of years, but its utilization has accelerated during the past 50 years. It is widely used today as an insulating and fireproofing material, both in the manufacture of textiles and in building and ship construction. In recent years, the United States has used over 800,000 tons per year to manufacture over 3,000 different products. Two-thirds of this has been utilized in the construction industry. Some of the uses include covering for pipes and exposed hot surfaces, patching and caulking compounds, floor and ceiling tiles, friction products (brake linings), and a wide variety of fireproof textiles.

Shipyards have been major consumers of asbestos because it can be used for insulating boilers, steampipes, hot water pipes and nuclear reactors on board vessels. It has also been used in mattresses, protective clothing, electrical cable coatings, boiler firebox insulation, tiles, putties, chalks, paints, joint fillers and cements. Many common construction materials such as gaskets, rings, tape, washers, etc., may also contain asbestos.

ASBESTOS AS A HEALTH HAZARD

Asbestos has attracted considerable public attention as a health menace. It is important to realize, however, that the presence of asbestos in an undamaged state normally poses no danger. It is the fine asbestos dust generated by cutting, working, chafing or tearing asbestos products which creates a health hazard. These actions may break asbestos into small dust particles which are easily inhaled. The consequences of inhaling such particles depends on their size, as the respiratory system cannot remove certain sized fibers from the body.

Most of the asbestos dust fibers which cannot be removed from the respiratory tract are less than 5 micrometers long. The chart in the next column indicates the ultimate disposition of inhaled asbestos fibers in the human respiratory system.

Exposure to asbestos dust increases the risk of four diseases: asbestosis, lung cancer, mesothelioma, and other cancers of the gastrointestinal tract.

Asbestosis results from accumulation of asbestos dust in the lung. The lung reacts to asbestos deposits by forming scar tissue around the fibers. This is termed "fibrotic disease of the lung." The fibers, once embedded in this tissue, cannot be removed by the body's natural removal systems. As time goes on the elasticity of the lung is reduced.

This disease is progressive. In the early stages a chest X-ray may reveal nothing unusual. However, after 10 years of exposure, shortness of breath upon physical exertion may become apparent. A dry, crackling sound (called rales), coming from the lungs during inhalation, is the most characteristic external symptom of asbestosis. With prolonged exposure, clubbing of the fingers and a bluish discoloration of the skin, the lining of the mouth and the tongue may occur. In the later stages of asbestosis, increased scarring of the lungs will develop and the alveolar walls will thicken; the maximum volume of air that a worker can inhale will be decreased and oxygen transport to the blood will be reduced. Heart failure may occur due to excessive strain on the heart. Additionally, many deaths result from asbestosis via bacterial infections which attack the weakened lungs.

The second disease that a worker may develop is *lung cancer*. Asbestosis does not necessarily lead to lung cancer, but it does indicate previous asbestos exposure—and, therefore, a greater risk of developing cancer. The biological reactions which lead to asbestotic lung cancer are unknown, but there are at least four basic theories:

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Length	Disposition
Over 10 micrometers	Fibers are deposited in the mucous layer of the bronchi (upper respiratory tract).
5-10 micrometers	Fibers are removed in the bronchi.
3-5 micrometers	Fibers will possibly pass deep into the lungs, but not in any appreciable quantity.
0.8-3 micrometers	Most fibers are deposited at the alveoli (air sacks). Although this size distribution is too small to be seen by the unaided eye, it is the size which causes injury in the lungs.
0.4-0.5 micrometers	Fewer fibers are deposited; 80 percent are exhaled; fiber behavior similar to Brownian molecular motion.
Under 0.2 micrometers	Electrostatic forces cause combination of these extremely fine particles and alveoli deposition is again high.

NOTE: The majority of asbestos fibers deposited in the lungs have lengths of 3.3 micrometers or less.

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Mechanical--irritation caused by the embedded asbestos fibers over many years initiates a cancerous lesion;

Chemical—a chemical reaction initiated by the presence of asbestos leads to a cancer;

Inhibition of Phagocytosis—certain cells of the body try to rid the lung tissue of the foreign asbestos fiber and this is inhibited; and

Immune Response—man may be "allergic" to asbestos, which results in a malignant reaction.

A cough, persistent chest pain or shortness of breath and blood-streaked sputum may be symptomatic of lung cancers. X-ray examination and sputum examination or biopsy is necessary to positively diagnose lung cancer.

Mesothelioma, an extremely rare cancer in the general population, involves the thin membrane lining of the chest and abdomen. This disease is much more common among asbestos workers than among the general population and can be traced to prior asbestos exposure. Shortness of breath and pains on the wall of the chest or abdominal pain are common initial symptoms of the disease. Diagnosis of this cancer is very difficult and usually requires exploratory surgery.

Recent scientific studies indicate a link between asbestos dust exposure and *other cancers*; for example, cancers of the esophagus, stomach, colon and rectum. These cancers may be secondary; that is, they will surface after the lung cancer or mesothelioma develops.

Asbestos-related disease is an occupational hazard for workers in asbestos mining and processing, shipyard construction and automotive brake lining repair. These people are commonly exposed to and may inhale or swallow asbestos fibers. The National Institute of Occupational Safety and Health (NIOSH) has stated that these workers have a greater risk of developing the above diseases. However, symptoms may not develop for 20, 30 or more years. Recent studies of shipyard workers show that some individuals exposed for short periods of time (even as short as one month) are showing signs of asbestosis 20 years later. Even those shipyard workers such as painters, electricians, carpenters and welders, who may not have realized that they were indirectly exposed to asbestos, are developing lung disease symptoms. Many of these personnel worked in the vicinity of asbestos in shipyards during and since World War II. In fact, records indicate that 11 million American workers may have been exposed to asbestos fibers, including an estimated 4.5 million workers in the shipyards between 1940 and 1944. There is also some evidence that family members of those workers heavily exposed to asbestos have an increased risk of asbestos-related disease. This may be due to asbestos dust brought home on work clothes and subsequently released in the home environment.

CIGARETTE SMOKING AND ASBESTOS

The risk of developing asbestos-related disease increases with cigarette smoking. Ashestos workers who smoke may be up to 30 times more likely to develop lung cancer than exposed nonsmokers, and 90 times more likely than unexposed nonsmokers. An asbestos worker who is a nonsmoker has approximately three to four times the chance of developing lung cancer as an unexposed nonsmoker. There is, however, recent evidence that stopping smoking reduces the risk among those workers who were previously exposed to asbestos dust. There also have been recent indications from industrial toxicologists that the 90-fold figure (exposed smokers versus unexposed nonsmokers) may be too high, that a more accurate figure is perhaps 17-fold. Additionally, asbestos alone may not be a lung cancer-causing agent, but may instead act in combination with other substances which are carcinogens. Further studies are underway to clarify this issue and resolve the accompanying controversies.

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Fibrous asbestos occurs naturally as masses of compact, long mineral fibers. When these fragile fibers are handled abrasively, they break into tiny fibers (shown here under magnification) and form asbestos "dust." This dust is easily inhaled or swallowed and may contain fibers of a length that lodge deep within the respiratory system, presenting a potential health hazard.

FEDERAL PERSONNEL PROTECTION STANDARDS

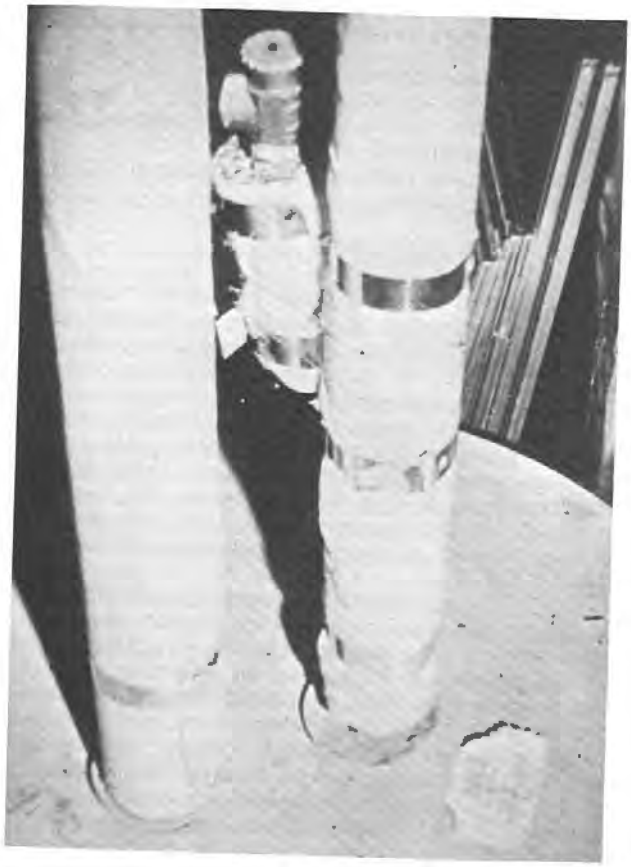
Several government agencies are currently calling attention to asbestos exposure hazards through regulations, standards, instructions, and public awareness programs.

The first asbestos criteria document was published in 1972 by the National Institute for Occupational Safety and Health (NIOSH). It recommended a standard of not more than two asbestos fibers per cubic centimeter (2 fibers/cc) of air, based on a count of fibers longer than 5 micrometers on an 8-hour time weighted average (TWA) basis. This standard was based upon the belief that a two-fiber level would "prevent" asbestosis, but not necessarily cancers. NIOSH also recommended that the standard be re-evaluated as new scientific data was obtained.

On June 7, 1972, the Occupational Safety and Health Administration (OSHA) established a standard of 5 fibers/cc (for fibers longer than five micrometers) for an 8-hour TWA, with 10 fibers/cc as a 15-minute ceiling limit. The OSHA standard also specified January 1, 1976 as the date for reducing the TWA to 2 fibers/cc. On October 9, 1975, OSHA published a proposed rulemaking to reduce its standard even further to 0.5 fibers/cc (for fibers longer than 5 micrometers) for an 8-hour TWA, and a 5 fibers/cc ceiling concentration for a 15-minute sampling period. This proposed change has not yet become effective. OSHA also requested that NIOSH evaluate all the information available on the health effects of occupational exposure to asbestos. In December 1976 NIOSH published the updated asbestos criteria document entitled "Revised Recommended Asbestos Standard." This revision specified exposure to be less than 0.1 fibers/cc for an 8-hour TWA, and a 0.5 fibers/cc ceiling limit (for fibers longer than 5 micrometers).

The existing OSHA standard, described in 1910.1001 of 29 CFR, specifies that the airborne concentrations of asbestos fibers to which an employee may be exposed shall not exceed 2 fibers/cc (longer than 5 micrometers) for an 8-hour TWA and a ceiling concentration of 10 fibers/cc for 15 minutes. The standard also specifies methods of compliance, environmental and employee monitoring, signs, labels and recordkeeping and medical monitoring.

Phase contrast microscopy is the technique specified for determining OSHA standards. This method consists of collecting breathing zone samples on a membrane filter during 15-minute to 8-hour sampling periods and then counting the fibers magnified 400 to 500 times. Asbestos fibers are defined as those particles longer than 5 micrometers and with a length-to-diameter ratio of 3 to 1 or greater. This technique is recognized as only an index of total fiber exposure and does not imply that shorter fibers do not pose a health hazard; they do, as previously shown by the fiber length versus disposition chart. Phase contrast may not be specific for different types of asbestos fibers. Despite these limitations, phase contrast represents the best current technique available that can reasonably be used for routine asbestos sampling and analysis.



The excellent fire resistant and insulating properties of asbestos make it ideal for use with boilers, steampipes, etc. on board vessels. Undamaged asbestos insulation usually presents no problem. However, deteriorated insulation, as seen here, is dangerous and should be replaced.

Section 112 of the Clean Air Act, as amended, (42 USC S 7401 et seq 1970) requires the administrator of the Environmental Protection Agency (EPA) to publish a list of hazardous air pollutants for which national emission standards will be issued. In 40 CFR, Part 61 (1977), EPA published emission standards for three hazardous air pollutants: asbestos, beryllium, and mercury.

The national emission standard for asbestos is directed principally toward the manufacture of asbestos products. However, demolition or modification of institutional, commercial, or industrial buildings containing asbestos (including residential buildings having five or more dwelling units) is also addressed. Procedures for handling, transporting and disposing of waste asbestos are prescribed in the standard.

The Materials Transportation Bureau of the Department of Transportation (DOT) has recently published a final rule requiring shipments of commercial asbestos fiber to be packaged in rigid, airtight or dust- and sift-proof containers. These minimum safety

Continued on next page.....

requirements are intended to reduce the risk to public health that may result from the handling of asbestos fiber shipments in commercial transportation. The DOT regulations were effective on April 30, 1979. The final rule was published on December 4, 1978 (43 233, pp. 5664-56668).

CURRENT DEVELOPMENTS

The current federal interest in asbestos fiber control was accelerated by the alarming findings from several ongoing studies. Scientific studies performed early in this century indicated a relationship between asbestos dust exposure and lung disease such as asbestosis. But not until the late thirties was the possible causal relationship between lung cancer and asbestos suspected. However, even these reports resulted from studies involving only the "asbestos worker," one who was working directly with and was heavily exposed to large concentrations of asbestos dust.

In 1968, reports of instances of mesothelioma among British and Dutch shipyard workers sounded a clear warning that asbestos might be an extensive and serious problem in shipyards. Significantly, the personnel concerned were not heavily exposed asbestos workers, but indirectly exposed individuals employed in other trades: boilermakers, fitters, welders and laborers. Questions were raised about the possibility of similar problems in U.S. shipyards. During this same period of time, it was discovered that workers who manufactured the asbestos insulation material used in U.S. yards during and after World War II were also suffering from asbestos diseases. Even the wives and children of some workers showed evidence of asbestos-related disease, indicating that exposure of much lesser intensity might also be seriously hazardous.

During 1974-75, cases of asbestos-associated disease among shipyard workers in Groton, Connecticut were brought to the attention of Irving J. Selikoff, M.D., at Mount Sinai Hospital in New York City. Dr. Selikoff, Professor of Medicine, is the Director of the Environmental Sciences Laboratory, Mount Sinai School of Medicine, City University of New York. About 1,000 men were examined, including boilermakers, pipefitters, insulators, painters, carpenters, welders, electricians, machinists and laborers, as well as office workers, draftsmen and guards. Approximately half of the workers examined showed X-ray evidence of pulmonary and pleural lung change of the sort regularly seen following direct or indirect occupational exposure to asbestos. The prevalence of such a very high proportion of asbestotic X-ray changes raised the very serious question of whether this could mean possible cancer problems in the future. X-ray changes often precede findings of asbestos-related cancers, but many workers could have asbestos exposure sufficient to cause death by mesothelioma and not show any prior X-ray evidence. Therefore, the extent of future cancer risk based solely upon current X-ray evidence cannot be predicted.

In April 1978, former Secretary Joseph A. Califano launched a public awareness program under the auspices of DHEW. The program was based on a number of factors, but the two most important were: the great number of individuals possibly affected who are unaware that their previous and/or present asbestos exposure may present a health risk; and the realization that asbestos dust is one of the most dangerous and insidious substances in the work place.

To initiate this awareness program, the Surgeon General sent an advisory letter to 400,000 doctors in the U.S. This letter described the nature of asbestos' health risk, steps to take during diagnosing or treating patients, and where to get more information about asbestos-related diseases. The National Cancer Institute and the National Institute of Environmental Health Sciences, in cooperation with DHEW, developed a detailed public information package in consultation with other Executive departments, unions, employees and other interested parties. The Department of Defense will assist this group in relaying this information to former military and federal civilian Naval shipyard workers. Finally, further measures are also under consideration. These include other information programs utilizing unions and employees, and additional research into the health hazards of asbestos.

The Department of the Navy, through the Office of Naval Operation, issued OPNAV Instruction 6260.1A on August 8, 1978. This instruction, "Control of Asbestos Exposure to Naval Personnel and Environs," sets forth the Navy's policy of complying with the existing OSHA and EPA standards. This policy extends the Clean Air Act amendments to include commissioned naval ships under the "rip-out" section.

The Navy has also established a program to monitor the air in potentially contaminated areas and medically monitor those individuals previously exposed and/or presently working with asbestos, either in construction or repair. Additionally, surveys of naval shore facilities for asbestos spray insulation have begun.

The United States Maritime Administration (MARAD) has contracted for a study entitled "Assessment of Asbestos Concentrations in the Engineroom Environment of Marine Vessels, Phase I." This study states two primary objectives: first, "to establish whether standard sampling methods and equipment are practical to study the concentrations of asbestos in the engine rooms of ships," and second, "to plan and recommend a protocol capable of generating the data needed to assess the exposure of ship's personnel to asbestos." The study results of the first objective show that there were no violations of the current OSHA workplace standard (2 fibers/cc), but levels of asbestos exist which are above the updated NIOSH recommended standard of 0.1 fibers/cc. A survey scheme has been developed to meet the second objective.

The MARAD study resulted from findings cited in a Tulane University report. This report indicated that a "rather impressive percentage of lung disease" was found upon examination of X-rays from more than 1,100 members of the Marine Engineers Benevolent

Continued on next page.....

Association (MEBA). The report stated that this lung disease was attributed to the individuals' exposure to asbestos. The X-rays showed pleural thickening and low-grade pulmonary fibrosis. It was concluded that even though lung changes were seen, these results could not be used to estimate cancer incidence. However, the report stated that "the X-ray evidence is an excellent means of alerting the individual of the possible existence of cancer."

The Coast Guard has initiated a study of older Coast Guard vessels, many of which have deteriorated asbestos insulation due to age and physical wear and tear. Inspection of two of the oldest high endurance class vessels showed marked insulation deterioration in fire rooms, enginerooms, galleys and laundries.

In order to more thoroughly investigate this problem, the Safety Programs Division of the Office of the Chief of Staff at Coast Guard Headquarters began an industrial hygiene study aboard selected Coast Guard vessels. The study serves a sixfold purpose--to:

Quantify airborne asbestos exposures in living-working environments aboard all classes of Coast Guard vessels;

Develop a hazard evaluation plan in assigning priorities for engineering corrections;

Identify exposed personnel for inclusion in the medical monitoring program;

Provide hazard awareness and asbestos handling training to shipboard engineering personnel;

Establish an asbestos exposure recordkeeping system; and

Identify those vessels to be included in a periodic industrial hygiene air sampling program.

Preliminary findings from the first phase of this study indicate that there is airborne asbestos fiber contamination aboard Coast Guard vessels in both engineering and living spaces, but at very low levels--much lower than the current OSHA standards. However, the chronic effects of 24-hour per day exposure at low contamination levels have yet to be determined.

Current plans are to continue industrial hygiene studies aboard a much larger representative number of Coast Guard vessels (approximately 50).

Continued on next page.....

Poor housekeeping can result in contamination of the work area. Proper techniques are required to protect employees from asbestos exposure. Insulation materials should not be allowed to drop to the deck, but should be placed immediately in disposal bags. Any wet wastes that do fall must be removed promptly, before they dry, to prevent airborne fibers.

BASIC CORRECTIVE MEASURES

There are three general means of control that are utilized to reduce or eliminate the hazards of asbestos dust exposure during shipboard work operations: engineering controls, administrative controls and personnel protection.

Engineering controls include substitution of a less hazardous material, isolation enclosure, exhaust ventilation, dilution ventilation and wet methods. These controls have previously been discussed in detail.[1]

Administrative controls include limiting the number of personnel in the work area, limiting the duration of exposure for any given person, good housekeeping, and restricting smoking and eating in work spaces.

Personnel protection[2] includes the use of special protective clothing and the use of proper respiratory gear.

During insulation rip out/replacement operations aboard ship there is a high potential for worker exposure to asbestos fibers. The following measures can be taken to reduce this hazard.[3]

Soaking insulation with water before removal will reduce airborne asbestos fiber dust clouds. Non-absorbent surfaces can be punctured to allow water to be introduced, while absorbent surfaces can be soaked by a fine low-pressure spray.

Do not tear away insulation. If possible, remove it by sawing or cutting away using tools fitted with dust collectors.

Asbestos insulation materials, once removed, should not be allowed to fall to the deck but should be placed immediately in disposal bags. Any slurries of wet waste that drop must not be allowed to dry, but should be removed while still wet.

If possible, a high capacity exhaust system should be employed at the work site.

It is important to remove asbestos dust accumulated on decks, web frames, equipment, bulkheads, overheads, etc. before it becomes airborne. Sweeping or even wet mopping will only tend to spread the dust around. Vacuum cleaning is the recommended means of dust removal.

Proper respiratory protection is important when working around asbestos dust. The NIOSH-approved filter dust mask (above) or, better yet, a half-mask respirator (below) is appropriate for low concentrations and intermittent exposure.
NOTE: References to specific equipment manufacturers are for example only and are not intended to indicate Coast Guard endorsement.

When working in an area contaminated with asbestos, full protective outer clothing with all openings sealed is essential. Disposable poly vinyl chloride (PVC) outerwear or non-disposable cotton-polyester coveralls may be used. A head covering is needed to prevent asbestos fibers from accumulating in the hair; a lightweight paper surgical-type cap can be worn under the worker's hard hat for this purpose.

Continued on next page.....

[1] Haas, T. J., "Safety and Health Hazards in Inspection and Response," *Proceedings of the Marine Safety Council*, May 1979, pp. 80-81.

[2] Haas, T. J., "Respiratory Protection—Your Right to Breathe Safely," *Proceedings of the Marine Safety Council*, September 1978, pp. 76-80.

[3] R. J. Levine, M.D., ed., *Asbestos: an Information Resource*, DHEW Publication No. (NIH) 78-1681, May 1978.

Because asbestos dust is primarily an airborne hazard, respiratory protection is important. For low concentrations and intermittent exposure, a NIOSH-approved half-mask respirator with appropriate filters or a disposable filter mask may be used. Mine Safety Appliances (MSA) markets a NIOSH-approved half-mask respirator which can be fit-tested to the individual. The canisters and appropriate filters are replaceable at the end of their service life. 3M Company manufactures a disposable filter dust mask which carries a NIOSH approval for asbestos. This mask has the advantage of being disposable.

A decontamination space is necessary to remove all work clothing and protective equipment at the end of each work shift. Showers should be taken prior to dressing in a separate "clean" area where street clothes and personal effects have been kept.

The level of personnel protection used should be determined by the level of asbestos hazard present. An industrial hygienist should be consulted to assist supervisory personnel in evaluating the hazard level. The hygienist can then suggest the level of personnel protection necessary to minimize the hazard.

CONCLUSION

Results of preliminary monitoring projects, initiated independently by MARAD and the Coast Guard, indicate that asbestos fiber concentrations in both engineroom and living spaces aboard operating vessels are within current OSHA time weighted average standards. The effect of low-level asbestos dust exposure on a 24-hour per day continuous basis has not yet been determined. Marine industry personnel should be aware of the hazards of asbestos inhalation and of proper protective measures. Crew personnel must be taught to safely repair asbestos insulation, internal boiler firebox insulation, steam pipe lagging, etc. with a minimum generation of asbestos dust. Large-scale vessel conversions and repairs in shipyards must be closely supervised to reduce asbestos dust generation as much as possible. Repair yard personnel must be aware of and actively participate in personnel protection programs to prevent asbestos dust inhalation. Removal or repair work involving asbestos materials previously installed aboard vessels will inevitably pose a problem, both at present and in the future. Finally, previously exposed shipyard personnel must be identified and located. These people need to know about the potential effects of their exposure and should undergo appropriate medical tests for early detection and control of any resultant medical problems.

See next page.....

We cannot hope to cover in a single article every aspect of a problem having a scope as extensive and a medical complexity as great as that of asbestos. Therefore, we recommend that readers having a desire for more information on a specific asbestos problem send in the self-mailer below, so that future articles can be focused directly on these areas of concern.

I would like more information about asbestos, specifically_____

I would like to see an article on (any subject)_____

(optional): name: _____

address: _____

About the Authors

Commander John E. Lindak

Commander John Lindak is Chief of the Hazard Evaluation Branch of the Cargo and Hazardous Materials Division at Coast Guard Headquarters. A 1963 graduate of the Coast Guard Academy, he has served aboard several Coast Guard cutters within their engineering departments and also as engineering officer. While assigned to the Office of Research and Development at Headquarters from 1969 to 1973, he was project officer for a number of chemical hazard evaluation projects including anhydrous ammonia, chlorine and liquid natural gas. Commander Lindak also worked on the preliminary development of CHRIS, the Coast Guard's Chemical Hazard Response Information System. His current duties involve assessing and disseminating information about the physical, chemical and toxicological properties of hazardous materials shipped aboard vessels.

Lieutenant Thomas J. Haas

Lt. Haas, a 1973 graduate of the Coast Guard Academy, received postgraduate training in chemistry and environmental health sciences (toxicology) from the University of Michigan. Since coming to the Cargo and Hazardous Materials Division at Coast Guard Headquarters, he has contributed to the Proceedings in addition to preparing articles for publication in other professional journals, such as the Journal of Veterinary and Human Toxicology. Recently, Lt. Haas has lectured on chemical hazards at the Coast Guard Reserve Training Center, Yorktown, Virginia and at the Maritime Institute of Technology and Advance Graduate Studies. He has also been instrumental in the developmental stages of a National Cancer Institute epidemiological study of Coast Guard marine inspectors, and is presently serving as the secretary of the Chemical Transportation Advisory Committee's Subcommittee on Personal Protection.

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Lessons from Casualties

A 70,000 gross ton oil tanker sustained a major internal explosion within the starboard boiler while dockside repairs were being made. This vessel has two automated tube-type propulsion boilers, each with a maximum allowable working pressure of 1,100 PSI. Each boiler has three burners and can be controlled from the boiler front console or remotely from the engine room.

On the morning of the casualty, both boilers had been shut down for six hours. The Chief Engineer brought up the port boiler to 900 PSI and shifted it from diesel fuel to black oil fuel at this time. When the port boiler reached 900 PSI, the Chief Engineer started the starboard boiler using diesel fuel. It is believed that only one burner was in use on each boiler. A short time later, both boilers shut down by themselves. The Chief Engineer and an automation manufacturer representative went to the port boiler to determine the cause of the shutdown. The Chief Engineer noted a feedwater pressure problem and went below deck to inspect the feedwater pump. The automation representative went to the starboard boiler front and glanced through one of the peepholes. He thought that the fire was out. The Chief Engineer then directed the automation representative to the boiler front control board, whereupon he pushed the air register button on the No. 1 burner in order to purge the starboard boiler. The ensuing explosion caused major structural damage to the boiler.

This casualty demonstrates the importance of monitoring boilers fired on diesel oil and under boiler front control. This operating condition, with the master fuel oil valve bypassed, presented an abnormal operating situation. Pressing the air register button added sufficient air to the boiler to ignite the diesel fuel that was still being pumped into it. In this particular operating condition, the fuel can only be shut down manually by the diesel oil bypass valve. The Chief Engineer should have recognized the potential for a hazardous situation and closely monitored the boiler front. A warning to this effect is included in the Chief Engineer's Technical Manual.

Nautical Queries

The following items are examples of questions included in the Assistant Engineer of Uninspected Motor Vessels examinations and Third Mate through Master examinations.

DECK

(1) Official proof of an American vessel's nationality is contained in

A. the Register.
B. the Certificate of Inspection.
C. the Official Log.
D. the Shipping Articles.

REFERENCE: Shipmaster's Handbook for Ship's Business, 1969 edition

(2) A declaration made by the master before a U.S. Consul, notary public, or magistrate, giving particulars regarding heavy weather or other incidents which may have caused damage to the vessel or cargo through no fault of the vessel, her officers, or crew is a/an

A. master's declaration.
B. exception report.
C. note of protest.
D. cargo addendum.

REFERENCE: Shipmaster's Handbook for Ship's Business

(3) The S. S. Microwave has been chartered to the Longline Steamship Company. The Longline Steamship Company agrees to pay ALL expenses and employ and pay the crew. What type of contract is involved?

A. Voyage Charter Party
B. Time Charter Party
C. Lease Charter Party
D. Bareboat Charter Party

REFERENCE: Shipmaster's Handbook on Ship's Business

(4) A welded joint's effectiveness is (when properly done) considered

A. 48%.
B. 121%.
C. 90%.
D. 100%

REFERENCE: Merchant Marine Officer's Handbook; Modern Ships—Ladage; Steel Shipbuilding --Baker

(5) In ship construction, keel scantlings should be the greatest

A. one-third the distance from the bow.
B. one-third the distance from the stern.
C. midships.
D. at each frame.

REFERENCE: Steel Shipbuilding —Baker

ENGINEER

(1) The use of lube oil with too high a viscosity in a diesel engine will result in

A. increased starting difficulty in cold weather.
B. increased oil consumption.
C. thickening at higher operating temperatures.
D. minimal friction losses.

REFERENCE: Modern Marine Engineers Manual, Osbourne

(2) If the buoyant force on a ship's hull is equal to the displacement tonnage, the ship will

A. require ballast.
B. be down by the head.
C. sink.
D. float.

REFERENCE: Modern Ships, LaDage

(3) Piston seizure is usually caused by

A. poor cooling of cylinder walls.
B. improper piston cooling.
C. insufficient piston lubrication.
D. all of the above.

REFERENCE: Diesel Engine Operation and Maintenance, Maleev

(4) Most fuel injection nozzles are opened by

A. fuel oil pressure.
B. a cam operated follower.
C. a spring loaded pressure plate.
D. timing gears keyed to the crankshaft.

REFERENCE: Diesel and High Compression Gas Engines, Kates & Luck

(5) The pH value of cooling water should be maintained at

A. 8 to 10.5.
B. 7.0
C. 4.0.
D. 0.0.

REFERENCE: Diesel Engineering Handbook, Stinson

ANSWERS

Deck
1. A; 2. C; 3. D; 4. D; 5. C

Engineer
1. A; 2. D; 3. D; 4. A; 5. A

MERCHANT MARINE SAFETY PUBLICATIONS

The following publications may be obtained from the nearest marine safety office or marine inspection office of the U.S. Coast Guard. Because changes to the rules and regulations are made from time to time, these publications can be kept current between revisions only by referring to the Federal Register. (Official changes to all federal regulations are published in the Federal Register, printed daily except Saturday, Sunday, and holidays.) Following the title of each publication in the table below are the date of the most recent edition and the dates of the Federal Registers affecting each.

The Federal Register may be obtained by subscription ($5 per month or $50 per year) or by individual copy (75 cents each) from SupDocs, U.S. Government Printing Office, Washington, DC 20402.

CG No.	TITLE OF PUBLICATION
101-1	Specimen Examinations for Merchant Marine Deck Officers (2d and 3d Mate) (4-1-77).
101-2	Specimen Examinations for Merchant Marine Deck Officers (Master and Chief Mate) (4-1-76).
108	Rules and Regulations for Military Explosives and Hazardous Munitions (4-1-72). FR 7-21-72, 12-1-72, 6-18-75.
*115	Marine Engineering Regulations (8-1-77). FR 9-26-77, 10-10-78, 12-4-78, 3-12-79.
*123	Rules and Regulations for Tank Vessels (8-1-77). (Ch-1, 4-28-78). FR 8-17-77, 9-12-77, 9-26-77, 10-25-77, 12-19-77, 3-12-79, 6-14-79, 7-2-79.
169	Navigation Rules - International - Inland (5-1-77). FR 7-11-77, 7-14-77, 9-26-77, 10-12-77, 11-3-77, 12-6-77, 12-15-77, 3-16-78.
169-1	Colregs Demarcation Lines (7-15-77).
172	Rules of the Road - Great Lakes (7-1-72). FR 10-6-72, 11-4-72, 1-16-73, 1-29-73, 5-8-73, 3-29-74, 6-3-74, 11-27-74, 4-16-75, 4-28-75, 10-22-75, 2-5-76, 1-13-77, 11-3-77, 12-6-77.
174	A Manual for the Safe Handling of Flammable and Combustible Liquids and Other Hazardous Products (9-1-76).
**176	Load Line Regulations (2-1-71). FR 10-1-71, 5-10-73, 7-10-74, 10-14-75, 12-8-75, 1-8-76.
182-1	Specimen Examinations for Merchant Marine Engineer Licenses (2d and 3d Assistant) (2-1-78).
182-2	Specimen Examinations for Merchant Marine Engineer Licenses (First Assistant) (3-1-78).
182-3	Specimen Examinations for Merchant Marine Engineer Licenses (Chief Engineer) (3-1-78).
184	Rules of the Road - Western Rivers (8-1-72). FR 9-12-72, 12-28-72, 3-8-74, 3-29-74, 6-3-74, 11-27-74, 4-16-75, 4-28-75, 10-22-75, 2-5-76, 3-1-76, 6-10-76, 7-11-77, 12-6-77, 12-15-77.
*190	Equipment Lists (5-1-75). FR 5-7-75, 6-2-75, 6-25-75, 7-22-75, 7-24-75, 8-1-75, 8-20-75, 9-23-75, 10-8-75, 11-21-75, 12-11-75, 12-15-75, 2-5-76, 2-23-76, 3-18-76, 4-5-76, 5-6-76, 6-10-76, 6-21-76, 6-24-76, 9-2-76, 9-13-76, 9-16-76, 10-12-76, 11-1-76, 11-4-76, 11-11-76, 12-2-76, 12-23-77, 4-4-77, 4-11-77, 4-21-77, 5-19-77, 5-26-77, 6-9-77.
191	Rules and Regulations for Licensing and Certification of Merchant Marine Personnel (11-1-76). FR 3-3-77, 8-8-77.
227	Laws Governing Marine Inspection (7-1-75).
239	Security of Vessels and Waterfront Facilities (5-1-74). FR 5-15-74, 5-24-74, 8-15-74, 9-5-74, 9-9-74, 12-3-74, 1-6-75, 1-29-75, 4-22-75, 7-2-75, 7-7-75, 7-24-75, 10-1-75, 10-8-75, 6-3-76, 9-27-76, 2-3-77, 3-31-77, 7-14-77, 7-28-77, 9-22-77, 9-26-77, 12-19-77, 1-6-78, 1-16-78, 3-2-78, 11-16-78.
257	Rules and Regulations for Cargo and Miscellaneous Vessels (9-1-77). FR 9-26-77, 9-29-77, 12-19-77, 3-12-79, 6-14-79, 7-2-79.
258	Rules and Regulations for Uninspected Vessels (4-1-77). (Ch-1, 3-17-78). FR 9-26-77, 6-14-79, 7-2-79.
259	Electrical Engineering Regulations (7-1-77). FR 9-26-77.
268	Rules and Regulations for Manning of Vessels (7-1-77).
293	Miscellaneous Electrical Equipment List (7-2-73).
*323	Rules and Regulations for Small Passenger Vessels (Under 100 Gross Tons) (7-1-77). (Ch-1, 3-17-78). FR 9-26-77, 12-15-77, 12-19-77, 7-17-78, 3-12-79, 6-14-79, 7-2-79.
329	Fire Fighting Manual for Tank Vessels (1-1-74).
439	Bridge-to-Bridge Radiotelephone Communications (12-1-72). FR 12-28-72, 3-8-74, 5-5-75, 7-11-77.
467	Specimen Examinations for Uninspected Towing Vessel Operators (10-1-74).
497	Rules and Regulations for Recreational Boating (7-1-77). FR 7-14-77, 8-18-77, 3-9-78, 7-19-79.

*Temporarily out of stock
**Under revision--can be found in Title 46 CFR Parts 41-69

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