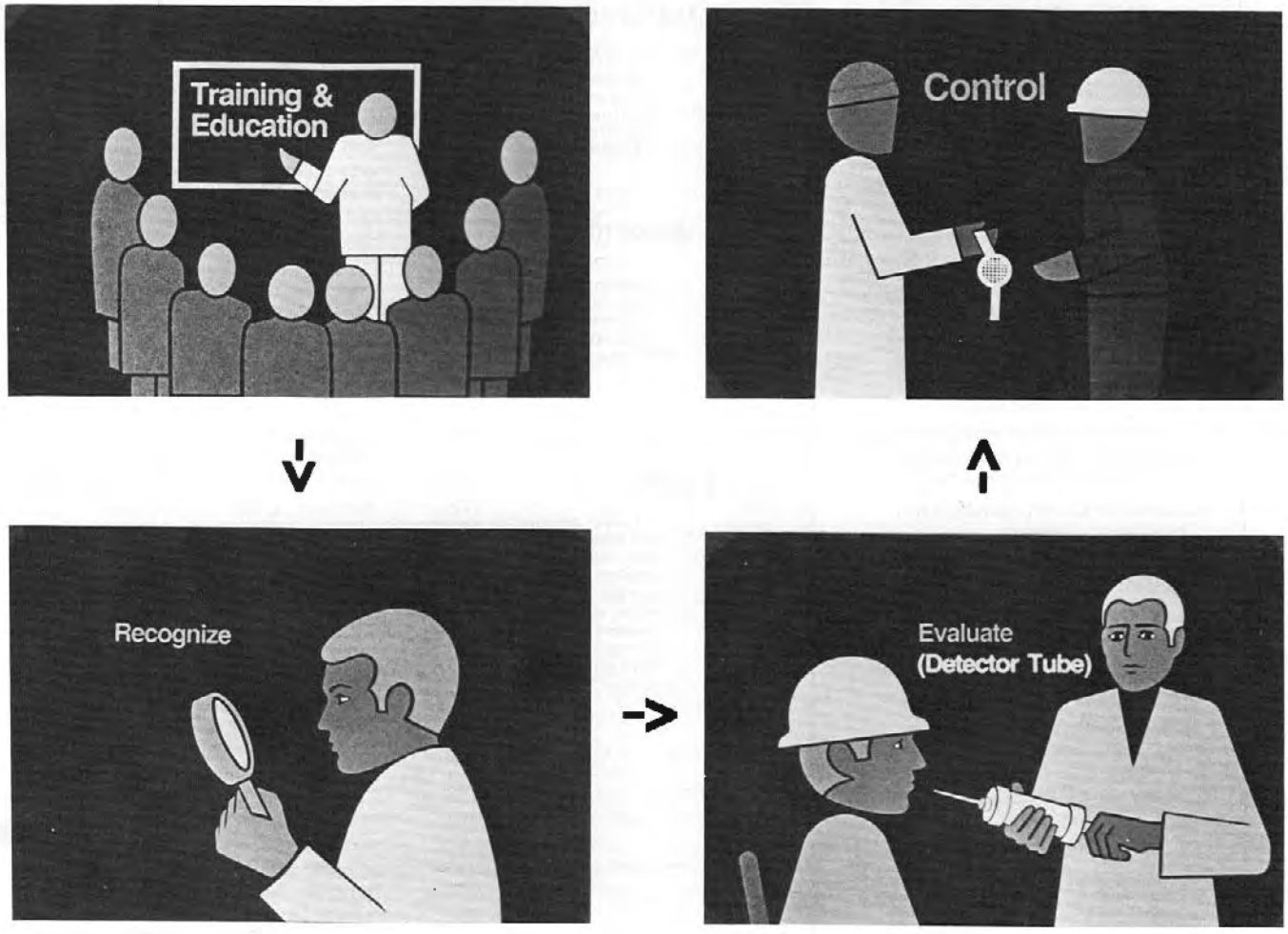
PROCEEDINGS
OF THE MARINE SAFETY COUNCIL

Vol. 36, No.4

May 1979



U.S. Department of Transportation **CG-129** United States Coast Guard

PROCEEDINGS

OF THE MARINE SAFETY COUNCIL

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Cover

Proper training is necessary for marine inspection and response personnel to identify the hazards associated with their duties. Once a safety or health problem is recognized, it should be evaluated for possible short- and long-term effects. Ideally, recognition and evaluation of hazards within a work environment will result in their control or elimination through corrective/preventive measures. Why is this ideal often not attained? Read the article beginning on page 78.

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THIS COPY FOR NOT LESS THAN 20 READERS— PLEASE PASS IT ALONG

maritime sidelights

SHIP'S MEDICINE CHEST

A new edition of The Ship's Medicine Chest and Medical Aid at Sea is now available through the Government Printing Office. Past editions have been used as texts at national and state merchant marine academies and have seen service with the crews of merchant ships and fishing vessels, as well as with outdoorsmen, explorers, and backwoodsmen.

This new volume is a substantial revision of the previous 1955 edition, incorporating the latest medical self-help techniques and pharmacological information. It begins with a thorough review of basic anatomy and moves on to patient examination techniques. Early chapters detail the emergency treatment of injuries, describe and illustrate cardiopulmonary resuscitation, and explain the diagnosis and treatment of common diseases. Specific information on the kinds and amounts of drugs to be stored and the use and dosage of these medicines is provided, and general nursing procedures are described. Later chapters discuss the specific medical problems associated with castaways, proper handling of births and deaths at sea, the prevention and control of communicable disease aboard ship, and the procedures for obtaining medical advice by radio and patient evacuation by helicopter.

No book can take the place of a doctor, but in areas where professional help is unavailable, The Ship's Medicine Chest can help you diagnose and treat common sicknesses and injuries until your patient can be transported or a doctor can be summoned.

The new 474-page clothbound edition, HE 20.5408:M 64/4, S/N 017-029-00026-6, can be ordered from Superintendent of Documents, U.S. Government Printing Office, Washington, DC 20402. The book sells for $10.25.

FUSIBLE PLUGS

The regulations prescribed in 46 CFR, Subpart 162.014, Subchapter Q, Specifications, require that manufacturers submit samples from each heat of fusible plugs for testing prior to their being installed aboard vessels subject to inspection by the Coast Guard. Below is a list of approved heats that have been tested and found acceptable.

Heat No.	Size (inch)	Type
800	1/2	Fireside
801	1/2	Waterside
802	3/4	Fireside
803	3/4	Fireside
804	3/4	Fireside
805	3/4	Fireside
806	3/4	Waterside
807	1/2	Fireside
808	1/2	Fireside
809	1/2	Fireside
810	3/4	Fireside
811	3/4	Fireside
812	3/4	Fireside
813	3/4	Fireside
814	1/2	Waterside
815	1	Fireside
816	1	Fireside
817	3/4	Fireside
818	3/4	Fireside
819	3/4	Waterside
820	3/4	Fireside
821	3/4	Fireside
822	1/2	Fireside
823	3/4	Waterside
824	3/4	Fireside
825	3/4	Fireside
826	3/4	Fireside
827	3/4	Fireside
828	1/2	Fireside
828	3/8	Fireside
829	3/4	Fireside
830	3/4	Fireside
831	3/4	Fireside

CAORF RESEARCH SUMMARIZED

Marine research at the Computer Aided Operations Research Facility (CAORF) is the subject of a paper authored by Stanley D. Wheatley, director of the Maritime Administration's National Maritime Research Center (NMRC). Mr. Wheatley presented his paper, entitled "Maritime Research at CAORF," at the 58th Annual Meeting of the Transportation Research Board this past January. It discusses the arrangement and use of the CAORF ship maneuvering simulator for research into areas impacting on safety and productivity of the maritime industry.

The presentation provides a description of the facilities and broad coverage of the experimental investigations performed over the three years of CAORF operation. During this period, CAORF has been engaged in a wide variety of research programs directed toward commercial shipping applications.

Among the investigations discussed are:

* A series of simulator experiments dealing with the effect of computer-based collison avoidance systems on bridge watch officer performance in potential collision situations in the open sea and in restricted waters.

* An evaluation of a marine radar interrogator/transponder system as a collision avoidance aid and as a navigation aid to the bridge watch officer.

* An assessment of the effects of wind speed on the safe docking of LNG carriers.

* An investigation into the ways experienced mariners interpret the recently revised Rules of the Road in potential collision encounters, and whether their reactions are influenced by training in the rule changes or by the type of ship they are conning.

* The use of off-line computer simulation to examine the conditions for safe passage of large oil tankers (40K to 400K DWT) through selected straits in the Puget Sound area.

* The use of the simulator to analyze operational procedures in approaching and leaving new ports such as Valdez, Alaska and a new LNG terminal at Port Arun, Indonesia.

Continued on next page.....

The various experiments are grouped in the presentation under such major research areas as "collision avoidance," "advanced bridge systems," and "restricted waterways." The salient results of each of these experiments are highlighted and discussed.

Copies of the paper are available directly from the National Maritime Research Center, Kings Point, NY 11024.

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

These regulations would redefine and establish qualifying criteria for certifying individuals engaged in the carriage and transfer of the various categories 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.

In the last issue (March-April 1979) it was stated that these rules would be withdrawn due to a combination of (1) extensive comments on the first NPRM, (2) new requirements imposed by the Port and Tanker Safety Act of 1978 and (3) requirements of the International Convention on Standards of Training, Certification and Watchkeeping for Seafarers of 1978. The proposed rules have been withdrawn (44 FR 25243) and new NPRM's are anticipated in June.

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.

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

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

These regulations would 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.

It was stated in the last issue that a final rule was anticipated in May 1979. The final rule was, in fact, published May 3, 1979 (44 FR 25986).

UPGRADE OF 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 which resulted from a Presidential initiative of March 17, 1977, directing 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 1974, the Coast Guard and the Maritime Administration performed a joint study of the tank barge pollution problem which found that certain construction techniques might provide a significant advantage for eliminating oil pollution from tank barges. However, the study had several weaknesses and regulatory action was not taken.

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) will be issued to gather additional data and assess impacts related to existing barges.

As we go to press, the notice of withdrawal of the old NPRM and the new ANPRM will be published in May 1979.

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 regulation 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). Public hearings were held in New Orleans, Louisiana on November 22, 1977; St. Louis, Missouri on November 30, 1977; and Washington, DC on November 28, 1977.

As stated in the last issue, the draft of the final rule is currently under legal review.

OFFSHORE OIL SPILL POLLUTION FUND
CGD 77-055

This document establishes procedural rules concerning administration and operation of the fund,

Continued on next page.....

including liability limits for certain facilities, financial responsibility factors, damage claim settlement procedures, et. al.

This regulation was passed in order to implement administration of the fund by creating 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 would govern the operation of tank vessels in the Puget Sound area to protect against environmental harm resulting from vessel or structure damage, destruction, or loss.

Considered a significant rulemaking due to Congressional and public interest, this regulation was initiated in order 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.

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) with a public hearing held April 20-21, 1978. 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.

Additional public hearings have been scheduled as follows: June 11, 1979, Seattle, Washington; June 12, 1979, Seattle, Washington; June 13, 1979, Mt. Vernon, Washington; and June 14, 1979, Port Angeles, Washington,.

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 expected the latter part 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). Public hearings were held in Washington, DC and San Diego, California in June 1977. An NPRM was published February 12, 1979 (44 FR 8984). Hearings were held on March 21, 1979 in Washington, DC and on March 28, 1979 in San Francisco, California; 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). Hearings were held on March 21, 1979 in Washington, DC and on March 28, 1979 in San Francisco, California; 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). Hearings were held on March 21, 1979 in Washington, DC and on March 28, 1979 in San Francisco, California; 138 comments have been received on the docket.

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All comments on proposed rulemakings should be submitted to:
Commandant (G-CMC/81)
U.S. Coast Guard
Washington, DC 20590

Comments are available for examination at the Marine Safety Council (G-CMC/81), Room 8117, Department of Transportation, Nassif Building, 400 Seventh Street, SW, Washington, DC 20590; phone (202) 426-1477.

MEETINGS AND PUBLIC HEARINGS FOR THE END OF MAY AND THE MONTH OF JUNE

MAY 1979

22: Public Hearing; Louisville and Nashville Railroad Company Bridge, Cumberland River Mile 126.5. Hearing at 1:00 p.m. in room 873, U.S. Court House, 801 Broadway, Nashville, Tennessee.

23 & 24: Committee Meeting;

Continued on page 93.....

Safety and Health Hazards in Inspection and Response

Lieutenant Thomas J. Haas
U.S. Coast Guard Headquarters
Cargo and Hazardous Materials Division

INTRODUCTION

A tenet of our modern society is that every worker has the right to the fulfillment of his spiritual and material needs, while at the same time enjoying freedom from fear of trauma and disease. Industry generally accepts and attempts to implement this principle, yet safety statistics often fail to reflect company concern for employee protection. Why? *Emphasis has not shifted from correction to prevention of safety and health hazards.*

The following sections relate three general principles of industrial hygiene to the inspection and response functions of the Coast Guard. These same general principles can be related to most work environments. The first and most important principle is recognition of the safety and health problems created within the work environment. Next, evaluation, in terms of long-range as well as short-term effects on health, through appropriate instrumentation, is performed to compile knowledge, experience and quantitative data. Finally, corrective measures to control or eliminate the problems are developed.

RECOGNITION

There are certain inherent hazards within the work environment of inspection and response personnel which must be recognized.

Approximately 800 Coast Guard officers are involved with the inspection of merchant vessels. About 150 of these individuals are required to enter cargo tanks, void spaces, cofferdams, and pumprooms, as well as normally manned spaces, for the purpose of ascertaining the integrity of the hull, machinery, and equipment on board vessels. The hazards associated with these inspections include:

(1) oxygen deficiency;

(2) acute/chronic toxicity; and

(3) flammable/explosive atmospheres.

An atmosphere containing less than 16 percent oxygen is considered immediately dangerous to life (normal air contains 21 percent oxygen) and an atmosphere containing 16 to 19.5 percent oxygen is marginal. Variables such as the person's activity in the confined space, age, weight, state of health and smoking habits may well determine the individual's ability to work and survive in an atmosphere with less than 21 percent oxygen without respiratory protective equipment.

A confined space can become oxygen deficient in several ways:

(1) Oxygen in closed spaces may be depleted if corrosion is taking place.

(2) Spaces which have been inerted obviously do not contain sufficient oxygen. The oxygen that may have been present prior to inerting is replaced by the inerting gas. Inerting can be provided by a flue gas scrubber, an inert gas generator or a nitrogen tank.

(3) Certain cargoes or residues of cargoes, such as scrap iron, fresh fruit, molasses and various drying oils, absorb oxygen. These tanks may not contain sufficient oxygen to support life.

Continued on next page.....

(4) Tanks which have been coated with preservatives or other coatings require oxygen for the curing process, thereby they deplete the oxygen supply.

Tanks and spaces containing toxic vapors may kill or injure immediately. This is referred to as acute toxicity. High concentrations of toxic vapors are immediately dangerous to life, and one breath of some vapors could render a person helpless instantly. Even after all the cargo is offloaded, a small puddle left in the tank may vaporize causing high airborne concentrations of the cargo. Sniffing is not a reliable means of testing. Some toxic substances are odorless, and still others are toxic in concentrations too small for your nose to detect them.

Many toxic cargoes in low vapor concentrations may not have an immediate effect. Repeated exposure to low concentrations of certain chemical vapors may produce harmful effects which will not become apparent for years afterward. This is termed chronic toxicity. Exposure to certain chemicals may lead to cancer. For example, exposure to vinyl chloride may lead to liver cancer; exposure to benzene vapors may lead to leukemia. Exposure to other toxic chemicals may lead to liver disorders, respiratory problems, blood disorders and a variety of other health problems.

A tank atmosphere may be extremely flammable yet contain sufficient oxygen and not be toxic. The hazard in this case is the possibility of fire and explosion; the tank is considered to be "safe for man--not safe for fire." If the atmosphere of the tank is within the flammable limits of the chemical vapor in question, then extreme caution must be exercised. The tank should be ventilated until the vapor concentrations are well below the lower explosive limit (LEL). Ten percent of the LEL is the recommended level.

The Coast Guard is mandated with observing and monitoring certain operations aboard tankships and barges. During transfer, tank cleaning, or boarding operations, marine safety personnel may be exposed to varying concentrations of different chemicals. The ambient conditions (temperature, humidity, wind), physical location of the inspectors and the substance in question all lead to uncertainty in providing a safe and healthful workplace. These inspectors must always be cognizant of their physical location and aware of possible toxic vapor exposure and fire/explosion hazards.

Finally, the Coast Guard must respond to spills of hazardous materials as well as oil. The response activities can range from passive, administrative support to active participation in ensuring safety of life. Because of the nature of this activity, exposure to toxic vapors and fire/explosion hazards is inherent in varying degrees.

Common to all of the above situations are miscellaneous hazards such as skin and eye contact with a chemical. Materials like caustic soda or sulfuric acid can corrode the skin and damage the eyes. Additionally, some substances may cause sensitization. When one is exposed to a hazardous substance, certain physiological effects can be seen. If the individual is exposed a second time, even to a lower concentration, more severe effects will be elicited. Physical hazards (noise, heat, radiation), and biological (bacterial) and social stresses may also be present in the inspector's work environment.

EVALUATION

The measurement of hazards through the use of appropriate instrumentation is necessary when evaluating the total magnitude of the environmental factors and stresses existing in a workplace. Sampling is performed for identification of contaminants present and their sources, determination of the amount of worker exposure, and the effectiveness of controls installed to minimize exposures.

The type of monitoring instrument used depends upon the strategy employed. Samples may be taken to obtain an area average concentration, or may be taken at breathing zones to obtain a worker exposure concentration. The chemicals to be monitored, duration of sampling, and the type of standards to which the result will be compared will determine the choice of instrument. There are two basic types of monitoring instruments, real-time and continuous. The first basic type--also called short-time, grab- or real-time instruments--employs a glass syringe, hand-held pump, or squeeze bulb to draw a sample through an impregnated filter paper, or a gas detection tube. Direct reading instruments (electronic sensors) also yield short-time readings.

Certain companies manufacture a number of the types of instruments described above. Drager, MSA, Bendix, and Kitagawa are some of the companies which manufacture colorimetric detector tubes. Some of the manufacturers indicate whether or not their detector tubes have received a certificate by NIOSH. Combustible gas indicators are not used to determine specific levels of materials, but to indicate if an organic vapor gas is below the lower explosive limits. Dynamation, Biomarine and Gasteck market small, lightweight, combustible gas indicators combined with sensing capabilities for oxygen and/or carbon monoxide level determination if needed for a particular operation.

Three high-cost short-term instruments are worth noting. Each uses a different analytical technique and, in some cases, yields both selective and sensitive results. In other words, these devices can tell you precisely what and how much of a chemical substance you have. Wilks-Foxboro (Miran) makes a "portable" infrared analyzer; HNu markets a photoionization detector; and Century has a portable gas chromatograph. Each of these instruments requires a trained individual to operate and interpret the results, but these are the best devices in the field to identify airborne substances.

The second basic type--continuous or long-term instruments--employs bubblers with reactive or absorbing solutions, adsorption tubes or slowly reacting gas detection tubes. Adsorption tubes, filled with silica gel or charcoal, draw an air sample through the bed slowly to "trap" the chemical of interest. After sampling for a specific period of time, the collected

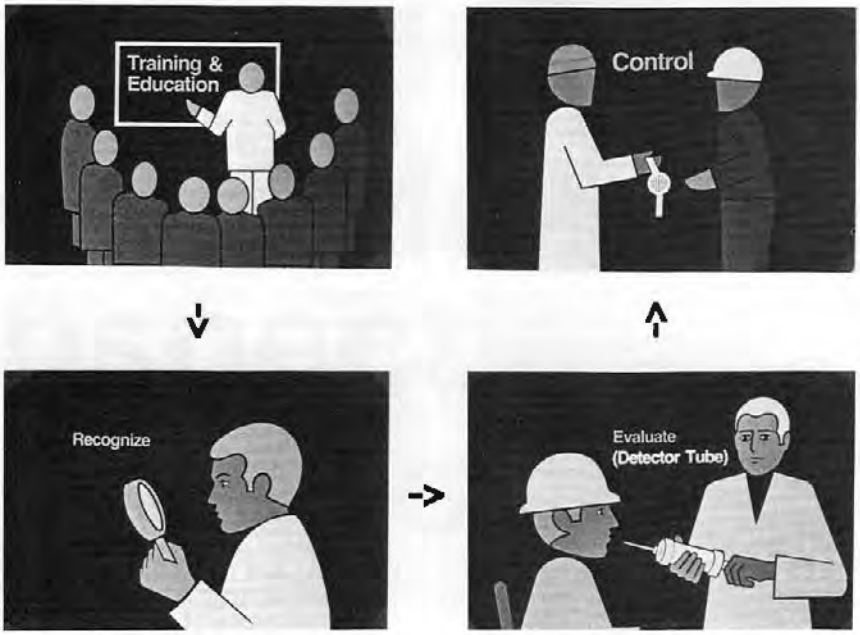
Continued on next page.....

material is desorbed and channeled through an analytical instrument such as a gas chromatograph, infrared analyzer, or other device yielding quantitative results. Additionally, qualitative detection of some gases and vapors may be obtained by indicator badges designated to be worn on the individual. These badges either change color upon exposure to the substance or can be subsequently analyzed in a laboratory. The radiation badge used in hospital X-ray rooms was a prototype for these gas and vapor badges.

As stated above, some instruments just collect a sample for subsequent laboratory analysis. The advantage in collecting a sample is that the laboratory analysis can yield very precise results. The primary disadvantage is that it takes considerable time to sample, send the sample, analyze the sample, and forward the results back to the originator. This approach is ideal for retrospective analysis when time is not of the essence. Drager, MSA, and Bendix manufacture charcoal/silica tubes which can be used to collect a sample. Additionally, in some cases a collecting bag can be filled (i.e. 15 liters) with air in an area of interest and sent to a laboratory for analysis.

Indicator badges or personal dosimeters described above are manufactured by 3-M and Abcor companies. These devices show promise in determining an individual's time-weighted concentration exposure to a chemical. They are new and untried to date in the Coast Guard, but are being evaluated for application. The same advantages and disadvantages exist for the badges as for instruments requiring subsequent analysis.

Another relatively new method of monitoring toxic gases uses chemically impregnated paper tapes, which carry color producing reagents on an almost completely dry strip of filter paper to give spot testing. Continuous monitoring may be performed by pulling the impregnated paper tape after a mitered sample of gas has been drawn over it, through an optics block, to "read" the concentration of the detected gas.



Marine safety personnel should be trained to recognize the health hazards encountered in inspection and response. Oxygen deficiency, acute/chronic toxicity, and flammable/explosive atmospheres can be detected through sampling with various monitoring instruments. Once contaminants and their sources are identified, steps can be taken to control or eliminate them.

Before going on, one thing must be said generally about detection instrumentation. There is no one instrument which can measure every substance of interest! Each instrument has inherent limitations (i.e. calibration, cost, the analytical methodology employed). Finally, the work practice, the accuracy necessary to make a comparison with a standard, time, etc. must always be taken into account when selecting the appropriate device.

CONTROL

Corrective measures, when necessary to protect health and safety, are based on experience, knowledge and quantitative data and are addressed to eliminate, control, or reduce the hazards.

There are three general means of control: engineering, administration and personal protection.

The classical means of engineering control include:

(1) Substitution--toxic material, equipment, or processes which are creating hazardous exposures can often be replaced to reduce the exposure potential;

(2) Isolation--a material, process or operation can be isolated physically to eliminate or reduce hazardous exposures;

(3) Enclosure--an entire process or portion can be enclosed to prevent escape of contaminants into the working environment;

(4) Local exhaust ventilation--toxic substances liberated into a work area can be effectively controlled by means of exhaust ventilation applied at a point as close to the source of emission as possible;

(5) Dilute ventilation--this type of ventilation can be successfully applied to low toxicity solvents, particularly when there are many

Continued on next page.....

small sources of emission in an enclosed space;

(6) Wet method--this method can be used to reduce dusting when friable material is handled and water does not interfere with the process.

A vapor control seminar was jointly sponsored by the Coast Guard and the Environmental Protection Agency in December 1978. It provided a forum for an exchange of technical ideas regarding the effectiveness and safety of vapor recovery as applied to barges and tankships. For some cargoes with special hazards, the following engineering controls are being contemplated:

(1) Requiring cargo tank segregation from the sea;

(2) Changing present gaging requirements from open to closed;

(3) Requiring B/3 vent heights or 3 meters, whichever is greater, for tankships;

(4) Requiring 3.6 meter vent heights for tank barges; and

(5) Purging cargo lines with water or an inert gas prior to disconnecting.

Administrative controls include:

(1) Limiting the number of people in a work area;

(2) Limiting the number of hours spent performing a single function;

(3) Good housekeeping; and

(4) Training.

Through the upgrading of the marine chemist program[1] the use of the marine chemist certificate (administration control) can minimize both acute and chronic hazards *in enclosed spaces only*.

Personal protection includes:

(1) Clothing, gloves, hard hats, protective shoes; and

(2) Respirator usage:

(a) emergency escape breathiag apparatus;

(b) self-contained breathing apparatus; and

(c) intermediate levels of respiratory protection (i.e. filters, half, full mask devices).

General programs have been instituted to provide a certain level of personal protection for both Coast Guard personnel and merchant mariners.[2] A description of respirators and a respiratory protection program has also been examined.[3] Since that article was published, a new positive pressure, self-contained breathing apparatus with NIOSH approval has been developed by BioMarine Industries. It is a lightweight device and is available in a 30-and 60-minute model.

CONCLUSION

Recognition, evaluation and control are three general principles of industrial hygiene which can be applied to inspection and response functions.

Proper training is necessary for marine safety personnel in identifying the hazards associated with their duties. Lectures and presentations have been given at the Coast Guard Reserve Training Center (Yorktown, Virginia) in courses such as the Marine Safety Management Seminar and Marine Safety Basic Indoctrination Course.[4]

Evaluation of the maritime work environment and the monitoring of the individual is a continuing process. Instrumentation to monitor the environment has been discussed. However, new approaches may be necessary to evaluate possible hazards in the ever-changing marine environment. For instance, the Coast Guard, with assistance from the National Academy of Sciences, is attempting to quantify specific biological function or behavioral change with chemical insult or other stress factors.

Engineering, administrative or personal protective controls must not only be identified but reevaluated to judge their effectiveness. Vapor control, marine chemist certificates, and respiratory protection may all be used either together or separately to ensure the safe and healthful work conditions of marine safety personnel.

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[1]Lindak, J. E., "Upgrading the Marine Chemist Program," Proceedings of the Marine Safety Council, October 1978, pp. 100-102.

[2]Lindak, J.E., and Haas, T. J., "Benzene--A Progress Report," Proceedings of the Marine Safety Council, November 1978, pp. 111-114.

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

[4]"What the hell is going on in Yorktown?", Proceedings of the Marine Safety Council, November 1978, pp. 121-122.

293-739 O - 79 - 2

Personnel Safety Problem Questionnaire

The following questionnaire was prepared for use at the Coast Guard's Marine Safety Management Seminar (MSMS). It was presented in the personnel safety session of the last seminar (October 1978) by CDR Fred Halvorsen, LT Thomas Haas, and LT Greg Yaroch. The MSMS is offered annually to senior Coast Guard officers, most of whom are new commanding officers or officers in charge in Captain of the Port (COTP) or Marine Safety Office (MSO) duty.

The questions below should be of interest to vessel personnel, especially those involved in enclosed space entry. They are purposefully ambiguous in an effort to elicit comment and discussion. Go ahead--test your knowledge of some common shipboard safety hazards....

1. Coast Guard personnel have been, and are, exposed to a variety of respiratory hazards during routine vessel boardings, internal tank inspections and pumproom entry on tank vessels.

   A. True.
   B. False.

2. There are no (specific) guidelines for Coast Guard personnel to follow insofar as preventing exposure to chemicals in the preceding situations.

   A. True.
   B. False.

3. A "competent person" under 29 CFR 1915 (OSHA Ship Repair Regulations) is permitted to test and certify an enclosed space aboard a vessel as safe for personnel to enter.

   A. True.
   B. False.

4. The "safe" level for oxygen in an enclosed space is:

   A. 19.5%.
   B. 20.9%.
   C. 16.5%.
   D. 10%.

5. A marine chemist must enter a cargo tank prior to certifying a tank as "safe for men."

   A. True.
   B. False.

6. A ventilation system in a pumproom on a petroleum tank vessel is designed to remove flammable vapors. Ventilation systems in these pumprooms are required to:

   A. Draw air (exhaust) from the top to the space since vapors are less dense than air.
   B. Force air (supply) at the top of the space to dilute vapors inside space.
   C. Draw air from (exhaust) the bottom of the space since vapors are more dense than air.
   D. Supply air at the bottom of the space to dilute the vapors inside space.

7. Toxic vapor concentrations can be accurately measured on a combustible gas indicator.

   A. True.
   B. False.

8. The threshold limit value (TLV) is a measure of the odor threshold (when most people can smell it) of a particular chemical.

   A. True.
   B. False.

9. An EEBA (Emergency Escape Breathing Apparatus) will adequately protect Coast Guard personnel from chronic vapor hazards.

   A. True.
   B. False.

10. Gasoline is a toxic product, both by inhalation and skin absorption.

    A. True.
    B. False.

11. There is no requirement for Coast Guard boarding personnel to wear eye and skin protection when boarding chemical tank vessels during cargo transfer operations.

    A. True.
    B. False.

12. An OSHA shipyard "competent person" must pass a rigorous training course.

    A. True.
    B. False.

13. Are Coast Guard personnel subject to OSHA regulations?

    A. Yes.
    B. No.

14. A flame safety lamp can be used for what purposes?

    A. Testing for flammable concentrations of gases or vapors.
    B. Measuring oxygen concentrations.
    C. Testing for toxic concentrations of gases and vapors.
    D. Determining that the oxygen concentration is above 16.5%.

15. How should the spaces adjacent to a cargo tank be considered insofar as tank entry is concerned?

    A. Same as cargo tank.
    B. Spot-checked for contamination.
    C. As a possible oxygen deficient space.
    D. As an open space.

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16. The Coast Guard shall only be required to respond to those chemicals designated by EPA as "hazardous substances."

    A. True.
    B. False.

17. In responding to discharges of hazardous chemicals, if the identity of the product is unknown, a minimal number of response personnel should enter the affected area to take samples.

    A. True.
    B. False.

18. In assessing the hazards of a chemical discharge, the information derived from the Chemical Hazards Response Information System (CHRIS) and/or the Hazard Assessment Computer System (HACS) will establish a recommended course of action to be taken by response personnel.

    A. True.
    B. False.

19. Outside chemical toxicology, industrial hygiene expertise should only be obtained when responding to a chemical product not appearing in the Chemical Hazard Response Information System (CHRIS).

    A. True.
    B. False.

20. Rank the following according to priority (highest to lowest) that should be considered in order to reduce/eliminate hazards to personnel.

    A. Administrative Controls.
    B. Engineering Controls.
    C. Personal Protection.

"ANSWERS" TO PERSONNEL SAFETY PROBLEM QUESTIONNAIRE

1. A. True.
2. B. False.
3. A. True (with qualifications).
4. B. 20.9%.
5. B. False (unfortunately).
6. C. Forced exhaust.
7. B. False.
8. B. False.
9. B. False.
10. A. True.
11. B. False.
12. B. False.
13. A. Yes.
14. D. Determining that 0_2 is above/below 16.5%.
15. A. Same as cargo tanks.
16. B. False.
17. A. False.
18. B. False.
19. B. False.
20. B. Engineering Controls; A. Administrative Controls; C. Personal Protection.

Marine Safety Council Membership

Rear Admiral Louis L. Zumstein has returned to Coast Guard Headquarters to serve as Chief, Office of Public and International Affairs, thereby assuming the Marine Safety Council membership vacated by Rear Admiral Raymond H. Wood.

Louis Zumstein was born in Auburn, New York, attended Mainland Senior High School in Daytona Beach, Florida, and graduated from the Coast Guard Academy in 1951 with a B.S. degree in mechanical engineering. He was first assigned to the cutter AURORA out of Savannah, Georgia. Fourteen months later he transferred to the RAMSDEN, based at Honolulu. During the cutter's 6-month deployment to Korea as a destroyer escort, he earned the Korean and United Nations Service Medals.

After executive officer duty on the BLACKTHORN out of Mobile, Alabama he began flight training in Pensacola, Florida. Advanced flight courses were taken at Corpus Christi, Texas, followed by an assignment as aviator to the Coast Guard Air Station, San Francisco.

Next, then-Lieutenant Zumstein returned to Pensacola for helicopter pilot training and was designated Coast Guard helicoper pilot number 281 on June 24, 1957. From San Francisco Air Station he reported to Sangley Point, Republic of the Philippines to be operations officer for the Coast Guard Air Detachment.

On May 9, 1961 he graduated with honors from an aircraft maintenance course at Chanute Air Force Base, Illinois, and went on to Memphis, Tennessee for additional maintenance training. He was subsequently assigned to the Coast Guard Detachment in Bermuda and promoted to Lieutenant Commander. In 1963 he began graduate school at Purdue University, earning an M.S.I.A. degree as a Krannert scholar the following year.

Stationed next at the Coast Guard Aircraft Repair and Supply Center, Elizabeth City, North Carolina, then-LCDR Zumstein worked with the team that computerized Coast Guard aircraft maintenance and overhaul functions. He became the Coast Guard's maintenance representative for the Eastern Region in 1966, receiving additional training in the Air Force's advanced managers course at Wright-Patterson Air Force Base, Ohio.

Following a tour in the Aeronautical Engineering Division at Headquarters he commanded Coast Guard Air Station Cape Cod, Massachusetts. During this command he was promoted to Captain and was awarded the Coast Guard Commendation Medal.

He reported to the Seventh District in 1975, then returned to Washington in 1978 as a special assistant in charge of developing a "master plan" organizational structure for Coast Guard Headquarters. Rear Admiral Zumstein assumed his present position February 1, 1979.

The Great Lakes Ship Riding Program

Commander Harold F. Norton, Jr.
Chief, Commercial Vessel Safety Branch
Ninth Coast Guard District
Cleveland, Ohio

INTRODUCTION

There are a number of contrasts between vessel inspections on the Great Lakes and the procedures followed on salt water. For example, almost all of the lake bulk carriers undergo an annual examination to check the structural integrity of the spar deck. Also, the Inspection for Certification is usually done on an annual basis on the lakes, rather than on a biennial basis as is common on the coasts. This is normally termed a "fitout inspection" because it is completed after winter layup prior to sailing in the spring. Dry dock examinations for credit are on a five-year cycle (except for tankers) and the regulations are silent with respect to tailshaft examinations. Many boilers are hydrostatically tested annually, whether they're of the firetube variety (which require such testing) or the watertube variety. The workload of each inspection office is subject to very pronounced peaks and valleys during the year. The busiest time is usually the spring fitout season.

Some of the procedural differences on the lakes are rooted in nothing more than tradition. There are also genuinely unique aspects to Great Lakes shipping that set it apart from its counterparts on the coasts. To begin with, the U.S. flag Great Lakes fleet is essentially a captive fleet designed to carry bulk commodities including iron ore, coal, grain, cement, stone and petroleum products to the various terminals within the lakes. The marine terminology used is remarkably different from that of the coasts and, for a newcomer, takes some getting used to.

Inspecting a 60-year-old lake freighter is not at all unusual, and until this decade inspecting a new one was impossible. The ever-present Scotch firetube propulsion boiler (named for its origin of design) survives into this modern age, although some are now automated. Coal is still used as bunker fuel. While some lakers sail the "late" season, even year-round on occasion, most lay up for the winter and are idle three or four months each year.

The design of lake freighters is unique. They are very shallow due to the limited water depths. They generally have one large cargo hold fitted with screen bulkheads, and an inner bottom combined with a number of side tanks running the length of the hold, thereby providing a generous ballasting capability. Lakers may be up to 1,000 feet in length, while being only 105 feet in breadth; this size permits passage through the Poe Lock at Sault Ste. Marie. A number of them have been sized to fit through an earlier lock, or designed to navigate a course up a particular river to a particular plant. While a salt water ship may be designed for speed and for the seas it will encounter, a lake freighter is designed to move maximum cubic cargo through the physical restrictions of the waterways it travels.

Much of this is changing as new automated diesel vessels replace the older steamers, but much still remains the same. The purpose of this article is to describe one inspection program, different in nature, which is conducted annually on the Great Lakes. The program is officially named the Pre-November Commercial Vessel Safety Inspection Program, but is better known as the Ship Riding Program.

BACKGROUND OF THE SHIP RIDING PROGRAM

Like many inspection matters, the Ship Riding Program was the direct outgrowth of marine disaster; specifically, the loss of the SS EDMUND FITZGERALD. The FITZGERALD sank during a fierce autumn storm on November 10, 1975, coming to rest in over 500 feet of water in Lake Superior. All 29 hands were lost. One of the newer lakers, she was built in 1958 at the Great Lakes Engineering Works, River Rouge, Michigan. She was a maximum size vessel at her time of build, with dimensions of 729 feet overall and a breadth of 75 feet (to permit passage through the MacArthur Lock at Sault Ste. Marie). At the time of her demise she was bound for Detroit from Superior, Wisconsin with a load of pelletized iron ore. Following a thorough investigation into the sinking, the Coast Guard Marine Board of Investigation, hampered by the lack of witnesses or survivors, concluded that the final sequence of events culminating in the sinking could not be determined. However, the board also concluded that the spar deck

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(weather deck) was not weathertight and that boarding seas had created undetected quantities of water in the cargo hold. The board recommended that the Coast Guard conduct a continuing program of inspections and drills for Great Lakes vessels prior to each severe weather season, coinciding with the date of winter loadline, November 1.

The Ship Riding Program actually preceded the final report of the FITZGERALD board by almost a year, having been instituted as the result of interim board recommended actions issued in the summer of 1976. These called for improved safety through a pre-severe weather inspection that would include:

a. emergency drills;

b. inspection of critical structural and non-structural members exposed to damage from cargo handling operations;

c. inspection of all alarms and watertight closures;

d. inspection of all navigational equipment and maintenance logs;

e. a check of ballast tank remote reading gages.

These items were considered relevant to the FITZGERALD loss.

In its own report concerning the FITZGERALD casualty, the National Transportation Safety Board agreed in the main with the Coast Guard's findings and went on to endorse the concept of the pre-severe weather inspections.

Thus the Ship Riding Inspection Program was born.

WHY AN UNDERWAY INSPECTION?

The decision to conduct the pre-severe weather inspection while underway was arrived at with the support of the Great Lakes vessel operators. With the exception of sea trials on a new vessel and tests and evaluation of automation systems, practically all inspections have traditionally been held dockside. There are valid reasons for this practice, but those reasons do not carry over to the pre-severe weather inspection. In fact, matters such as navigation practices, equipment operation, the operation and audibility of alarms, and the actual use of watertight closures are best--and possibly only--observed while underway. An added benefit to the vessel owner is the minimal disruption of the ship's schedule. In 1978, the Ship Riding Program also addressed loading operations and an evaluation of the phenomenon of vessel "springing" and torsional deflections. Matters such as these can be addressed only on operational vessels.

Another aspect of the Ship Riding Program which distinguishes it from other inspections is its concern for the "people factor." It is intended that the program be conducted in a cooperative atmosphere characterized by a free exchange of information. Toward this end, the inspector lives with the crew for the duration of the riding inspection. He asks questions of the masters and crewmembers which, in essence, provide an inward look at Coast Guard policy and programs. The questions have centered around crew complaints, recommendations for regulatory changes and changes to Coast Guard procedures. Questions asked during the 1978 program also addressed two areas of recent concern, reduced manning/crewing of vessels and steering gear casualties.

A valuable side aspect of the Ship Riding Program is that it affords a better understanding of the commercial vessel industry. Unlike the marine inspectors of old, most Coast Guard marine inspectors today did not grow up with the Merchant Marine. While there are common threads among seafarers, regardless of their experiences, there is a world of difference between a merchant vessel and a Coast Guard cutter. The Coast Guard has long recognized the importance of knowing the industry it regulates. A Coast Guard officer may be assigned for a period of time to the industry he helps regulate to participate in an industry training program. This is one of the strengths of the Ship Riding Program. Whether an inspector is assigned to material inspection duties, casualty investigation duties or licensing and certificating duties, he's bound to have acquired an improved understanding of his responsibilities from his participation in the Ship Riding Program.

THE MECHANICS OF THE PROGRAM

For the past three years, the Ship Riding Program has been conducted mainly during October. This month immediately precedes the severe weather season, and also falls about two-thirds of the way through the operating season for most lakes vessels. This is a logical inspection time, for in most instances, these vessels were last inspected at the start of the navigation season (around April) and have experienced varying degrees of damage from cargo operations during their sailing season.

The Ship Riding Program is not entirely formalized. The matters it addresses vary somewhat from year to year, and the emphasis of

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The uniqueness of Great Lakes shipping led to the establishment of the Ship Riding Program.

the program will periodically shift. While the program was initially established to examine certain items, additional subjects have been addressed as the program has developed. For example, the subject of exposure suits was included in the last riding program; in particular, who has them, how many, and where they are stowed. Loading and unloading operations and the use made of the loading manuals are other subjects which have been added to the program since its inception. No doubt the 1979 Ship Riding Program will include other changes.

The operation of the program has both strengths and weaknesses. In terms of weaknesses it creates an extremely busy time for the riding inspectors, as well as their home offices, because the time devoted to ship riding is taken "out of hide" with no additional personnel resources. On the other hand, monetary resources devoted to the program have been minimal, necessary only to cover the travel expenses of the riding inspectors. The ease with which the program can be conducted is its major strength. Unlike the slow boat to China, lakes vessels are on relatively short runs and in many instances there are intermediate embarking or debarking points. For example, a number of riding inspections have been conducted by boarding a vessel in port near the head of Lake Superior and riding it to the locks at Sault Ste. Marie. The inspector then changed to an upbound vessel, thereby completing two inspections on one trip.

The program has had its difficult moments. An inspector may board a vessel and ride it to an industrial site which is so remote that he winds up making a round trip. It's conceivable that an inspector boarding a vessel for a riding inspection could meet his counterpart from another office in the process of disembarking, having already completed the inspection. Under normal routine, inspectors work within their own geographical inspection zones. The Ship Riding Program has resulted in inspectors becoming scattered all over the Great Lakes, with the home office often uncertain when they will return.

Planning for the 1979 program promises changes aimed at improving coordination efforts. Participating vessels will be preselected by the Coast Guard district office. They will include vessels not inspected under this program the previous year, plus several others included for observation or evaluation. Vessels selected will comprise about 50 percent of the active fleet, which breaks down to approximately 70 riding inspections. The participating vessels will be pre-assigned to a particular inspection office, which must complete the inspection prior to November 1. Vessel assignment will be predicated on route and the ease with which the vessel can be boarded. Additionally, the program will commence in September rather than October. These changes should eliminate the problem of conducting riding inspections of the same vessels year after year, while others go uninspected. The workload can be more evenly spread among inspection offices, and inspectors better utilized. This will allow more time to correct any serious deficiencies found as a result of the riding inspection prior to the November 1 deadline. As in the past, each riding inspector will complete two copies of the underway evaluation for each vessel. One copy is for the vessel's master and the other is for Coast Guard use. These reports will be sent to the district office for followup action.

RESULTS OF THE 1978 SHIP RIDING PROGRAM

The 1978 underway evaluation form, completed for each riding inspection, addressed the following subjects:

a. emergency drills;

b. alarms;

c. closures;

d. heavy weather procedures;

e. electronic equipment;

f. navigation procedures and equipment ;

g. communications;

h. navigation safety regulation procedures;

i. ballast tank gages;

j. exposure suits;

k. loading/unloading operations ;

l. springing and torsional deflections.

The 1978 inspector's report form addressed the following subjects:

a. crew complaints and recommendations for changes in regulations and Coast Guard procedures;

b. comments on reduced manning/crewing of vessels;

c. steering gear failure.

An analysis of the results of both the underway evaluations and the inspectors' reports not only revealed a number of items falling into the "suspicions confirmed" category, but also disclosed a number of items that alerted the Coast Guard to new problems in the marine safety program. One example in the "suspicions confirmed" category would be that although everyone managed to conduct a satisfactory fire and boat drill on the first try, there were general comments expressing concern that the present lifesaving equipment was inadequate. Evidence to this fact was that three vessels were found to have dangerously malfunctioning lifeboat winches. This situation prompted a followup program during winter layup directed toward lifeboat winches on all vessels. In contrast, it was interesting to note the acceptance of the exposure suit for lifesaving purposes. Almost all vessels were already equipped with them, were aware of the number of suits on board and their storage locations. Several vessels held exposure suit drills in conjunction with their fire and boat drill, and in one instance, a suit was donned and the crewman entered the water wearing it.

While most alarms functioned properly, some required repair.

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Most vessels had properly operating watertight closures, or only minor deficiencies, but three vessels required extensive repairs to their hatch closure systems. it was found that most navigation, radio and other electronic equipment was functioning properly and a good deal of emphasis was placed on its maintenance.

Unexpected problems which were encountered ranged from a crewman reporting a fire station that hadn't been operable for two years to a sidelight visibility problem which affects a number of newer vessels and required further inspection action.

The use and acceptance of loading manuals, so critical to the prevention of overstressing the hull girder, was found to vary so widely that further evaluation is deemed an absolute necessity. Further investigation into the phenonmenon of vessel "springing" is seen as a valuable pursuit, as well.

The comments that inspectors received were many and varied. Most prevalent were comments related to aids to navigation, speed limits and traffic control, radio telephone matters and licensing and certificating matters involving crews.

These are only a few problems identified by the 1978 Ship Riding Program, but these are considered reflective of those generally disclosed.

THE FUTURE OF THE SHIP RIDING PROGRAM

In the interest of marine safety, it is believed that this program should continue. There are too many safety related matters which cannot be adequately addressed at the dockside annual inspection. These matters not only concern the hardware aspect, but also the people aspect of marine safety. An inspection for certification, partially completed during the winter and primarily completed in the spring (aboard what has essentially been a dead ship), may leave many a stone unturned. These inspections lack the contribution of the people who have been sailing the vessel, as they're often either new or absent during phases of the inspection. The Ship Riding Program, while it considers hardware matters, also puts a great deal of emphasis on the crew and their jobs on board. Emphasis on both people and hardware is seen as essential to an effective marine safety program.

It is under consideration that the riding inspection might be utilized to complete the mid-period reinspection required for Great Lakes vessels currently operating with two-year certificates. This reinspection is normally held during the 10th to 14th month of validity of the two-year certificate. Also, dovetailing the riding inspection with the annual spar deck examination could be possible in many instances. In any event, deficiencies noted during a spar deck examination can readily be reexamined for satisfactory correction during the riding inspection.

While ship riding inspections are by no means an entirely new concept, the scope of the program is. It has achieved a degree of acceptance among seafarers, as evidenced by the number of positive comments received during the 1978 program. This attitude of acceptance can serve only to improve the safety effectiveness of the program. In addition, the program provides the Coast Guard inspector with an understanding of the commercial vessel industry.

Hopefully, the program will never become entirely formalized; inspection requirements change as vessels and operating conditions change. As experience is gained in the program, it should move closer to achieving its potential.

CONCLUSION

The marine safety mission of the Coast Guard, viewed in its entirety, cannot be accomplished solely with dockside inspections. "After the fact" casualty investigations and occasional personnel actions do not provide all the answers, either. Regardless of whatever did, in fact, cause the sinking of the EDMUND FITZGERALD, it certainly was not a failure of the state of the art. The Ship Riding Program is intended to help prevent another serious casualty such as that one, and in order to do so places emphasis on matters that the traditional inspection routine cannot adequately address. Until marine safety procedures can reasonably ensure safety in sailing throughout the entire term of a vessel's certificate of inspection, procedures such as the Ship Riding Inspection Program are a necessity.

About the Author

CDR HAROLD F. NORTON, JR.

Since September 1978, Commander Harold F. Norton, Jr. has served as Chief, Commercial Vessel Safety Branch at the Ninth Coast Guard District Office in Cleveland, Ohio. He entered the field of marine safety in 1964, following several North Atlantic assignments aboard Coast Guard cutters. He was a marine inspector at the Marine Inspection Office, Baltimore, Maryland until 1967. At that time he transferred to Yorktown, Virginia to instruct at the Coast Guard's Merchant Marine Safety School. Commander Norton received industry training in 1971 from the Lake Carriers Association in Cleveland, then served as Commanding Officer of the Marine Inspection Detachment, Sturgeon Bay, Wisconsin. Prior to taking his present position, he was Commanding Officer of the Marine Safety Office, Duluth, Minnesota.

Commander Norton is a graduate of the Coast Guard Academy and holds a Master of Education degree from the College of William and Mary, Williamsburg, Virginia. He is a member of the Society of Naval Architects and Marine Engineers (SNAME).

CONFINED SPACE ACCIDENT FATALITIES —*AGAIN!*

CDR John E. Lindak
Hazardous Cargo and Materials Division
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It is time to reemphasize, by citing two recent tragic examples, the need for continual safety awareness on the part of shipboard personnel who must enter tanks or other confined spaces. Proper tank entry procedures are relatively simple and straightforward. Unfortunately, many personnel have a tendency to take "safety shortcuts" in order to expedite a job requiring tank entry. In reality, a safety procedure "shortcut" is a wager, with the stake being injury or death. The following accidents illustrate this point.

Freight Barge FOSS 210

A fatality occurred in Tacoma, Washington aboard the non-self-propelled freight barge FOSS 210, which is homeported in Seattle. This steel vessel, a converted U.S. Navy LST, has an overall length of 315 feet and displaces 2,796 gross tons. FOSS 210 was not in active commercial service at the time of the accident; her most recent Coast Guard Certificate of Inspection had expired on January 8, 1977. There was no cargo aboard on the date of the accident.

On May 16, 1978 FOSS 210 was scheduled to be surveyed by two local, experienced marine surveyors prior to being sold. The enclosed spaces on the second and third decks had been checked the previous day for the presence of sufficient oxygen and also for the presence or absence of toxic/flammable vapors by an NFPA-certified marine chemist. He had issued a gas-free certificate on May 15 certifying the second and third deck spaces as "safe for men." The compartments, void spaces and tanks on the fourth level of FOSS 210 were not inspected by the marine chemist at that time; their inspection was planned for the next day. To this end, several of the manhole covers located in the third deck providing access to the fourth level spaces were removed for overnight natural ventilation. However, not all of the access covers were opened that day.

On the morning of May 16, the two marine surveyors uneventfully conducted their condition survey of the second and third deck compartments. In spite of two separate warnings by the facility manager, they entered the fourth level spaces that were as yet untested by the marine chemist but had been opened to natural ventilation the day before. They wore no respiratory equipment and did not test the atmosphere of those spaces prior to entry. The survey of these spaces was also completed uneventfully. Before leaving for lunch, the marine surveyors requested that the facility personnel open the remaining fourth level compartment access covers. These spaces, including compartments B-404-W and B-410-W, were then opened to natural ventilation.

Later that afternoon, one of the marine surveyors returned aboard FOSS 210 and, accompanied by a facility representative, descended to the third deck. Evidently, his intention was not to enter the newly opened accesses to the fourth level spaces, but just to ascertain the extent of the remaining survey work. The survey was scheduled to resume the next day.

Looking down through the third deck manhole into B-404-W, the two men could see greenish water covering the tank bottom. Also, the air at the access to this space had a foul odor. Neither man attempted to enter this tank. They proceeded to B-410-W, and again noticed the foul air smell at the third deck access manhole to this tank. This time, however, the marine surveyor apparently decided that he wanted a closer look. Stating that he just wanted to climb down

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into the tank far enough to "duck my head under the overhead and shine my flashlight around," he descended the ladder into the tank. Within a few seconds, the surveyor apparently lost consciousness and fell from the ladder 14 feet to the bottom of the tank.

The facility representative immediately proceeded up to the main deck to obtain assistance. Nearby shipyard personnel were notified and the alarm was sent to a local fire department. One of the shipyard workers rushed to the manhole opening to B-410-W and, observing the body of the marine surveyor on the tank bottom, immediately descended the ladder into the tank--with no safety or life support equipment. He managed to reach the bottom of the ladder before he, too, lost consciousness and collapsed. A second would-be rescuer then entered the tank, with no safety equipment other than a safety line tended from above. This man got halfway down the ladder before he started to lose consciousness and signaled to be hoisted out of the tank.

Approximately 10 minutes later, local fire department personnel wearing Scott Air-packs descended into B-410-W and brought both the marine surveyor and his first would-be rescuer out of the tank. Efforts to revive the surveyor were unsuccessful; the other unconscious man was soon revived, although he suffered aftereffects indicative of possible brain damage.

Two hours later, a test of the oxygen level in B-410-W revealed a 6 percent by volume concentration in that space! Normal air contains about 21 percent oxygen by volume. National Fire Protection Association Standard No. 306, "Control of Gas Hazards on Vessels to be Repaired 1975," requires at least 18 percent oxygen by volume to be present in the atmosphere of an enclosed space in order for that space to be certified "safe for men." (Incidentally, a soon-to-be-published revision to NFPA-306 will increase from 18 percent to 19.5 percent the concentration of oxygen required for a "safe for man" designation.)

An average healthy person can survive in spaces with an oxygen concentration as low as 16 percent by volume, although at this reduced level physical exertions of any kind will be extremely difficult. At approximately the 15 to 16 percent level, the oxygen concentration in an enclosed space is too low to support combustion--a match flame will be extinguished. A man breathing air containing only 13 to 15 percent oxygen will begin to be seriously affected by oxygen depletion, and may be so affected that he is mentally incapable of realizing it. Symptoms of this oxygen depletion will include mental disorientation, drowsiness, lassitude, errors in judgement and loss of coordination.* The individual may also have a prevailing sense of euphoria or happiness which blinds him to the danger inherent in these symptoms.

An enclosed space atmosphere containing between 6 and 12 percent oxygen is deadly to human life, primarily because consciousness can be lost without warning. Unconsciousness can occur so quickly (within about 30 seconds) that there is no time to escape. Brain damage or death may occur within 8 to 10 minutes if the individual is not removed from the oxygen-depleted space.

An atmosphere containing only 6 percent oxygen by volume will cause unconsciousness within a few seconds, followed by convulsions and immediate death. Tank B-410-W contained less than 6 percent oxygen at the time the marine surveyor entered it. Therefore, it is reasonable to conclude that once he lowered himself far enough into the tank to breathe the depleted oxygen environment, he immediately lost consciousness and fell. He died almost instantly, not because of the fall but because of continued exposure to the severely oxygen-depleted tank atmosphere.

This casualty illustrates the fact that even trained professionals such as ship surveyors, who continuously work in and about confined spaces, are not immune from the tragic consequences of entering unchecked spaces without suitable life-support equipment. A tank entry safety procedure shortcut--in this case, not waiting for a marine chemist gas-free certificate to be issued for the fourth level spaces--resulted in a fatality.

Proper tank entry procedures must always be followed. In this case, neither B-410-W nor any of the other fourth level spaces were tested for a respirable atmosphere prior to entry by the surveyor, nor were any of the spaces mechanically ventilated prior to entry. The surveyor did not wear a self-contained breathing apparatus or utilize a tended lifeline while entering these unchecked spaces. While there were standby personnel available outside the enclosed spaces, they were neither trained nor equipped to perform emergency rescue operations.

Fishing Vessel SWASHBUCKLER

A confined space casualty can occur even aboard a small fishing vessel. The shrimper SWASHBUCKLER was the scene of this type of accident on July 19, 1978, while trawling for shrimp in the Gulf of Mexico. The 83-gross-ton SWASHBUCKLER (62.7 feet long, 19.8 feet wide, 10.1 feet deep) is a fiberglass, single screw, diesel powered vessel constructed in 1977. SWASHBUCKLER has three below deck watertight compartments: engine room, fish hold, and aft lazarette.

The fish hold, where the casualty occurred, is 23 feet long, 18 feet wide and 7 feet deep; it is partitioned into 6 fish bins, passageway and hold space. The entire fish hold is lined with 8 inches of polyurethane foam as insulation to help maintain as low a storage temperature as possible. Since there is no installed refrigeration system, ice is used in the hold to refrigerate the catch. The hold is constructed with no provision for natural or forced ventilation, as a constant supply of warmer outside air would accelerate the melting of the ice. A single airtight hatch, normally secured, provides access to the hold from the

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*Compressed Gas Association Safety Bulletin SB-2, "Oxygen Deficient Atmospheres," March 1966.

main deck. Immediately beneath the hold is a bilge which is accessible through several covers in the deck of the fish hold.

On July 19, 1978, after trawling for 11 days, the three-man crew of the SWASHBUCKLER had caught about 4,000 pounds of shrimp. The shrimp had been processed and then stowed on ice in the fish hold. Processing the shrimp included dipping them in a dilute solution of sodium bisulfite in seawater, a commercially available product used to retard the growth of black spot bacteria. Black spot bacteria discolors freshly caught shrimp and will affect the market value of the catch.

During an early morning trawl that day, one of the crew who was working in the fish hold was discovered unconscious at the foot of the entry hatch ladder. The captain immediately descended the ladder into the fish hold and began to give mouth to mouth resuscitation to the prone deckhand. After a few minutes the captain also lost consciousness, collapsed, and fell to the fish hold deck. The last crewmember of the shrimper then entered the fish hold and attempted to revive both stricken men. He, too, collapsed. At this point, the SWASHBUCKLER was underway with nets out, and her entire three-man crew was unconscious on the deck of the fish hold.

Fortunately, a short time later the captain regained consciousness and was able to climb out of the hold and stagger to the pilot house, where he resumed control of the vessel and initiated a radio call for

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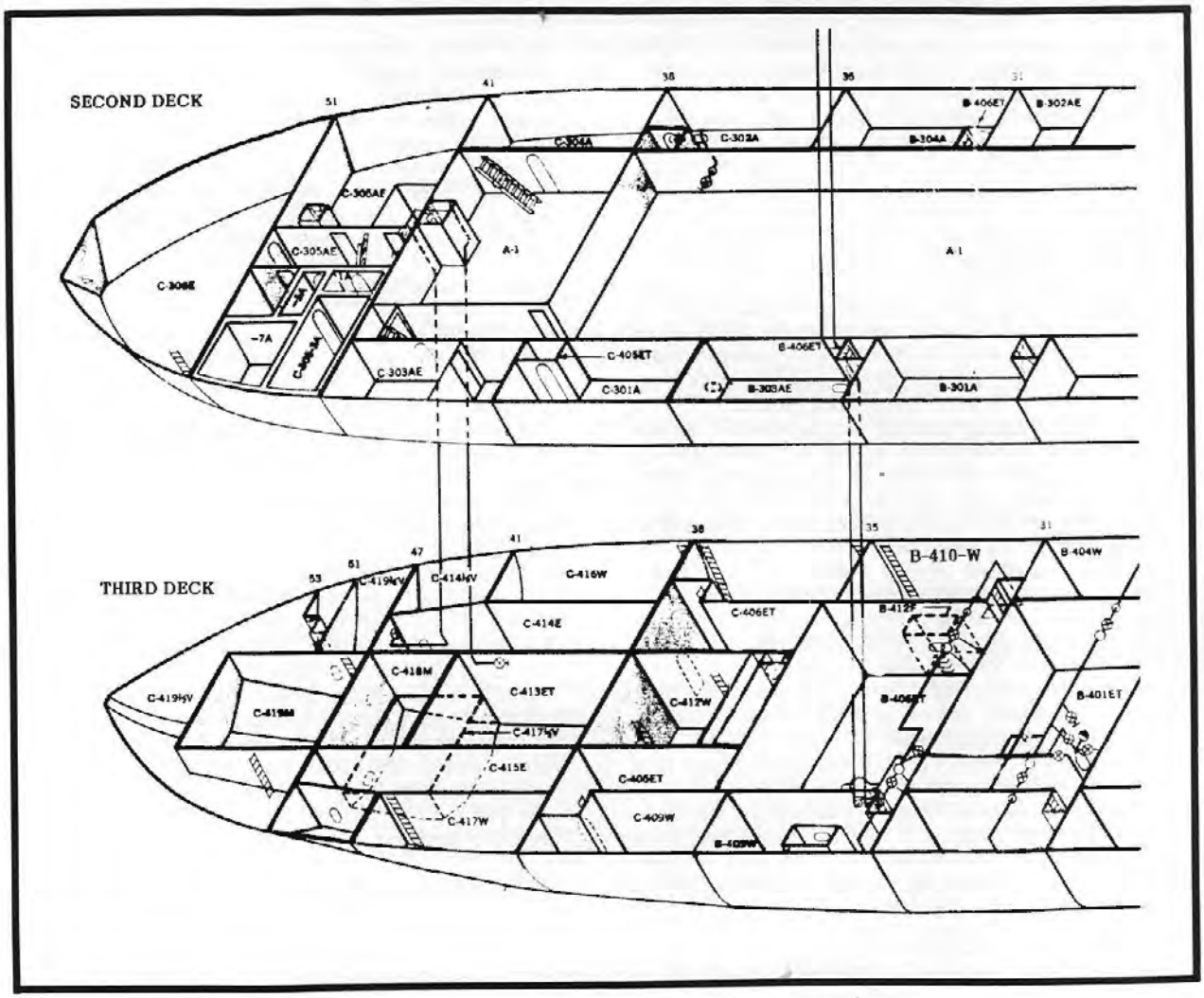
Section of blueprint of typical LST, similar to the barge FOSS 210. Two men lost their lives in B-410-W because they entered the tank without life-support equipment. Oxygen deficiency is an invisible killer which continues to claim an alarming number of unsuspecting victims each year.



assistance. Help from another shrimp boat arrived within minutes; however, it was too late for the two crewmen. They were found dead in the fish hold.

Subsequent investigation of this casualty indicates that the air in the unventilated fish hold was probably severely oxygen-depleted. Also, the toxic gas hydrogen sulfide was probably present, produced by the action of pseudomonas putrefaciens bacteria on the slowly decaying shrimp in a low oxygen level environment.

Within the bilges of the fish hold of the SWASHBUCKLER, the action of bacteria on the rich organic material accumulated in the runoff water from the shrimp consumed large quantities of oxygen. This biochemical oxygen demand, as it is called, has been theoretically estimated to be almost two and one-half times the total amount of oxygen available in the hold, assuming no replacement of oxygen through the open hatch. Although oxygen in the fish hold atmosphere will be replenished each time the hatch is opened, the potential for severe oxygen depletion still exists. As illustrated by the SWASHBUCKLER casualties, this can be deadly.

Casualties of this nature within the fishing industry, involving oxygen depletion and high concentrations of carbon dioxide and hydrogen sulfide gases within hold spaces, have occurred frequently in the past few years. A future article in the Proceedings will discuss in detail the nature of the unique health hazards found aboard fishing vessels.

The Coast Guard Marine Investigation Report of the SWASHBUCKLER incident is available upon request from Commandant (G-MMI-1/83), U.S. Coast Guard Headquarters, 400 Seventh St. SW, Washington, DC 20590. The report includes the following recommendations:

*The fishing and shrimping industry should be advised by all available means of

a. the hazards involved with retaining untreated bilge wastes on board for prolonged periods of time;

b. the possible hazards associated with the misuse of sodium bisulfite;

c. the need to ventilate holds before entering them.

*Shrimpers and fisherman should be encouraged to procure safety harnesses for use in evacuating men overcome in holds.

*Shrimpers and fishermen should be encouraged to procure a means of detecting the presence of hydrogen sulfide and oxygen depletion.

Conclusion

Accidents due to oxygen depletion in confined spaces can occur aboard any vessel, from the largest tanker down to the smallest fishing boat. Age, experience, or even training does not grant immunity from this type of casualty. Confined space entry accidents frequently result in death for both the person originally entering the space and for the well-intentioned but untrained and unequipped rescuers. These deaths are avoidable, *yet they occur with a tragic regularity!*

Personnel entering enclosed spaces must be instructed in the recognition of possible hazards and also in proper entry procedures. Tank entry procedures must be well-defined, well-understood, and strictly followed. Providing sufficient training and equipment for backup personnel is also a must. Finally, frequent repetition of this training/instruction will serve to reinforce awareness of the hazards of oxygen-depleted spaces.

STOP-THINK-PREPARE before entering any enclosed space. A minute of preparation might save your life, and the lives of those who could die trying to save you in the event of an accident.

Coast Guard publication CG-474, entitled "When You Enter that Cargo Tank," provides useful safety guidelines to personnel who must enter cargo tanks and other enclosed spaces aboard vessels. This publication is available free of charge from Commandant (G-MHM-3/83), U.S. Coast Guard Headquarters, 400 Seventh St. SW, Washington, DC 20590.

Keynotes (Cont'd).....

Rules of the Road Advisory Committee. Meeting 9:00 a.m., Willamette Room, Thunderbird Motor Inn, Jantzen Beach, Portland, Oregon.

31: Public Hearing; Proposed conversion of a drawbridge to a fixed structure across the Bohemia River, mile 4.0, Cayots, Maryland. Hearing at 8:00 p.m., Bohemia Manor High School, Maryland Route 213, Chesapeake City, Maryland.

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5: Committee Meeting; Ship Structure Committee. Meeting 9:00 a.m., room 8334, U.S. Coast Guard Headquarters, 400 Seventh St. SW, Washington, DC.

6: Committee Meetings; (a) Chemical Transportation Advisory Committee, Subcommittee on Commercial Explosives. Meeting 9:30 a.m. in room 6200, Nassif Building, 400 Seventh St. SW, Washington, DC.

(b) Chemical Transportation Advisory Committee, Personnel Protection Subcommittee. Meeting 10:00 a.m. in room 2230, Nassif Building, 400 Seventh St. SW, Washington, DC.

11-14: Public Hearings, Puget Sound (Tank Vessel Operations):

11: 9:00 a.m., north and south auditorium, Federal Building, Seattle, Washington.

12: 1:00 p.m.; same as address above.

13: 1:00 p.m.; Town and Country Motor Inn, Mt. Vernon, Washington.

14: 1:00 p.m., Coast Guard Air Station, Port Angeles, Washington.

Nautical Queries

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

DECK

(1) For a vessel on an international voyage, the minimum Pitot tube pressure for a number of outlets when two fire pumps are operating simultaneously is approximately

A. 35 p.s.i.
B. 50 p.s.i.
C. 70 p.s.i.
D. 100 p.s.i.

Reference: 46 CFR 95.10-15(c)

(2) The horizon glass of a sextant is

A. silvered on its half nearer the frame.
B. mounted on the index arm.
C. forward of the shade glasses.
D. all of the above.

Reference: Bowditch.

(3) When a winch breaks down, or some similar occurrence makes only one winch available at a hatch, which of some of the following alternate rigs would provide a temporary solution while repairs are made? Cotton is being hauled.

A. Single whip and skid method
B. Yard and stay jury rig
C. Frisco rig
D. West Coast rig

Reference: Marine Cargo Operations--Saurbier 1956

(4) A vessel loads 100 tons of glass jars. The mate on watch discovers that some of the cartons have been damaged and has an exception made on the Bill of Lading. What is this document called?

A. Unclean Bill of Lading
B. Damage Bill of Lading
C. Non-negotiable Bill of Lading
D. Letter of Indemnity

Reference: Martin, Ben--Shipmasters Handbook on Ship's Business

(5) The atmosphere in the vicinity of a low pressure area is called a(n)

A. cyclone.
B. anticyclone.
C. cold front.
D. occluded front.

Reference: American Practical Navigator H.O. #9

ENGINEER

(1) Why is the ring belt of a piston for use in a diesel engine made smaller in diameter than the skirt?

A. To allow for greater expansion due to higher operating temperature.
B. To seal the cylinder against leakage of combustion gases
C. To provide an additional surface for oil cooling.
D. To provide additional strength for the crown and lower structure.

Reference: Stinson, page 134

(2) On small low pressure air compressors the cylinders are usually lubricated by

A. the splash method.
B. mechanical force feed lubricators.
C. the detached sump method.
D. internal cooling passages in the crankshafts and connecting rods.

Reference: Principles of Naval Engineering, page 405

(3) The distillate produced by a flash evaporator has a salinity of 0.21 grains of sea salt per gallon and the temperature of feedwater entering the first stage of the evaporator is 170 degrees F. Under these conditions the three-way solenoid trip valve will

A. direct distillate to the bilge.
B. direct distillate to the fresh water tanks.
C. recirculate distillate to the first stage feed inlet.
D. recirculate the distillate to the distiller salt water heater.

Reference: Marine Engineering, Harrington, page 536

(4) If the jacket water temperature of an auxiliary diesel engine cooling system is lower than normal you would suspect

A. air binding of the engine cooling system.
B. cracked water cooled exhaust manifolds.
C. a clogged heat exchanger.
D. faulty thermostat operation.

Reference: Stinson, page 322

(5) Tankers carrying cryogenic cargoes such as LNG are fitted with gas detector systems alarmed at 30 percent of the lower explosive limit. If the gas detector alarm sounds, this means

A. the detector sensor is sampling a space where the cargo vapor concentration is 30 percent by volume.
B. an explosion is about to take place.
C. the detector is sampling a space in which 30 percent of the atmosphere is explosive.
D. a flammable vapor concentration exists at the sample point, but it is too lean to burn.

Reference: CG-174, pages 1-19

ANSWERS

Deck
1. B; 2. A; 3. B; 4. A; 5. A

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

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.
	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.
*	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.
	258	Rules and Regulations for Uninspected Vessels (4-1-77). (Ch-1, 3-17-78). FR 9-26-77.
	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.
	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.

*Temporarily out of stock.

Changes Published During April

CG-169, Federal Register of April 16

U. S. GOVERNMENT PRINTING OFFICE : 1979 O - 293-789

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