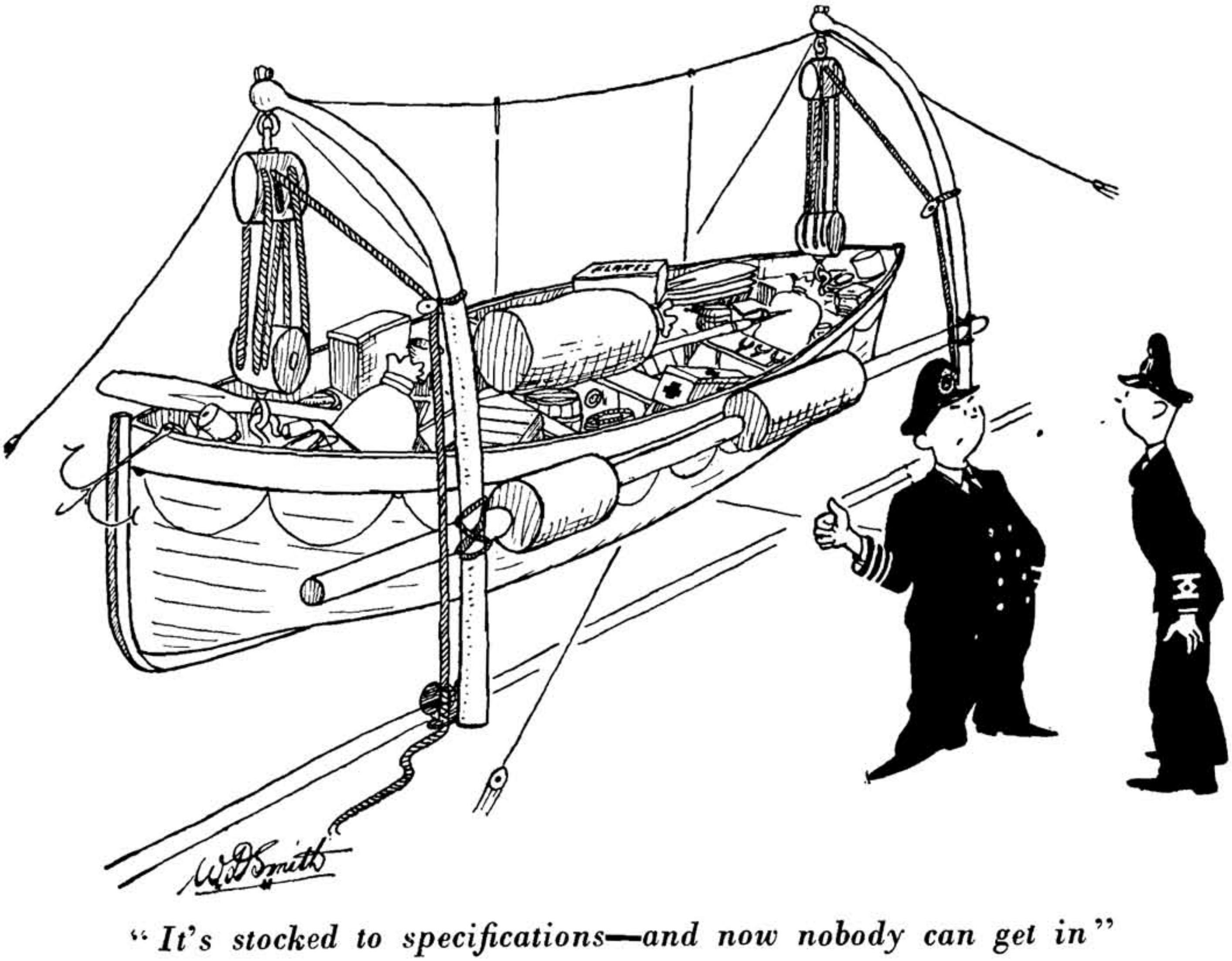
# Proceedings

## of the Marine Safety Council



*"It's stocked to specifications—and now nobody can get in"*

**United States Coast Guard**

January 1984

# Proceedings
of the Marine Safety Council

Vol. 41, No. 1

January 1984



Published monthly by the Commandant, USCG, in the interest of safety at sea under the auspices of the Marine Safety Council. Special permission for republication, either in whole or in part, with the exception of copyrighted articles or artwork, is not required provided credit is given to the *Proceedings of the Marine Safety Council*. The views expressed are those of the authors and do not represent official Coast Guard policy. All inquiries and requests for subscriptions should be addressed to Commandant (G-CMC), U.S. Coast Guard, Washington, DC 20593; (202) 426-1477. Please include mailing label when sending in a change of address. The Office of the Secretary of Transportation has determined that the publication of this periodical is necessary in the transaction of the public business required by law of this agency. Use of funds for printing this publication has been approved by the Director of the Office of Management and Budget through March 31, 1985.





DIST. (SDL No. 118)
A: abcde(2); fghklmntuv(1)
B: n(50); c(16); e(5); f(4); gj(3); r(2); bkiq(1)
C: eglmp(1)
D: adgklm(1)
E: mn(1)
F: abcdehjkloqst(1)
List TCG-06


**When you have finished reading this issue, please pass it on.**

# Contents

## Features



## Departments



## Cover

*Lifeboats and their equipment packs are just one of the subjects covered in a new revision of the Lifesaving Appliances and Arrangements chapter of the Safety of Life at Sea Convention. The article beginning on page 9 explains how and why the new requirements were developed and how they affect U.S. vessels. Illustration by W. D. Smith; source unknown.*

# Hazardous Materials

*Many different concerns and jurisdictions enter into the regulation of hazardous materials shipments. If water is involved, so is the Coast Guard.*

**by LCDR James W. Gormanson, Cargo and Hazards Branch**
**and Frits Wybenga, Chemical Engineering Branch**
**Marine Technical and Hazardous Materials Division**

For marine transportation, the Coast Guard places hazardous materials in one of three basic categories: packaged, bulk solid, or bulk liquid. The form in which the cargo is transported determines the specific approach taken to ensure safety.

## Packaged Hazardous Materials

In the United States, the Department of Transportation (DOT) has overall responsibility for ensuring the safe transportation of packaged hazardous materials in all modes of transportation. Specific safety matters relating to particular modes are addressed by the DOT agency responsible for that mode. The Coast Guard is responsible for the marine mode. Since transportation is often "intermodal," the same package may end up being moved by any combination of road, rail, air, or water transportation. The DOT regulations thus concentrate on package design/strength, proper shipping documentation, and identification of individual cargoes through marking and labeling of the package.

Domestic regulations for packaged hazardous materials are found in Parts 100 - 199 of Title 49 of the Code of Federal Regulations (49 CFR 100 - 199). These regulations mirror for the most part the International Maritime Dangerous Goods (IMDG) Code of the International Maritime Organization (IMO). Part 176 of Title 49 deals specifically with the water mode. Other packaged hazardous materials regulations are located in the Shipping Regulations (Title 46) of the CFR; regulations governing military explosives and marine portable tanks, for example, are found in Parts 146 and Part 64 of that Title, respectively.

The packaged hazardous materials regulations have seen some radical changes within the last year. These changes show a definite trend toward harmonizing U.S. regulations with international recommendations. On August 4, 1983, 49 CFR 100 - 199 was amended to give vessel owners and operators the option of complying with the IMDG Code in lieu of DOT regulations for both domestic and international shipment of hazardous materials (with the exception of shipment of explosives and radioactive materials and stowage). A similar development took place in air transportation in January 1983, when the International Civil Aviation Organization's Technical Instructions for air shipment of hazardous materials were adopted as an alternative for both domestic and international air shipments of hazardous materials.

DOT's Materials Transportation Bureau is responsible for administering (issuing and updating) all packaged hazardous materials regulations, while the initiative for developing regulations applicable to a single mode is left to the appropriate agency. The Coast Guard is charged with developing, monitoring compliance with, and enforcing the DOT hazardous materials regulations for the marine mode.

## Bulk Shipments

For packaged hazardous materials, ship design enters into the picture only as it relates to the need for proper stowage, segregation, and other operational requirements. For bulk shipments, vessel design becomes much more important. In essence, the ship becomes the "package" that contains the cargo. Bulk carriers must be designed to withstand the stresses imposed by their cargoes during loading and discharge as well as in transit. In addition, they must be designed to control and minimize the hazards associated with their cargoes.

Regulations governing the two classes of bulk shipments, solids and liquids, are found in Title 46 of the Code of Federal Regulations. Unlike the packaged materials regulations, which are issued by DOT, the bulk shipments regulations are issued by the Coast Guard.

## Bulk Solids

Coast Guard regulations for bulk solid hazardous materials, found in Part 148 of Title 46 of the Code of Federal Regulations, specify operational requirements for each product listed there. Ship design criteria are specified in the Coast Guard regulations for cargo vessels (46 CFR 90 - 99). When a new cargo (one not listed in Part 148) is proposed for shipment, the Coast Guard classifies the cargo in accordance with the DOT hazard definitions, assigns appropriate carriage requirements, and issues a Coast Guard Special Permit authorizing its shipment. Periodically, new cargoes are added to Part 148.

The Coast Guard bulk solids regulations are similar to the recommendations contained in Appendix B (Materials Possessing Chemical Hazards) of the IMO Code of Safe Practice for Solid Bulk Cargoes (Bulk Solids Code). In many cases the requirements imposed for products proposed for shipment are taken from the IMO Bulk Solids Code.

## Bulk Liquids

In regulating the bulk shipment of hazardous liquid chemicals and liquefied gases on self-propelled vessels, the Coast Guard has implemented the IMO Code for the Construction and Equipment of Ships Carrying Dangerous Chemicals in Bulk (Bulk Chemical Code) and the Code for the Construction and Equipment of Ships Carrying Liquefied Gases in Bulk (Gas Carrier Code) by placing the substance of these codes in U.S. national regulations (46 CFR 153 and 154).

The regulations are updated from time to time to reflect amendments to the IMO Codes. In the case of U.S.-flag vessels, the Coast Guard ensures compliance with these requirements through plan review and inspection as construction proceeds. It ensures that the vessels are maintained to these standards by means of annual and periodic inspections.

The regulations are also applicable to foreign-flag vessels entering U.S. waters. In the case of foreign vessels, an IMO Certificate of Fitness is accepted as evidence of compliance. When a foreign vessel first enters a U.S. port to load or discharge a hazardous chemical or liquefied gas, it is examined by the Coast Guard. Upon satisfactory inspection, a Letter of Compliance is issued. This certificate remains valid for a period of two years. In the interim period the vessel is inspected on an unscheduled basis by Coast Guard boarding teams.

The inspection status of both foreign and domestic chemical and liquefied gas carriers is logged into the Coast Guard's computer network. Local inspection offices can determine if any deficiencies were noted on previous Coast Guard inspections by inquiring through the computer system.

Non-self-propelled vessels (tank barges) carrying large quantities of chemicals and liquefied gases in bulk are covered in a separate set of regulations found in 46 CFR 151. These regulations take into consideration the same concerns addressed in the IMO Codes.

The U.S. uses the IMO Criteria for Hazard Evaluation of Bulk Chemicals, outlined in the

IMO Bulk Chemical Code, to evaluate new products proposed for bulk movement by ship. This system is based on generally available test results for products' flammability, toxicity, reactivity, and corrosivity. Flexibility is built in for products which present greater or lesser hazards than the evaluation system suggests. New products proposed for shipment by tank barge are also evaluated on the basis of these properties.

## Ships' Stores

Regulations governing hazardous materials intended for use or consumption in the course of normal activities on board domestic vessels are specific to the water mode of transportation. The Coast Guard's regulations governing the use of hazardous materials as ships' stores are contained in 46 CFR 147. These regulations are intended to provide the users of a hazardous material on board a domestic vessel with adequate safety information regarding the product. Products not listed in 46 CFR 147 are classified by the Coast Guard on the basis of the DOT hazard definitions found in 49 CFR 173; the Coast Guard issues Ships' Stores Certifications to allow use of these materials on board domestic vessels.

## Shipboard Fumigation

The Coast Guard's regulations governing shipboard fumigation (46 CFR 147A) come from the Ships' Stores regulations. Grain and other agricultural products are generally not regulated by the Coast Guard, nor are grain or other agricultural products required to be fumigated. The Coast Guard does regulate the use of pesticides on board vessels, however, and it has established minimum safety standards to ensure the safety of the vessel and crew. With some exceptions, these standards are similar to the recommendations found in IMO Maritime Safety Committee Circular 298—Recommendations on the Safe Use of Pesticides in Ships.

## Coast Guard Responsibilities

Within the Coast Guard, technical support for ensuring that hazardous materials will be safely transported is provided at the Headquarters level. The Marine Technical and Hazardous Materials Division (G-MTH) of the Office of Merchant Marine Safety is most directly involved with setting standards for shipment. The Cargo and Hazards Branch deals specifically with the cargo, i.e., packaged hazardous materials, bulk solids, bulk liquid classifications, ships' stores, and shipboard fumigation. The Chemical Engineering Branch is tasked with establishing specific ship design criteria and administering the Letter of Compliance Program. Enforcement activities are carried out through routine and unscheduled inspections by Coast Guard units located in U.S. ports. Information on how hazardous materials should be handled is disseminated to the Coast Guard field units and the public in the form of regulations, Navigation and Vessel Inspection Circulars, films, brochures, and such manuals as the Chemical Data Guide for Bulk Shipment by Water.

## Coast Guard Involvement with International Regulation of Hazardous Materials

The Coast Guard participates in the International Maritime Organization, the United Nations agency tasked with overseeing the Safety of Life at Sea Convention (SOLAS) and its implementing Codes dealing with hazardous materials. It participates in the IMO Subcommittee on Containers and Cargoes, which deals with issues related to bulk solid hazardous materials and stability items concerning bulk solid cargoes. It also participates in the IMO Bulk Chemical Subcommittee, which administers the Bulk Chemical and Gas Carrier Codes. To better understand intermodal transportation of packaged hazardous materials, the Coast Guard participates in the U.N. Committee of Experts on the Transport of Dangerous Goods, the international body charged with the development of recommendations addressing the multimodal transportation of hazardous materials. Information gained from its participation in this committee is used to assist the U.S. delegation to meetings of the IMO Carriage of Dangerous Goods Subcommittee, the body dealing with the marine transportation of packaged hazardous materials and administration of the IMDG Code.

All of the Coast Guard's international work is coordinated with the industry through the SOLAS Working Groups set up for each IMO subcommittee. By conducting its business in this way, the Coast Guard strives to allow industry and government to arrive at equitable safety requirements for international and, ultimately, domestic shipments of hazardous materials. ⚓

# IMO Codes

*Regulation of the carriage of chemicals and liquefied gases will change with the coming into force of an amendment to SOLAS 74 and Annex II of MARPOL 73/78. Compliance with certain standards that are now IMO recommendations will become mandatory.*

**by Anthony L. Rowek**
**Chemical Engineering Branch**
**Marine Technical and**
**Hazardous Materials Division**

**Terms frequently used in this article**

**IMO** - International Maritime Organization

**SOLAS 74** - The International Convention for the Safety of Life at Sea, 1974

**MARPOL 73/78** - The International Convention for the Prevention of Pollution from Ships, 1973, as modified by the Protocol of 1978 relating thereto

**Bulk Chemical Code** - IMO Resolution A.212(VII), Code for the Construction and Equipment of Ships Carrying Dangerous Chemicals in Bulk, including the ten sets of amendments to that Code

**IBC Code** - IMO's International Code for the Construction and Equipment of Ships Carrying Dangerous Chemicals in Bulk

**Gas Carrier Code** - IMO Resolution A.328(IX), Code for the Construction and Equipment of Ships Carrying Liquefied Gases in Bulk, including the four sets of amendments to that Code

**IGC Code** - IMO's International Code for the Construction and Equipment of Ships Carrying Liquefied Gases in Bulk

IMO recently completed work on two new codes, the IBC Code and the IGC Code. Its purpose in developing the new codes was to provide up-to-date, harmonized guidelines for bulk shipment of two types of products, chemicals and liquefied gases. The two new codes use similar terminology, cover similar areas, and ensure equivalent levels of safety in carriage of the two types of products. The IGC Code is substantially the same as its forerunner, the Gas Carrier Code. The IBC Code, in order to be consistent with the IGC Code, had to depart somewhat from its forerunner, the Bulk Chemical Code.

The Bulk Chemical and Gas Carrier Codes, first published in 1971 and 1975, respectively, were developed only as IMO-recommended standards. Unless a government chooses to implement them through its national regulations, the Codes have no force. The United States published implementing regulations in Parts 153 and 154 of Title 46 of the Code of Federal Regulations, making the Codes applicable to both U.S. vessels and foreign-flag vessels in U.S. waters. Several other countries have also implemented these Codes through national regulations.

Compliance with certain of the recommended standards contained in these Codes will become mandatory when an amendment to SOLAS 74 and Annex II of MARPOL 73/78 enter into force.

## SOLAS 74

The safety aspects associated with the carriage of hazardous materials are addressed in Chapter VII of SOLAS 74. A recent amendment to Chapter VII furthers the aim of promoting safety by making compliance with the IBC and IGC Codes mandatory for those products listed in the Codes. The amendment will enter into force on July 1, 1986; the Codes will apply in full to any vessel constructed on or after that date engaged in an international voyage.

Owners and operators of vessels constructed prior to July 1, 1986, will continue to be urged to comply with the standards recommended in the Bulk Chemical Code, the Gas Carrier Code, and the companion code of the latter, the IMO Code for Existing Ships Carrying Liquefied Gases in Bulk.

## MARPOL 73/78

MARPOL 73/78 addresses those technical aspects of ship design, equipment, and operation which may contribute to marine pollution through controlled discharge (such as ballasting or tank cleaning) or uncontrolled accidental discharge. Annex I of MARPOL 73/78 deals exclusively with the bulk carriage of oil; it entered into force on October 2, 1983. Annex II of MARPOL 73/78 deals exclusively with the bulk carriage of noxious liquid substances (chemicals) and is scheduled to enter into force three years after Annex I, in other words, on October 2, 1986. Countries ratifying the Convention are bound to enforce Annex I and Annex II.

The noxious liquid substances regulated under Annex II are divided into four categories, A, B, C, and D, according to the pollution hazard they present. There are three appendices to Annex II. Appendix I contains the criteria for hazard evaluation. Appendix II is a list of the noxious liquid substances along with their hazard categories. Appendix III is a list of other substances which were evaluated and not found harmful.

Regulation 13 of Annex II makes compliance with the Bulk Chemical Code mandatory when Category A, B, or C noxious liquid substances are being carried. The provision making compliance with the Code mandatory was included in MARPOL to minimize the possibility of uncontrolled accidental discharge of hazardous substances.

In view of the changes made over the years to the Bulk Chemical Code and the development of the IBC Code, questions naturally arose about how and to what extent the standards in the Bulk Chemical Code should be applied to present and future chemical vessels. IMO's Marine Environment Protection Committee (MEPC) discussed this subject at its 18th session, held March 21 - 25, 1983, and agreed to amend Regulation 13 to clarify the application. A draft application scheme was developed and approved in principle by the MEPC. This application scheme is shown in the table accompanying this article.

Under the scheme, vessels built prior to July 1, 1986, carrying Category A, B, or C noxious liquid substances will have to comply with the Bulk Chemical Code. How the Code will apply will depend on the type of voyage (domestic or international) and the vessel's date of construction. "New" ships as defined by the Code are covered in Paragraph 1.7.2 of the Code, while "existing" ships are covered in Paragraph 1.7.3.

Vessels built on or after July 1, 1986, carrying Category A, B, or C noxious liquid substances will have to comply with the IBC Code on both domestic and international voyages. (This is in contrast to the SOLAS 74 amendment, which requires compliance from vessels only when they are on international voyages.)

[Vessels carrying Category D noxious liquid substances must meet the pollution prevention provisions of Annex II but are not required by the annex to meet the Bulk Chemical Code or IBC Code.]

These requirements become effective October 2, 1986, the current date for entry into force of Annex II to MARPOL 73/78. Should this date change, as may be decided by a two-thirds majority of those party to MARPOL 73/78, the effective date of the requirements will be revised accordingly. It is not expected that the application scheme shown in the table will change.

## U.S. Activities

The United States has ratified both the SOLAS 74 and MARPOL Conventions and is expected to accept the amendments to these Conventions making compliance with the IBC, IGC, and Bulk Chemical Codes mandatory. The U.S. will implement the IGC and IBC Codes in accordance with the international entry into force of the amendments to SOLAS 74 and Annex II of MARPOL 73/78. Minor regulatory revisions to 46 CFR 153 and 154, such as inclusion of several Category A, B, or C noxious liquid substances not currently in the regulations, are expected.

Compliance with the Bulk Chemical and Gas Carrier Codes is presently a condition for trading in U.S. waters. Making compliance with the Bulk Chemical Code mandatory internationally will have little effect on U.S. efforts, other than to possibly ease the burden of enforcement.

## Annex II of MARPOL 73/78 Requirements for Chemical Tankers Carrying Category A, B, or C Substances

(Effective October 2, 1986)

| Type of Voyage | Date of Construction | Requirements |
|---|---|---|
| International or domestic | On or after July 1, 1986 | IBC Code as amended. |
| International | November 2, 1973 - June 30, 1986 | Bulk Chemical Code, including the 10 sets of amendments, as applicable to "new" ships (Paragraph 1.7.2 of the Code) |
| International | Before November 2, 1973 | Bulk Chemical Code, including the 10 sets of amendments, as applicable to "existing" ships (Paragraph 1.7.3 of the Code) |
| Domestic | July 1, 1983 - June 30, 1986 | Bulk Chemical Code, including the 10 sets of amendments, as applicable to "new" ships (Paragraph 1.7.2 of the Code) |
| Domestic | Before July 1, 1983 | Bulk Chemical Code, including the 10 sets of amendments, as applicable to "existing" ships (Paragraph 1.7.3 of the Code) (Exception: Ships under 1,600 gross register tons must meet the construction and equipment requirements of the Code by June 1, 1994) |

# SOLAS Chapter III

*The Maritime Safety Committee of the International Maritime Organization recently approved a complete revision of Chapter III of the Safety of Life at Sea Convention, "Lifesaving Appliances and Arrangements." The new requirements for lifesaving equipment, scheduled to go into effect for new ships on July 1, 1986, and for existing ships on July 1, 1991, reflect recent advances in survival technology.*

**by Robert L. Markle, Jr.**
**Chief, Survival Systems Branch**
**Office of Merchant Marine Safety**

It has been over 70 years since the TITANIC sank, and people still wonder why it was allowed to be put out to sea without enough lifeboats for all the people on board.

The safety requirements in effect today had their genesis with the TITANIC disaster. After the TITANIC went down, authorities in several maritime nations realized that an international treaty was needed to set minimum standards for passenger ship navigation, construction, radiotelegraphy, fire protection equipment, and lifesaving equipment. SOLAS, the International Convention for the Safety of Life at Sea, was first drafted in 1914 (although this first agreement never entered into force). It has since been expanded and revised several times, and the agreement currently in effect is known as SOLAS 74.

Prior to June 1983, when the finishing touches were put on the new version, SOLAS Chapter III, "Lifesaving Appliances and Arrangements," had not been completely revised since 1948. The new requirements in the chapter, which represent ten years of negotiation at the International Maritime Organization, were developed when the international community recognized that it would no longer be sufficient merely to amend the existing requirements. It was time to start with a clean sheet of paper, analyze what happens during a casualty at sea, and develop new requirements based on the concept of lifesaving equipment as a "subsystem" of the whole ship "system."

Aiming at performance requirements that could be satisfied many ways rather than requirements for specific types of equipment, the IMO Lifesaving Appliances Subcommittee developed a set of "functional criteria." These requirements, which were intended to be the central focus of the revised chapter, were very general and were written in nontraditional terms. To interpret the functional criteria into more conventional terms, the Subcommittee went on to develop more specific requirements for ship lifesaving systems that met the functional criteria using familiar and available equipment. Eventually, this more traditional presentation of equipment requirements became the new SOLAS Chapter III and the functional requirments became a "Code of Practice

*This article was adapted from a paper the author presented to the Marine Section of the National Safety Congress and Exposition on October 18, 1983.*



428-796 O - 84 - 2 : QL 3

for the Evaluation, Testing and Acceptance of Prototype Novel Life-Saving Appliances and Arrangements." The Code serves as a guide for approving authorities to use when a radically new lifesaving system is presented for evaluation and approval.

The new SOLAS Chapter III will affect ships that are begun on or after July 1, 1986. There are also some requirements for older ships, but these will not become effective until July 1, 1991. The remainder of this article explains how the new requirements were developed and how they will apply to ships registered in the United States.

## Exposure Suits

The delegates who drafted the new Chapter III were influenced by the maritime community's growing awareness of the role of hypothermia in loss of life at sea. Although the term has become familiar in sea survival only over the past few years, hypothermia is an old killer. Indeed, it was hypothermia that claimed the lives of those who died in the water in the TITANIC disaster. Even though many of the people for whom there was no room in the lifeboats managed to abandon ship successfully in their life jackets, the frigid water quickly sapped them of their strength.

Some seventy years after the sinking of the TITANIC, about 300 nautical miles north of the place where the TITANIC rests off the coast of Newfoundland, hypothermia claimed the lives of some 110 U.S., Canadian, and Soviet men in a single night when bad weather and heavy seas took their toll on the U.S. drilling rig OCEAN RANGER and the Soviet ship MEKHANIK TARASOV. Thirty or forty of the men on the OCEAN RANGER abandoned ship in a lifeboat that, apparently damaged during launch, capsized alongside a rescue ship. The frigid water rendered the men helpless almost immediately, and all of them died just a few feet from rescue. In the case of the MEKHANIK TARASOV, the Soviet sailors apparently waited to launch the lifeboats until their damaged ship was listing too heavily for them to do so successfully. Only 5 of the 37 on board were saved. Rescuers reported that the survivors were dressed in heavy clothes and were in the water less than ten minutes. Others in the water only a few minutes longer did not survive.

In February 1983, the collier MARINE ELECTRIC sank off the coast of Virginia. There was not enough time to launch the lifeboats, and only 3 of the 34 men on board survived the two hours it took for rescuers to arrive and pull them out of the 40°F water. Two of these had managed to get themselves out of the water and onto a lifeboat and a life raft that were floating in the area.

Water transfers heat from the human body 25 times faster than air at the same temperature. In cold water, heat is removed faster than the body can replace it. The result is that the victim eventually becomes helpless and either drowns or succumbs to the effects of hypothermia itself. To prolong survival time in cold water it is necessary to keep water from coming into contact with the skin and to provide insulation between the water and the skin.

Attempts to provide protection against hypothermia are not new. The use of rubber suits dates back to the early part of the century. Although these suits are credited with having saved lives, they were heavy, they generally required a life jacket to be worn underneath, and they tended to leak and fill with water. The danger they posed in terms of lost thermal protective value and added weight for victims trying to climb out of the water spurred the development, during World War II, of lighter-weight suits made of synthetic rubber.

It took modern materials to make today's "exposure suit"* a practical reality. The material that made the difference was neoprene foam sheeting. This material, which first came into use for divers' wet suits, is a closed-cell foam made up of individual air cells, so it floats and also provides excellent thermal insulation. With a nylon fabric bonded to each side to protect the foam, this material is ideal.

Studies and experiments conducted in Canada and the U.S. in the mid-1970s indicated that immersion suits could be an effective lifesaver. In 1980, the Coast Guard issued regulations requiring exposure suits for everyone on board on large commercial vessels on the Great Lakes. In February 1983, just 11 days before the MARINE ELECTRIC tragedy, the Coast

* The terms "survival suit," "exposure suit," and "immersion suit" are synonymous for the purpose of this discussion. "Survival suit" was the original term and is still popular. "Exposure suit" is the term used in U.S. government regulations. "Immersion suit" is the term used in the new SOLAS requirements.

Guard proposed regulations that would require most large oceangoing cargo ships to carry the suits for everyone on board as well.

The delegates who met for the SOLAS negotiations in the late 1970s were divided on the issue of immersion suits. Some countries (the United States, Canada, the United Kingdom, France, and the Scandinavian countries) considered the issue of supreme importance. Other countries, while supportive, were cautious about a device with which they had not yet become familiar. As a result, the new SOLAS Chapter III requirements are a compromise. Small cargo ships that carry inflatable life rafts as their only survival craft and which require the survivors to jump from the deck of the ship to the raft will have to have immersion suits for everyone on board. Larger ships which have conventional open lifeboats would have to have only three immersion suits for each open lifeboat. These would be for the crew operating the lifeboat. The rest of the persons in the boat would have "thermal protective aids." These are bag-like garments made of "space-blanket" material. They are intended only to conserve the heat of those persons riding in a lifeboat, and they are not suitable for use on a person in the water. Finally, immersion suits will be required for the crew of the rescue boat, which is the boat designated to pick up persons that fall overboard. Ships with totally enclosed lifeboats would not need to carry suits.

The rules proposed for U.S. ships last February go farther than the new SOLAS rules. Other countries will probably exceed them as well. This issue is one that will probably come up again in future negotiations as everyone gains more experience in the use of immersion suits. As proposed, the U.S. rules would require exposure suits for all persons on board oceangoing cargo ships and, in addition, would require spare suits for persons on duty in work stations remote from the berthing area where the suits are normally stowed. Some exemptions to the rules were proposed. Ships with totally enclosed lifeboats would not need to carry the suits. These lifeboats have fast and efficient launching devices which reduce the probability that the crew will find itself in the water before it has a chance to launch the boat. Once the boat is in the water, its enclosure provides protection from hypothermia.

Like the new SOLAS rules, the proposed U.S. rules include a warm-water exemption. Generally, the exemption applies to ships operating solely between 35$^{\circ}$N and 35$^{\circ}$S latitude. In this area, water temperature is generally greater than 60$^{\circ}$F (15.5$^{\circ}$C). The 35$^{\circ}$N demarcation line in the U.S. is near Cape Hatteras on the East Coast and about 40 miles north of the Santa Barbara Channel, near Santa Maria, California, on the West Coast. The exempted area includes the entire Gulf of Mexico.

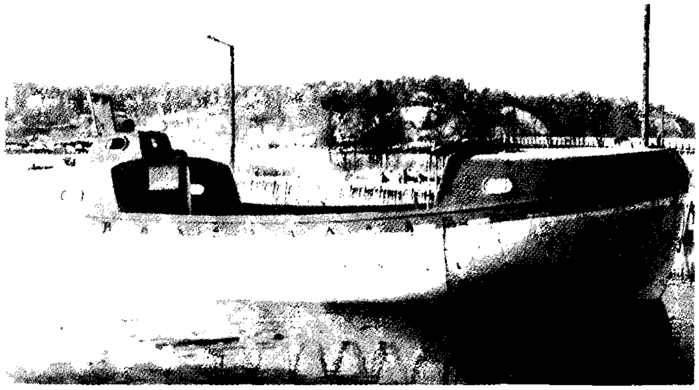
[A final rule on the requirements proposed in February was being readied for publication in the Federal Register as this issue went to press.]

**Striking a graceful pose . . .**

A 1918 version of a lifesaving suit, touted by its manufacturer as "The SENSIBLE Safety Suit," "Made on PRACTICAL and SCIENTIFIC PRINCIPLES," could be fastened at the ankles or above or below the knees—"the latter producing knickerbocker or bloomer effects for women." Once a person had donned such a suit, he or she was "ready to go overboard, or for dancing, playing deck games on board, or for skating, fishing, motorboating, automobiling, etc."

## Lifeboats

Hypothermia is a problem that, while certainly of most immediate concern to people in the water, is not limited to them. Open lifeboats expose their occupants to the elements, too. Although keeping survivors out of the water does much to stave off hypothermia, in heavy seas water will enter the boat and get those inside wet. Worse yet is the progressive flooding that occurs with each breaking wave. The more water that enters the boat, the less stable it becomes. If the occupants don't keep up with the bailing, the boat may capsize.



*This partially enclosed lifeboat is typical of those that will be used on passenger ships under the new revision of SOLAS Chapter III. During bad weather a cover can be pulled over the exposed part. Astern is a protected steering position for the helmsman.*

The solution to the problem is a permanent cabin for the lifeboat that keeps water out and the occupants dry. Several totally enclosed lifeboats were designed and built as early as the 1920s and 1930s. One designed by Ole Brude, a pioneer in the field, looked something like a torpedo and, instead of being lowered by wires, slid off the low side of the ship on rails. Another groundbreaker was the more conventionally hulled, self-righting "Lundin housed lifeboat" built by Welin Davit & Boat Corp. as early as 1914. In spite of the obvious advantages of the totally enclosed lifeboat, the heavy, expensive, steel boats designed in the first half of the century did not catch on. It took something other than cold to spur the development of the modern totally enclosed boat—fire.

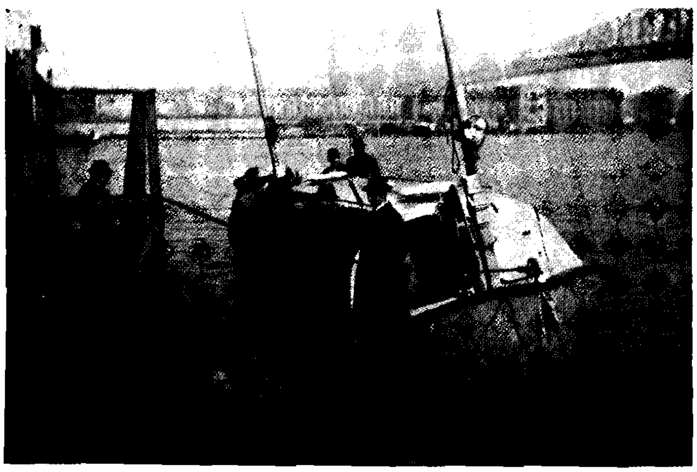
In the 1960s the transportation of oil by ship grew dramatically, as did the size of the ships carrying the oil. Offshore oil exploration and development, too, expanded, as onshore oil reserves were depleted and drilling rigs capable of operating in deeper water were developed. Concern grew for the lives of the crews of such ships and offshore drilling rigs: What would happen if a tanker were involved in a casualty that ignited the cargo or a rig were involved in a blowout or fire? A number of countries began working on totally enclosed lifeboats that would be able to travel for 5 or 10 minutes through fire on the water. After a number of designs were tried, the best solution

*A modern immersion suit, like the one to the left, is designed to prevent shock when the wearer enters cold water, lessen the effects of hypothermia, and provide flotation for the wearer. Thermal protective aids, like the suit to the right, are designed to conserve the heat of people riding in life boats or inflatable life rafts and will be part of the equipment pack in those two craft. The suit shown here weighs less than seven ounces and can be packaged into a small envelope.*

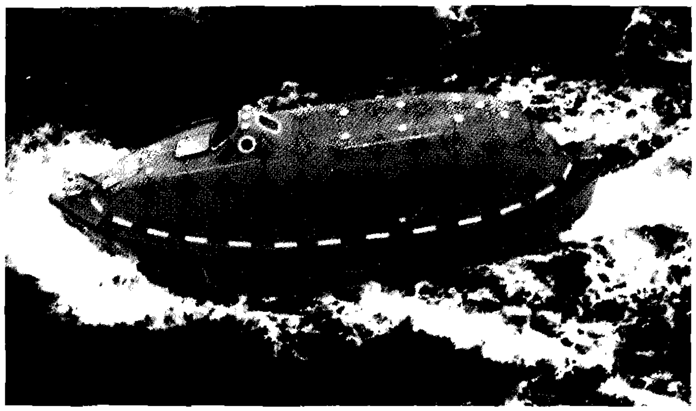
was found to be a totally enclosed lifeboat made of fiberglass-reinforced plastic and equipped with an exterior water spray system and an interior air supply system for the engine and occupants. Once again it was the modern material, the fiberglass-reinforced plastic, that made it all work.

Today totally enclosed lifeboats are found on many tankers and most mobile offshore drilling rigs. While the manufacturers of these lifeboats put them through spectacular fire tests, the boats are more likely to demonstrate their greatest lifesaving potential in cold, rough seas. This was recognized by the IMO members, and, consequently, one of the new SOLAS requirements is for cargo ships to carry totally enclosed lifeboats on both sides of the ship to accommodate everyone on board. If the ship is not carrying a flammable or toxic gas cargo in bulk, the lifeboat will not have to have the external sprinklers and internal air supply, but otherwise the ship will be required to have the same boats tankers do.

The new SOLAS Chapter III will bring some changes to the totally enclosed lifeboat. Although such boats have performed superbly in numerous casualties, they are not invulnerable. Most of them are designed to be self-righting, but that's only if there is no water inside. On some occasions they have been damaged during launching in the hazardous conditions often surrounding casualties. This allows water to enter the boats, and a flooded boat is not very stable. In at least three casualties, totally enclosed lifeboats have capsized and trapped would-be survivors inside. The new chapter will require that occupants be provided with an



*The groundbreaking Welin Davit & Boat Corp. was making self-righting enclosed lifeboats as early as 1914. This one, the "Lundin housed lifeboat," dates from 1930.*

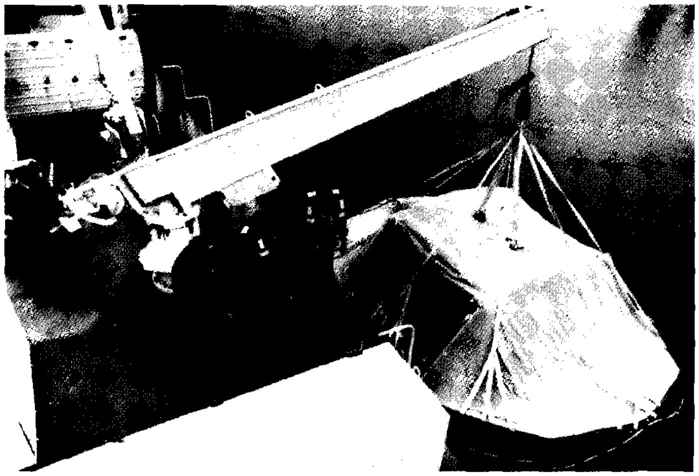


*One new SOLAS requirement is for cargo ships to carry a sufficient number of totally enclosed lifeboats on each side of the ship to accommodate everyone on board.*

above-water means of escape for use in flooded capsizings. This could take the form of some type of escape hatch on the bottom, but most boat builders will add either rigid or inflatable flotation to the boat canopy to make their boats self-righting in the flooded condition. This should improve the lifesaving potential of these boats even further.

With the coming of the totally enclosed lifeboat, the oar-propelled boats and boats with hand-powered propelling gear will be gone. The totally enclosed boats will be powered by diesel engines equipped with starting aids for use in the cold. These engines and their fuel systems will be designed to allow the engine to continue operating or come to a safe shutdown during a capsizing and re-righting of the boat. This will allow a boat that capsizes in heavy seas to re-right and be in a ready-to-run condition.

The partially enclosed lifeboat mentioned in SOLAS Chapter III is a recent development. It has rigid covers at both ends and a canopy that can be pulled closed quickly. These boats will have many of the advantages of the totally enclosed boat but should have some extra space and some weight saving, important considerations in larger boats. Governments have the option of permitting cargo ships operating in limited, protected areas to carry partially enclosed lifeboats. The primary application for the partially enclosed boats will be on passenger ships, which will be required to have either partially or totally enclosed lifeboats for everyone on board (davit-launched inflatable life rafts may be substituted to cover up to 25 percent of this passenger capacity, 40 percent on ships engaged in "short international voyages").



*A davit-launched life raft can be launched fully inflated.*

## Lifeboat Release Mechanisms

Another improvement called for in the new SOLAS Chapter III has to do with the release mechanism of the lifeboat. Most countries in recent years have required lifeboats to have a type of release hook that will not allow the boat to be released from the wires until the load of the boat is off the hooks. The idea is that the hooks can be opened when the boat is waterborne but not before. The problem with this arrangement is that if the boat is launched into heavy seas, if the ship is still moving, or if the ship is aground or anchored in a current, there will still be a load on the hooks when the boat is in the water that will prevent the hooks from being released. In the United States, lifeboats have been required to have a release mechanism that will allow the boat to be released at any time, whether or not a load is on the hooks. This solves the problem of launching in heavy seas or in a current, but it also allows the accidental release of the boat from any height above the water. A number of people have been killed and injured over the years because of accidental release of a lifeboat resulting from such a mechanism.

The release gear included in the new SOLAS Chapter III will combine the best of both systems. The gear will be arranged so that it normally will allow release when the boat becomes waterborne. If the boat is launched into heavy seas or a current that will not allow normal operation of the release, a protected safety device will allow release of the boat with a load on the hooks.


*How <u>not</u> to board an inflatable life raft*

## Lifeboat Launching Equipment

Most current davit-and-winch systems for lifeboats require that the lifeboat be moved from an inboard stowage position to an embarkation position over the side of the ship for boarding. "Tricing pendants" keep the lifeboat close to the edge of the deck at the embarkation position, and "frapping lines" must be secured around the wires to hold the boat securely in position. After the boat is boarded, the tricing pendants are released and the frapping lines let out slowly. This allows the boat to hang free over the side of the ship. A winch operator remains on deck and lowers the boat to the water. Once the boat is launched, the winch operator must make his way down the side of the ship, either by using a long debarkation ladder or by jumping. The boat crew then must pick him up. This is obviously a time-consuming procedure, and, in many cases, the time available for abandoning ship may be short.

The most modern and efficient gravity davit-and-winch systems for totally enclosed lifeboats allow the boat to be boarded in its stowage position and the persons in the boat to launch it directly from that position, using a control that is operated from the boat. The new Chapter III requires such a system on cargo ships and includes it as an option for passenger ships as well. Equipping boats with this type of launching system should lead to more rapid and effective abandonments.

Another launching improvement is the requirement that launching devices operate up to an angle of list of at least 20°. SOLAS 74 requires launching devices to operate only up to a list of 15°.

## Inflatable Life Rafts

Inflatable life rafts came into widespread use in the maritime community after World War II, when large ships began carrying them to provide a spare survival craft—the inflatable life rafts could automatically float free of a sinking ship, inflate, and be ready for use in case the lifeboats could not be used. Carriage of the life raft as a spare survival craft became mandatory for both passenger and cargo ships with the 1960 revision of SOLAS.

Like its predecessors in SOLAS 60 and 74, the new Chapter III continues to allow davit-launched inflatable life rafts to be substituted for some of the lifeboats on passenger ships, but it goes farther. A cargo ship is currently

*Totally enclosed lifeboats such as this "survival capsule," intended for use on tankers and drilling rigs, must pass a fire test in which temperatures approach 2,000°F.*

required to have enough life rafts to accommodate 50 percent of the people permitted on board the ship. These are float-free life rafts and are intended to be used in the event that the lifeboats are not available. The drafters of the new SOLAS chapter asked themselves what the other 50 percent of the people on board the ship were supposed to do and concluded that life rafts needed to be provided for all people on board. Old casualty reports confirmed that a shortage of life rafts had figured in the loss of life in a number of casualties. To some of those involved in the negotiations, it was somewhat reminiscent of the TITANIC situation. The new Chapter III will require cargo ships to carry life rafts, in addition to the lifeboats, for 100 percent of the people on board.

The life raft also has a new place on smaller ships. It has always been difficult to find space on smaller ships for lifeboats. This is where the life raft, in particular the inflatable life raft, has a major role to play. Cargo ships less than 85 meters (279 feet) long and passenger ships less than 500 gross tons and carrying fewer than 200 passengers have the option of carrying life rafts on each side of the ship in sufficient numbers to accommodate all people on board. These life rafts are carried in place of the lifeboats that would otherwise be required. If the distance between the water and the deck from which the rafts are boarded exceeds 4.5 meters (15 feet), the rafts must be the davit-launched type so that the people abandoning ship do not have to jump from an excessive height to get to the rafts. Since the life rafts have no means of propulsion, some powered boat needs to be provided. To provide for this function, each of these ships must carry at least one rescue boat *(see discussion in following section).*

The inflatable life raft also comes in for some improvements under the new Chapter III. Although one of the primary functions of the inflatable life raft is to float free, allowing people in the water to board the raft, a number of casualty cases have shown that it can be very difficult for people to board the raft from the water, especially if they are cold and weak. Ladders made of rope or webbing are provided at the entrances, but since they are flexible, they can be hard to use. One way to improve boarding access is to provide a water-level platform outside the raft at an entrance. A person can easily roll onto the platform from the water and then climb on board the raft from there. Such a platform is required by the new SOLAS Chapter III.

## Rescue Boats

The rescue boat described in the new Chapter III revision is being included in SOLAS for the first time. A rescue boat is a boat which is designed to facilitate man-overboard rescues, assist other ships in distress, and tow the ship's life rafts short distances to move them away from the danger area near the scene of a casualty and gather them to await a rescue. These functions in the past had typically been performed by the ship's lifeboats or, on passenger ships, by small lifeboats designated as emergency lifeboats. The new rescue boat requirements were developed in recognition of the fact that not all lifeboats are suitable for these functions. This is especially true of the totally enclosed lifeboat, which might be of limited usefulness for rescuing people in the water. Under the new requirements, each cargo ship and small passenger ship would have to have at least one rescue boat and larger passenger ships would have to have one on each side of the ship. The requirements are written in such a way that a properly designed lifeboat could be counted as both a lifeboat and a rescue boat, but new boats intended specifically as rescue boats are being designed and built. Some countries may require specially designed rescue boats on their ships in addition to the required lifeboats and life rafts.

## Radiocommunications Equipment

Lifeboats and life rafts all keep people out of the water until they can be rescued, but how do rescuers know where to find them or even know that there has been a casualty? The answer is, of course, radio. Radio was an important part of the first SOLAS convention, and for many years ships have carried, in addition to their radios, a "portable" lifeboat radio (these radios actually could weigh 40 pounds or more and be fairly complex to operate). In general, portable lifeboat radios have not proved useful in casualty situations. In 1975 the United States began requiring its large oceangoing merchant ships to carry emergency position-indicating radio beacons (EPIRBs). These devices are designed to float free of a sinking ship and automatically send a distress signal on aircraft distress frequencies. An overflying aircraft within 100 miles or so (depending on altitude) can pick up the signal and either alert rescue forces or enable them to home in on the beacon.

EPIRBs voluntarily carried on yachts and fishing boats have contributed to the saving of many lives, but the beacons have not yet been a factor in any casualties involving U.S. ships that were required to carry them. Either there has been no need to use the EPIRB to locate the casualty or the EPIRB signal was not received. An EPIRB signal might not be received if there are no overflying aircraft within range of the casualty with their radios tuned to the distress frequency.

Satellites are now being used in an experimental project known as SARSAT/COSPAS *(see the July 1983 issue of the* Proceedings). Under this program, the United States, Canada, the United Kingdom, France, Norway, and the Soviet Union are cooperating to monitor the distress frequency using U.S. and Soviet satellites. The project will reach its full capability later this year, when the last of the SARSAT/COSPAS satellites is placed in orbit. The purpose of the SARSAT experiment is to determine what technology is best for a satellite-aided search-and-rescue system. The experimental SARSAT system, which has already been used in a number of rescues involving small vessels, was designed to work with EPIRBs already in use as well as an experimental EPIRB operating on another frequency better suited to satellite reception.

The new revision to SOLAS Chapter III contains a new EPIRB requirement for two EPIRBs on either side of a ship. These EPIRBs are intended to be carried to one of the lifeboats or life rafts on that side of the ship, where they will provide a signal for rescuers to home in on. While Chapter III will not at present require float-free EPIRB similar to that required on

U.S. vessels, a requirement for the satellite EPIRB that will supersede the float-free ship EPIRB is anticipated. IMO is considering a complete revision of SOLAS Chapter IV on Radiocommunications which will provide for a "Future Global Maritime Distress and Safety System" (FGMDSS). This system will include satellite EPIRBs, the requirements for which will be based in part on the information gathered under the SARSAT project. A future revision of Chapter III is expected to include a requirement for an EPIRB that will operate effectively with the permanent search and rescue system that will be part of the FGMDSS. The satellite EPIRBs will be "alerters," as opposed to the lifeboat/life raft EPIRBs, which will be "locators."

*Rescue boats are designed for specialized functions such as rescuing people from the water. This example is similar to the boats now being used on Coast Guard cutters.*

Another new radio requirement in SOLAS Chapter III is for two-way radios to provide for communication between the ship and its survival craft and between survival craft. Two-way radios have been used for years on ships to provide communication between remote locations. The new requirement recognizes the utility of these devices in a casualty and will require that they be available for use.

## Training

The best lifesaving equipment in the world will not be of any use if the people on board a vessel do not know how to use it. SOLAS 74 and its predecessors required lifeboat drills to be carried out on board regularly, but these can be cursory affairs, with crews just going through the motions. The new SOLAS Chapter III extends the lifeboat drill requirements to include on-board training in the use of not only lifeboats but the rest of the survival equipment as well. Inflatable life rafts were of particular concern, since they are stowed on board the ship in their canisters; this prevents the crew from ever seeing them until the need to use them arises. For the first time, manufacturers of lifesaving equipment will be required to provide training materials for their equipment. These materials will be carried on board the ship. They may be provided in the form of manuals or as audiovisual material.

## Future Developments in Lifesaving Systems

Progress is continually being made in the field of lifesaving equipment. The members of the IMO Lifesaving Appliances Subcommittee took this into account when they drafted the new Chapter III requirements. Chapter III now permits, for example, the newest type of abandonment system, the free-fall launch, in lieu of davit launching. This Norwegian-developed system consists of a specially designed totally enclosed lifeboat and an inclined launching ramp. This first version of the system has been approved by Norwegian authorities for launch heights of up to 20 meters (65 feet). The boat slides off a ramp mounted over the stern of the ship, dives into the water, and surfaces, moving away from the vessel. The passengers sit in padded seats, facing away from the direction of launch, and are held in place by six-point seat belts. Though the prospect of dropping through the air without restraint from such a height is frightening at first, the system is gradually gaining worldwide acceptance and may well be the lifesaving system of the future.

Future revisions of Chapter III are anticipated in regard to inflatable life raft stability, an area identified for further improvement, in



428-796 O - 84 - 3 : QL 3

addition to the already described requirement for a satellite EPIRB. As effective as the inflatable life raft has been, it is not without its shortcomings. High winds can pick up a lightly loaded life raft and blow it away before anyone has had a chance to get on board. In heavy breaking seas, the rafts can be capsized, trapping occupants inside and underwater. One way to lessen the chance that this will occur is to fit the rafts with large water-ballast chambers. Several manufacturers and approval authorities are working on this problem. Predictably, each one has its own preferred approach. Development continues on this important matter, and the next revision of the SOLAS lifesaving requirements may very well address stability standards for inflatable life rafts.

The aforementioned "Code of Practice for the Evaluation, Testing and Acceptance of Prototype Novel Life-Saving Appliances and Arrangements" should ensure that the new IMO regulations will not quickly fall behind technological development. This code is intended to be a guide for approving authorities to use when a new lifesaving system is presented for evaluation and approval. It describes the functions that a ship's lifesaving system should perform, rather than being a "cookbook" detailing the specific ingredients of a shipboard lifesaving system. The Code should serve as a framework for international lifesaving system requirements of the future.

# Major Changes in SOLAS Chapter III

## For new ships (begun on or after July 1, 1986):

**Emergency position-indicating radio beacons (EPIRBs)**

- Two EPIRBs (one on each side of the ship) will be required, stowed in a manner that allows them to be readily placed in any lifeboat or life raft. (These EPIRBs are in addition to the float-free ship EPIRB already required on U.S. ships.)
  Note: The float-free ship EPIRB will eventually be replaced by a satellite EPIRB when the Future Global Maritime Distress and Safety System becomes operational.

*Free-fall lifeboats can be launched from heights of up to 20 meters or more. The occupants face to the rear and are strapped into special contour seats with three ("six-point") seat belts.*

**Two-way radiotelephone apparatus**

- Ships will be required to carry at least three "walkie-talkies" to provide for communication between the ship and its lifeboats and life rafts.

**Exposure suits (referred to as "immersion suits" in SOLAS)**

- Suits will be required for the crew of the boat designated to conduct man-overboard rescues (rescue boat).

**Lifeboats**

- Increased hypothermia protection is required in lifeboats. Lifeboats on most cargo ships must be totally enclosed and self-righting in both the dry and flooded conditions. Lifeboats on passenger ships must be either totally enclosed or partially enclosed with rigid covers over bow and stern and a quickly deployable flexible cover in between.

- Lifeboats on ships carrying toxic cargoes must have a self-contained air supply system for the engine and crew.
- Lifeboats on ships carrying flammable cargoes must have a self-contained air supply system for the engine and crew and an external sprinkler system to permit the boat to proceed through the fire on the water.
- Lifeboats are required to have a release mechanism that unlocks when the boat enters the water but that can also be released before the boat is waterborne by activating a protected safety lock.
- All lifeboats must be motor lifeboats.

**Life rafts**

- In addition to the lifeboats on either side of a cargo ship, float-free life rafts must be provided for 100 percent of the people on board rather than the present 50 percent.
- Life rafts must be provided with a boarding platform at one entrance to facilitate boarding from the sea.
- Life rafts may be substituted for lifeboats on small ships (passenger ships under 500 tons and with fewer than 200 passengers, cargo ships less than 85 meters (279 feet) in length), but a rescue boat for man-overboard rescues must be provided.

**Launching capability**

- Lifeboat and life raft launching gear will be required to operate at up to a $20^{\circ}$ list rather than up to a $15^{\circ}$ list, as is currently required.
- Ships such as tankers, chemical carriers, and gas carriers will have to have launching gear that operates at greater angles of list on the low side if the ship in a damaged condition has a final angle of heel greater than $20^{\circ}$.
- Launching devices must be arranged so that they can be operated from within the lifeboat or life raft so that no one will be required to remain on board the ship.
- Launching devices on cargo ships must be arranged so that the boats are boarded and launched from their stowed position rather than some intermediate position.
- Free-fall lifeboat launching is permitted in lieu of davit launching.

**Training and maintenance**

- Formal on-board training for the crew in the use of the lifesaving systems will be required in addition to the traditional fire and boat drills.
- Proper maintenance of lifesaving equipment is specifically required.

## For existing ships (begun before July 1, 1986; requirements to apply July 1, 1991):

**Emergency position-indicating radio beacons (EPIRBs)**

- Two EPIRBs (one on each side of the ship) will be required, stowed in a manner that allows them to be readily placed in any lifeboat or life raft. (These EPIRBs are in addition to the float-free ship EPIRB already required on U.S. ships.)
  Note: The float-free ship EPIRB will eventually be replaced by a satellite EPIRB when the Future Global Maritime Distress and Safety System becomes operational.

**Two-way radiotelephone apparatus**

- Ships will be required to carry at least three "walkie-talkies" to provide for communication between the ship and its lifeboats and life rafts.

**Life rafts**

- In addition to the lifeboats on either side of a cargo ship, float-free life rafts must be provided for 100 percent of the people on board rather than the present 50 percent.

**Exposure suits (referred to as "immersion suits" in SOLAS)**

- Three suits will be required for the crew of each open lifeboat with "thermal protective aids" (similar to "space blankets") provided for everyone else on board the ship.
- Governments have the option of requiring exposure suits for each person on board. ⚓

# Watchkeeping

*While the circumstances of a vessel in port may be very different from those of a vessel at sea, proper keeping of a watch is just as important if life, property, and the marine environment are to be protected.*

This is the second in a four-part series on watchkeeping adapted from the International Maritime Organization's International Convention on Standards of Training, Certification and Watchkeeping for Seafarers, 1978 (STCW). Part 1 covered the navigational watch; this month's installment covers the in-port watch for deck officers; parts 3 and 4 will cover the engineering watch underway and in port.

The STCW Convention will go into effect for signatory nations in April 1984. Since the United States has not yet ratified the Convention, the principles elaborated in the articles are only recommendations at this time and cannot take the form of regulations or policy. However, U.S. mariners who enter ports of signatory nations will be required to comply with the Convention's provisions, and all licensed mariners should familiarize themselves with the guidelines and the STCW Convention.

The regulatory proposal for a new U.S. licensing structure (described in detail in the February 1983 issue of the *Proceedings* and published in the Federal Register on August 8, 1983) was developed with an eye to harmonizing its provisions with those of the STCW wherever possible.

## STCW
## Resolution 3

## Recommendation on Principles and Operational Guidance for Deck Officers in Charge of a Watch in Port

**Introduction**

1. This Recommendation applies to a ship safely moored or safely at anchor under normal circumstances in port. For ships at an exposed anchorage, reference should be made to the additional precautions contained in Regulation II/1 of the Convention, "Basic Principles to be Observed in Keeping a Navigational Watch," and in Resolution 1, the "Recommendation on Operational Guidance for Officers in Charge of a Navigational Watch" *(see the December 1983 issue of the* Proceedings). Special requirements may be necessary for special types of ships or cargo.

2. The following principles and operational guidance should be taken into account by ship owners, ship operators, masters, and watchkeeping officers.

**Watch and its arrangements**

3. Arrangements for keeping a watch when the ship is in port should

(a) ensure the safety of life, ship, cargo, and port;

(b) conform to international, national, and local rules;

(c) maintain order and the normal routine of the ship.

4. The ship's master should decide the composition and duration of the watch on the basis of the conditions of mooring, type of the ship, and character of duties.

5. A qualified deck officer should be in charge of the watch, except in ships under 500 gross register tons not carrying dangerous cargo, in which case the master may appoint whoever has appropriate qualifications to keep the watch in port.

6. The necessary equipment should be so arranged as to provide for efficient watchkeeping.

**Taking over the watch**

7. The officer of the watch should not hand over the watch to the relieving officer if he has any reason to believe that the latter is obviously not capable of carrying out his duties effectively, in which case he should notify the master accordingly.

8. The relieving officer should be informed of the following by the officer being relieved:

(a) the depth of water at the berth, ship's draft, the level and time of high and low waters; fastening of the moorings, arrangement of anchors, and the slip of the anchor chain and other features of mooring important for the safety of the ship; state of main engines and availability for emergency use;

(b) all work to be performed on board ship; the nature, amount, and disposition of cargo loaded or remaining or any residue on board after unloading of the ship;

(c) the level of water in bilges and ballast tanks;

(d) the signals or lights being exhibited;

(e) the number of crew members required to be on board and the presence of any other persons on board;

(f) the state of firefighting appliances;

(g) any special port regulations;

(h) the master's standing and special orders;

(i) the lines of communication that are available between the ship and the dock staff or port authorities in the event of an emergency arising or assistance being required;

(j) other circumstances of importance to the safety of the ship and protection of the environment from pollution.

9. The relieving officer should satisfy himself that

(a) fastenings of moorings or anchor chain are adequate;

(b) the appropriate signals or lights are properly hoisted and exhibited;

(c) safety measures have been taken and fire protection regulations are being complied with;

(d) he is aware of the nature of any hazardous or dangerous cargo being loaded or discharged and the appropriate action in the event of any spillage or fire;

(e) no external conditions or circumstances imperil the ship and that his own ship does not imperil others.

10. If, at the moment the watch is to be handed over, an important operation is being performed, it should be concluded by the officer being relieved, except when ordered otherwise by the master.

**Keeping a watch**

11. The watchkeeping officer should

(a) make rounds to inspect the ship at appropriate intervals;

(b) pay particular attention to

(i) the condition and fastening of the gangway, anchor chain, or moorings, especially at the turn of the tide or in berths where the water level rises and falls considerably, and, if necessary, take measures to ensure that they are in normal working condition;

(ii) the draft, underkeel clearance, and the state of the ship to avoid dangerous listing and trim during cargo handling or ballasting;

(iii) the state of the weather and sea;

(iv) observance of all regulations concerning safety precautions and fire protection;

(v) water level in bilges and tanks;

(vi) all persons on board and their location, especially those in remote or enclosed spaces;

(vii) the exhibition of any signals or lights;

(c) in bad weather or on receiving a storm warning, take the necessary measures to protect the ship, personnel, and cargo;

(d) take every precaution to prevent pollution of the environment by his own ship;

(e) in an emergency threatening the safety of the ship, raise the alarm, inform the master, take all possible measures to prevent any damage to the ship, and, if necessary, request assistance from the shore authorities or neighboring ships;

(f) be aware of the state of stability so that in the event of fire, the shore firefighting authority may be advised of the approximate quantity of water that can be pumped on board without endangering the ship;

(g) offer assistance to ships or persons in distress;

(h) take necessary precautions to prevent accidents or damage when propellers are to be turned;

(i) enter in the appropriate logbook all important events affecting the ship.

*Questions and comments regarding the STCW should be directed to LCDR George N. Naccara, U.S. Coast Guard (G-MVP-3), Washington, DC 20593; tel. (202) 426-2240.* ⚓

# Engineering Data Base Aids in Selection and Sizing of Anchors

To improve the Navy's and commercial sector's capabilities to understand, design, and install more demanding and complex moorings, the Naval Civil Engineering Laboratory (NCEL), Port Hueneme, California, is developing an engineering data base to take the guesswork out of the selection and sizing of anchors. The Laboratory has completed a comprehensive 4-year program involving more than 200 at-sea tests of a wide variety of Navy and commercial anchors, ranging in size from 1,000 to 20,000 pounds, in various seafloors common to worldwide Navy fleet moorings.

As a result of the at-sea tests, the Navy now has a better understanding of what causes erratic anchor behavior and now knows what should be avoided in specifying anchors and installation procedures for specific applications. This new understanding allows Navy engineers to improve anchor behavior by modifying anchor configuration. The data base resulting from the tests forms the basis upon which anchor-holding capacity prediction schemes can be developed. The data base will enable engineers to select the correct anchor for use at a given site, an anchor which would satisfy the Navy's newly upgraded requirements calling for stronger and more reliable moorings.

The approach taken by NCEL has been to test full-sized anchors in environments typical of fleet moorings. The anchors tested were instrumented. Their response in terms of force at the anchor, drag distance, pitch and roll of the anchor, and depth of embedment into the seafloor were measured during each installation. With this technique, it is possible to observe in detail the anchor's behavior as it penetrates the seafloor. These data provide insight that permits engineers to make simple and quick alterations to anchors. These alterations improve anchor performance, help establish anchor-holding efficiency (the ratio of anchor-holding capacity to anchor weight), and isolate the holding effects of the anchor from those of the anchor chain. The information developed thus far allows the Navy to effectively use anchors already in its inventory, which results in a cost savings to the Navy.

*Reprinted from the* Navy Technology Transfer Fact Sheet, *Vol. 8, No. 7, July 1983* ⚓

# Keynotes

The Coast Guard published the following items of general interest in the Federal Register between October 13, 1983, and November 10, 1983:

**Final rules:**

| | |
|---|---|
| CGD11 95-83 | Establishment of Special Local Regulations for the "Bud Warmington International Grand Prix" (published October 13) |
| CGD3 82-016 | Drawbridge Operation Regulations; Oceanport Creek, New Jersey (October 13) |
| COTP San Frsco Reg. 83-3 | Safety Zone Regulations; San Francisco Bay (October 13) |
| CGD8-83-06 | Safety Zone; Mississippi River Gulf Outlet (October 13) |
| COTP Hmptn Rds Reg. 83-22 | Safety Zone Regulations; James River, Newport News, Virginia (October 14) |
| CGD 76-088b | Tank Vessels Carrying Oil in Bulk; Cargo Monitors; editorial correction (October 17) |
| CGD 83-027 | Towing of Barges; Towing Hawser Length Requirements (October 18) |
| CGD14 83-01 | Drawbridge Operation Regulations; Kalihi Channel, Honolulu Harbor, Hawaii; revocation of final rule (October 20) |
| CGD3 82-020 | Drawbridge Operation Regulations; Passaic River, New Jersey (October 20) |
| COTP Honolulu Reg. 83-4 | Safety Zone Regulations; Lahaine, Maui (October 20) |
| COTP Miami Reg. CGD7 83-11 | Safety Zone Regulations; South Channel, St. Lucie Canal, Mile 28.2, Vicinity of Seaboard System Railroad Swingspan Bridge Near Indiantown, Martin County, Florida (October 20) |
| COTP Jacksonville Reg. 83-10 | Security Zone Regulations; St. Johns River, Jacksonville, Florida (October 20) |
| CGD 82-101 | Shipping Safety Fairway; Adoption of Corps of Engineers' Designation for Port Hueneme, California (October 24) |
| CGD 08-83-03 | Drawbridge Operation Regulations; San Bernard River, Texas (October 27) |
| COTP San Frsco Reg. 83-04 | Safety Zone Regulations; San Franciso Bay (October 27) |
| CGD8-83-06 | Safety Zone; Mississippi River Gulf Outlet (November 3) |
| CGD 79-023 | Subdivision and Stability Regulations (November 4) |
| CGD 83-011 | Interpretative Rule for Inland Navigation Rules; Composite Unit (November 10) |
| CGD3-83-29 | Security Zone; New London Harbor, Connecticut (November 10) |

## Notices of proposed rulemaking (NPRMs):

| | |
|---|---|
| CGD 77-084 | Licensing of Pilots; Manning of Vessels—Pilots; reopening and extension of comment period (October 13) |
| CGD 83-004 | Navigation Safety Regulations (October 14) |
| CGD 82-069a | Casualty Reporting Requirements (October 19) |
| CGD3 83-038 | Drawbridge Operation Regulations; Great Channel, New Jersey (October 20) |
| CGD 83-049 | Requirements for Safety Approval of Cargo Containers (October 24) |
| CGD13 83-12 | Regulated Navigation Area; Puget Sound, Washington; NPRM and notice of public hearing (October 27) |
| CCGD-83-10 | Anchorage Regulations; Lower Mississippi River (November 1) |
| CGD1 83-3R | Enlargement of Special Anchorage Area in Marblehead Channel/Salem Harbor, Massachusetts (November 1) |
| CGD 81-079 | Marine Engineering Regulations for Merchant Vessels; Acceptance of ASME S, E, A, and H Symbol Stamps for Power and Heating Boilers; extension of comment period (November 3) |
| CGD 81-059 | Licensing of Officers and Operators and Registration of Staff Officers; extension of comment period (November 10) |

## Notices:

| | |
|---|---|
| CGD 83-054<br>CGD 83-055<br>CGD 83-056<br>CGD 83-057<br>CGD 83-058 | National Boating Safety Advisory Council; notices of full council and subcommittee meetings (October 13) |
| CGD 83-060 | Coast Guard Academy Advisory Committee; notice of meeting (November 1) |
| CGD 83-061 | Houston/Galveston Navigation Safety Advisory Committee; notice of meeting (November 1) |
| CGD 83-059 | Rules of the Road Advisory Council; notice of meeting (November 3) |
| CGD 83-062 | Registration of House Flag of United States Lines, Inc. (November 10) |

**Requests for copies of NPRMs should be directed to the Marine Safety Council at the following address:**

**Commandant (G-CMC)**
**U.S. Coast Guard**
**Washington, DC 20593**
**Tel.: (202) 426-1477**

**The Marine Safety Council office, Room 4402 at Coast Guard Headquarters, 2100 Second Street, SW, Washington, DC, is open between the hours of 9:00 a.m. and 4:00 p.m. Monday through Friday. Comments are available for inspection or copying during those hours.**

* * *

## Final rules:

### Towing of Barges; Towing Hawser Length Requirements (CGD 83-027)

This final rule, published October 18, 1983, eliminates the towing hawser length requirements for vessels navigating the harbors, rivers, and inland waters of the United States. The equipment, methods, and practices involved in the towing of vessels have changed considerably since the regulation governing towing hawser lengths was originally promulgated. A simple limitation of towing hawser length is no longer appropriate. This rule will allow masters of towing vessels to use their discretion to determine the length of towing hawsers suitable for any situation.

### Subdivision and Stability Regulations (CGD 79-023)

In this final rule, published November 4, 1983, the Coast Guard transferred a rewritten version of the subdivision and stability regulations for merchant vessels to a new Subchapter S consisting of Parts 170, 171, 172, 173, and 174 of Title 46 of the Code of Federal Regulations.

The old regulations on subdivision and stability were scattered in various places throughout Title 46 and Title 33 and included several redundant and poorly stated requirements. By rewriting the regulations and placing them in one subchapter the Coast Guard provides a set of uniform standards that can be more easily understood. This will reduce the time and costs entailed in complying with the various requirements.

The new subchapter also includes requirements that had been previously issued as policy statements or interpretations and had not yet been published in the Code of Federal Regulations.

## Notices of proposed rulemaking (NPRMs):

### Navigation Safety Regulations (CGD 83-004)

This NPRM, published October 14, 1983, is a proposal to revise the Navigation Safety Regulations found in Part 164 of Title 33 of the Code of Federal Regulations. These regulations apply to self-propelled vessels of 1,600 gross register tons or more operating on navigable waters of the United States other than the St. Lawrence Seaway.

This proposal would make the requirements imposed under the Port and Waterways Safety Act consistent with certain international standards. These standards include the operating requirements adopted in a revision to the International Convention for the Safety of Life at Sea, 1974 (SOLAS 74), and requirements for carriage of Automatic Radar Plotting Aids (ARPA), speed and distance indicators, rate-of-turn indicators, RPM indicators, and pitch and mode indicators adopted by the International Maritime Organization in November 1981 as part of the first set of amendments to SOLAS 74. The proposed revision would also modify the requirements for maneuvering tables and data and amplify the regulations pertaining to non-operating equipment.

### Casualty Reporting Requirements (CGD 82-069a)

In a final rule published April 7, 1983, CGD 82-069, the Coast Guard amended the reporting requirements for vessels involved in marine casualties (Title 46 of the Code of Federal Regulations). Under this rule, the costs of salvage, cleaning, gas freeing, and drydocking are no longer to be considered when damage costs are estimated.

Because of an oversight, identical revisions to the casualty reporting requirements in the Outer Continental Shelf Activities and Deepwater Port sections of Title 33 were not included in that rulemaking. The purpose of the new NPRM, CGD 82-069a, published October 19, 1983, is to amend those regulations in the same manner that 82-069 amended Title 46. This NPRM will have a negligible effect on the number of reports submitted.

### Requirements for Safety Approval of Cargo Containers (CGD 83-049)

In this NPRM, published October 24, 1983, the Coast Guard proposes to amend certain requirements in the Safety Approval of Cargo Container regulations. The proposed rules would

- require all gross weight markings on a freight container to be consistent with the gross weight information on the safety approval plate,
- increase the time period between periodic examinations from 24 months to 30 months, and
- allow owners of containers to develop and submit to the Coast Guard for approval a program of continuous examination of their containers as an alternative to the periodic examination currently required.

These changes are being proposed to make the regulations consistent with amendments to the International Convention for Safe Containers and give owners flexibility in the examination of their containers.

### Licensing Structure (CGD 81-059)

On August 8, 1983, the Coast Guard published a notice proposing to amend the regulations concerning the licensing of officers and operators and registration of staff officers. The comment period was to extend until December 6. A notice published November 10, 1983, extends this comment period to March 5, 1984.

Readers with questions about the proposal should refer to the February issue of the *Proceedings*, where it was described in detail, or contact Commandant (G-MVP), U.S. Coast Guard, Washington, DC 20593; tel.: (202) 426-2240, requesting a reprint of the Federal Register section in which it appeared.

## Actions of the Marine Safety Council

*The Marine Safety Council did not meet during the month of November.* ⚓

## Semi-annual agenda available

On October 17, 1983, the Department of Transportation published in the Federal Register its Department Regulations Agenda; Semi-Annual Summary. The agenda summarizes all current and projected rulemakings, reviews of existing regulations, and completed actions of the Department. These are matters on which action has begun, is projected to begin during the 12 months following publication of the agenda (or such longer period as may be anticipated), or has been completed since publication of the last agenda.

Each entry in the agenda includes the following information: 1) a short descriptive title, 2) a summary, and 3) a timetable of anticipated action. The summary includes such things as an abstract of the proposed or final regulation or review, the related regulatory citation in the Code of Federal Regulations, and the name of the office or official serving as a contact on the matter.

Copies of the semi-annual agenda are available from Commandant (G-CMC), U.S. Coast Guard, Washington, DC 20593. ⚓

# Hot Work

*The importance of strict adherence to recognized safety precautions on tankers cannot be stressed too much. Failure to follow recommended practices can easily turn a tanker into a "floating bomb."*

So many unsafe conditions existed prior to the explosion and fire that destroyed the GOLDEN DOLPHIN that the Coast Guard Marine Board of Investigation had difficulty determining the precise ignition sequence. Little doubt, however, exists as to the cause of this casualty, which cost nine crewmen their lives: hot work was being conducted in an environment that had not been properly rendered gas-free.

The GOLDEN DOLPHIN, built in 1974, was a 44,881-gross-ton SAN CLEMENTE-class tanker. It had six tank sections, each divided into center and wing tanks. The house was aft, and the pumproom was immediately forward of the engine room. During October, November, and December of 1981, the vessel was in a shipyard for repairs, installation of an Inert Gas System (IGS) and a Crude Oil Washing (COW) system, and Coast Guard inspection. One part of the ship that had to be repaired was the system of steam heating coils in the cargo tanks—382 leaks had been discovered in the coils during hydrostatic tests.

On the first voyage after the shipyard period, the steam heating system was energized, and a section of the 6-inch deck steam-supply line was found to be leaking and beyond repair. The most deteriorated section was located over cargo tanks 2, 3, and 4 center. Materials were ordered, and repairs were to be made while the vessel was underway. By the time the materials were delivered, the ship had carried cargo. An unusual amount of sludge remained in the tanks, about 10,000 barrels, compared to the normal 300 barrels. The sludge had to be consolidated, and, as it worked out, this consolidating was done at the same time the repairs were made to the steam line.

On March 1, 1982, the crew inerted tanks 1 and 2 port and starboard and washed them with unheated sea water, using the COW system. This effort was ineffective and left 10 to 11 inches of sludge in the tanks. The slops were put into tank 5 center.

On March 3, tanks 1, 2, 3, and 4 center were butterworthed and ventilated; the slops from these tanks were also put into tank 5 center.

On the morning of March 4, the chief mate entered tanks 3 and 4 center (without benefit of standby personnel or emergency equipment, it should be noted). Although he spent 45 minutes inspecting tank 4, he did not check it with a combustible gas indicator to see that it was gas-free. As for tank 3, he descended to the platform at the halfway level, determined that the tank had sludge remaining, and ordered a 2½- to 3-foot blanket of water placed over the sludge to retard the production of hydrocarbon gases. While the water blanket was being pumped in, the chief mate tested the tank with a combustible gas indicator held the length of his arm into the butterworth opening. Although there was no sampling hose attached to the indicator, he took the results to indicate that the tank was gas-free. He did not do any tests on tanks 1, 2, and 4 center but judged them on the basis of his experience to be gas-free. At the time of his determinations, the steam coils and lines had not been water flushed, tested for gases, or isolated. The positions of the valves on those lines were unknown.

The chief mate ensured that all butterworth openings had covers in place and that the covers were flush with their gaskets. He instructed the boatswain to put two nuts on the butterworth covers on tank 3 center only.

The master gave permission to start hot work on the basis of the chief mate's report that tanks 1 through 4 were gas-free (he had seen the chief mate exiting from one of the tanks and assumed he had checked them all with a combustible gas indicator), the relative wind (ship's speed plus wind speed) across the deck of about 38 knots (this, he thought, would disperse any flammable vapors), the plan discussed with him for creating a safety island around the hot work during repairs, and his visual examination of the vessel.

No logbook entries were made regarding the butterworthing, determinations that the tanks were gas-free, or the safety inspection required prior to the beginning of hot work. No firefighting precautions were taken. The master did not order any of the tanks to be inerted, because the deck crew was going to enter tanks 2 and 4 center to muck them out and he felt uncomfortable about people working in a tank adjacent to an inerted one. Even though he had attended a 5-day course on IGS and COW, he later testified, neither he nor the ship's officers were very familiar with the systems.

The crew began the job (scheduled to be completed March 6) of repairing the leaky deck steam-supply line. It used flame cutting to remove about 140 feet of pipe which ran over the tops of tanks 2, 3, and 4 center. The crew disassembled the flanged joints at the ends and at the connections to the manifolds for the coils. It did not, however, blank off the flanges on the open ends of the steam line and the heating coil manifolds. To begin installing the new pipe, the crew had to weld a jig to the deck for use in welding flanges to the new pipe sections.

The master estimated that at this time tanks 1 through 4 center contained 9 to 12 inches of sludge each and wing tanks 1 and 2 contained 8 to 9 inches of sludge each. The plan for cleaning the tanks was to place about two feet of water over the sludge and use the repaired steam heating system to heat the sludge and water to the pour point of the sludge. The tanks would then be stripped and the slops placed in tank 5 center. In addition, tanks 2 and 4 center would have to be mucked out so that they could take on clean ballast.

On March 6, although repairs on the steam-supply line had not been completed, crew members opened tank 4 center to start mucking. An ordinary seaman testified later that he and others smelled gas. A coppus blower was used to ventilate the tank for three hours before the cleaning crew entered to work. No combustible gas indicator was used before the crew entered the tank (as was the case with the chief mate's tank entry two days earlier, no emergency equipment was broken out and placed near the tank, either). The chief mate testified that the atmosphere in the tank following ventilation was very fresh and that the ordinary seaman who said he smelled gas earlier said that he could smell no gas at this time.

The air temperature that afternoon was probably above 69 degrees. In other words, it was warm enough for vapors to be forming quite rapidly from the sludge.

In the middle of the afternoon, welding or flame cutting on the last section of the new steam line ignited flammable gases. The resulting explosions blew large sections of the deck wide open and blew a hole in the side of the ship. The evidence can support more than one scenario, but the most likely sequence of events is this: Flammable gas in tank 2 starboard entered the heating coils through a leak and spread through the steam line to the location of the hot work. The gas ignited, and a flame front propagated back into tank 2 starboard, which exploded. Flames from tank 2 starboard then propagated through the inert gas system pipeline (this had not been isolated) into tank 3 center, which exploded moments later and set off an intense fire.

The men working on the steam pipe and in tank 4 center were never seen again. The ordinary seaman who was operating the mucking winch over tank 4 center was blown 40 feet aft by the first explosion. He was in midair during the second explosion. When he recovered, he found himself sitting on the deck. He looked forward and saw a cargo tank transverse swash bulkhead standing straight up in front of him. This shielded him from the fire forward. He saw no other crewmen around him, and he made his way aft past or over three more swash bulkheads to safety.

As the crew attempted to respond to the emergency, some additional problems came to light. There was no firefighting equipment laid out on deck. When the fire pumps were put on line, the deck foam monitor over the pump room was not operating at full pressure, and the stream of foam coming from it would reach no farther than 20 feet. No one closed the deck isolation valve on the fire main. The chief mate did not even know that one was located in the foam room. Both radio antennas had been blown down, and the satellite communications unit was also inoperative. Fortunately, the M/V NORRLAND, a Swedish ship, was about 32 miles away and received a "Mayday" on channel 16 VHF-FM. The M/V NOVA GORICA, a Yugoslavian bulk carrier, also answered the "Mayday."

Realizing that 9 members of the crew were lost and that a number of the 16 surviving crew members were not physically capable of fighting the fire, the master gave orders to abandon ship. The number 1 and 2 lifeboats were lowered to the embarkation deck and prepared for launching. The second mate was put in charge of the number 1 lifeboat, and the steward's department and all crew members with ailments (heart conditions, obesity) were put into the boat. The boat was launched carrying one of the ship's walkie-talkies and directed to lay off the stern to pick up survivors in case the ship blew up. The chief mate and an A.B. went to the stern to launch the 15-man liferaft, but, even though both were young and strong, they could not lift it over the 40-inch-high railing. They opened the container, tied the painter to the rail, draped the raft over the side, and pulled the painter to inflate it. The raft inflated upside down. Fortunately, the rest of the crew members could fit in the second lifeboat.

A third explosion occurred at this time. Even though this was a small one, the master feared the worst and ordered the rest of the crew members to abandon ship. They made one final contact with the M/V NORRLAND, restated their position, and reported that the number 1 lifeboat was away, number 2 would be away soon, and they would use the walkie-talkies on channel 16 to communicate. A final check of the deckhouse and engine spaces was made to assure that nobody was left behind. The port boiler, fire pump, steam turbine generator, and diesel generator were left on line. Important papers were collected. The number 2 lifeboat was launched into 16-foot swells with 3-to 5-foot seas on top.

Within hours, the M/V NORRLAND was on scene and rescued the 16 survivors. The NOVA GORICA also arrived and helped in an unsuccessful search for additional survivors.

The loss of the GOLDEN DOLPHIN and nine of its crewmen was an unnecessary one. The steam cargo heating system should have been properly tested and repaired in the shipyard. Performing repairs requiring hot work on a tankship that is not gas-free is a risky business. If it should appear to be unavoidable, the procedures followed have to be absolutely correct. In this case, the investigators noted multiple violations of federal regulations and of accepted industry practice as described in the *International Safety Guide for Oil Tankers and Terminals.*

The U.S. Coast Guard, in Section 35.01-1 of Title 46 of the Code of Federal Regulations, requires that NFPA (National Fire Prevention Association) publication 306, *Standard for the Control of Gas Hazards on Vessels,* be used as a guide for determining whether repairs involving welding or burning can be safely undertaken. *The International Safety Guide for Oil Tankers and Terminals* also contains excellent guidance concerning safety precautions to be taken before hot work is performed or personnel are permitted to enter enclosed spaces. Several of these recommended practices were not followed by the crew of the GOLDEN DOLPHIN. They were noted in the report of the Marine Board of Investigation and reiterated for emphasis in the Commandant's Action approving and commenting on that report. They can be summarized as follows:

## Deviations from Recommended Industry Practices

- The cargo tank heating coils and the on-deck steam-supply line were never flushed with water or steam, blanked off, or checked to see that they were gas-free.

- The procedures used to test cargo tanks 1, 2, and 4 center to see whether they were gas-free were improper in that the tank atmospheres were not tested with an approved combustible gas indicator. While the chief mate did reach into cargo tank 3 center with a combustible gas indicator, he did not follow the recommended practice of testing the tank atmosphere at the bottom and at several depths through several tank openings.

- The cargo tanks were not checked after the chief mate's determinations of March 4, 1982, to see whether they were being maintained in a gas-free state. When gas was smelled following the opening of tank 4 center on March 6, 1982, the tank was simply ventilated. Neither a combustible gas indicator nor an oxygen analyzer was used to evaluate the tank.

- Welding of brackets was permitted on a cargo tank without anyone's ensuring that all pipelines to the tank being worked on had been isolated and that all adjacent tanks had been rendered safe by gas freeing, inerting, or filling with water.

- Butterworth covers were improperly secured in the area in which hot work was being conducted.

- No provisions were made to prevent the entry of flammable or inert gases into a cargo tank in which men were working. This could have been done by blanking off the on-deck steam line and closing off the valves in the inert gas main.

- Satisfactory precautions were not taken to ensure that the environment in the cargo tanks that were entered was safe for personnel. These precautions include isolating all pipelines to tanks which have been inerted or contain flammable gas mixtures, testing the atmosphere with a combustible gas indicator and an oxygen analyzer, having a responsible member of the crew standing by the hatch opening, and having emergency equipment broken out and available for immediate use. ‡

# Safe Gangways

Ensuring that the gangway is safe is the first step in providing a safe workplace for ship's personnel as well as other workers who must board the vessel. A gangway is considered safe if it meets at least the following conditions:

1. It has a step tread width of at least 20 inches.

2. It has a railing on both sides and around the turntable of at least 30 inches in vertical height with a mid-rail.

3. Rope, chain, or wire railings are kept taut at all times.

4. Removable rail stanchions are supported or secured to prevent accidental dislodgment.

5. It is rigged with a safety net when the lower platform overhangs the water between the vessel and stringpiece.

6. The support bridles are rigged clear so as not to obstruct passage.

7. A duckboard is rigged when a fixed-tread ladder is used and the angle is low.

8. A bridge piece is rigged with appropriate railing if the bottom of the gangway is more than one foot away from the edge of the stringpiece.

9. It has adequate lighting during darkness.

All gangways must be inspected frequently to ensure proper trim, security, use, and overall condition.

*A safe gangway will never let you down.*

The points enumerated here are contained in a Safety and Health Information Sheet issued by the National Safety Council, Marine Section. While the information is believed to represent the best current opinion on the subject, readers should not assume that the sheet covers all acceptable safety measures or that other or additional measures would not be required under particular or exceptional conditions or circumstances.

# Chemical of the Month

## Hydrogen Sulfide: $H_2S$

| | |
|---|---|
| Synonyms: | sulfuretted hydrogen<br>hydrosulfuric acid<br>stinkdamp |

**Physical Properties**

| | |
|---|---|
| boiling point: | -60°C (-76°F) |
| freezing point: | -82°C (-116°F) |
| vapor pressure at | |
| 20°C (68°F): | 19 atm |
| 25°C (77°F): | 20 atm |

**Threshold Limit Values (TLV)**

| | |
|---|---|
| Time Weighted Average: | 10 ppm; 14 mg/m3 |
| Short Term Exposure Limit: | 15 ppm; 21 mg/m3 |

**Flammability Limits in Air**

| | |
|---|---|
| lower flammability limit: | 4.3% by vol. |
| upper flammability limit: | 46% by vol. |

**Combustion Properties**

| | |
|---|---|
| flash point: | Not listed, since the chemical is a gas |
| autoignition temperature: | 260°C (500°F) |

**Densities**

| | |
|---|---|
| liquid (water = 1.0): | 1.54 |
| vapor (air = 1.0): | 1.19 |

**Identifiers**

| | |
|---|---|
| U.N. Number: | 1053 |
| CHRIS Code: | HDS |

"Sour" is the name given to crude oil which contains a high concentration of this issue's Chemical of the Month, hydrogen sulfide. "Smelly" might be more appropriate. Hydrogen sulfide is a colorless, flammable gas with an offensive odor reminiscent of rotten eggs. It has not always gotten the best press—early accounts tell of deaths from hydrogen sulfide in sewer gas (Paris and London) and the gas formed in an outhouse (the United States). Miners dubbed the chemical "stinkdamp."

The concentrations of hydrogen sulfide released into the air by sour crude can be lethal. During one topping off operation, for example, the sour crude oil going into a tank had a hydrogen sulfide concentration of only 70 ppm (parts per million); the vapor stream coming out of an ullage opening in the tank measured a deadly 7,000 ppm. Personnel would thus be well advised to stand upwind of such an operation. The table accompanying this article shows different types of crude and their hydrogen sulfide content (values are for ppm by weight in the liquid).

A second possible source of exposure for mariners is molten sulfur. Hydrogen sulfide is released during the loading, carriage, and discharge of molten sulfur. This is more of a problem with "dark" sulfur than "bright," since the "dark" sulfur comes from deposits near petroleum deposits and has a higher hydrogen sulfide content. *(For more information on sulfur, see Chemical of the Month, September/October 1981).*

Hydrogen sulfide has a density of 1.19 on a scale where air = 1, meaning that it can be found at the bottom of confined spaces or cargo

| Crude | Hydrogen sulfide |
|---|---|
| Arabian | 20 - 60 |
| Agha Jari | 20 |
| Jambur/Bai Hassan | 40 |
| Kirkuk | 40 - 70 |
| Gach Saran | 70 |
| Brega | 260 |
| Qatar | 200 -300 |
| West Texas | Up to 1,000 |
| Murban | Below 70 |

tanks. Mariners entering such areas should thus be on guard against walking into a pocket of hydrogen sulfide.

While the human nose can detect the scent of hydrogen sulfide at concentrations as low as 1 ppm or less, the nose is not always a reliable guide. The odor of hydrogen sulfide is deceptively sweet in the 30 - 100 ppm range, and hydrogen sulfide at higher concentrations will deaden the sense of smell. As a person breathes, the strong odor of hydrogen sulfide seems to disappear.

The primary hazard of hydrogen sulfide is its toxicity. Death is apparently instantaneous if concentrations in the range of 1,000 - 2,000 ppm are breathed. Respiratory paralysis with consequent asphyxia will result from exposure to concentrations of 700 to 900 ppm. Over time, concentrations in the range of 10 to 50 ppm may cause headache, fatigue, cough, burning or watery eyes (conjunctivitis), gastrointestinal upset, dizziness, and insomnia. Eye irritation has been reported from exposure to concentrations below the 10 ppm approved by the American Conference of Governmental Industrial Hygienists as a time-weighted average (i.e., the maximum exposure level, averaged over the eight-hour workday, thought safe for workers with a traditional work schedule).

Personnel may continue working in the presence of low concentrations (10 ppm) of hydrogen sulfide for several hours or even days before experiencing irritation or discomfort. Symptoms of eye irritation (a "scratchy" feeling accompanied by burning and tearing) generally start after several hours of exposure and may not appear until after the workday is over. Repeated exposure to hydrogen sulfide results in increased susceptibility, so that a concentration previously tolerated without any effects results in eye irritation and a cough.

In the event of an emergency, the following first-aid measures should be taken:

Eye exposure - If liquid hydrogen sulfide gets into the eyes, they should be washed immediately with large amounts of water, the lower and upper lids being lifted occasionally. If the eyes feel irritated after the washing, medical attention should be sought. People with contact lenses should not wear them while working with this chemical.

Skin exposure - If liquid hydrogen sulfide gets on the skin, the contaminated area should be immediately flushed with water. If the substance penetrates the clothing, the clothing should be removed immediately and the affected skin area flushed with water. If the skin feels irritated after the washing, medical attention should be sought.

Breathing - If a person breathes in large amounts of hydrogen sulfide, he should be moved to fresh air at once. If breathing has stopped, artificial respiration should be performed. The victim should be kept warm and at rest. Medical attention should be gotten as soon as possible.

Rescue - If an exposed person has been overcome, the rescuer should notify someone else and put into effect the established emergency rescue procedures. Breathing hydrogen sulfide can impede a person's ability to reason. Rescuers must take care not to become casualties themselves. All mariners should understand the emergency rescue procedures and know the location of rescue equipment before the need for it arises.

Hydrogen sulfide is not carried in bulk on board tank vessels. It is carried in packages (gas cylinders). The U.S. Department of Transportation regulates hydrogen sulfide as a flammable gas and requires it to have both a flammable gas and a poison label. The International Maritime Organization assigns it to Hazard Class 2.1. The International Maritime Dangerous Goods (IMDG) Code (page 2078) requires that hydrogen sulfide be accompanied by both inflammable gas and poison gas labels.

**Cargo and Hazards Branch**
**Marine Technical and**
**Hazardous Materials Division**

*The assistance of the U.S. Department of Health and Human Services, the U.S. Department of Labor, and industrial hygienist LT Rex J. Prosser in the writing of this article is gratefully acknowledged.*

# Nautical Queries

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

DECK

1. The "dip" correction for a sextant is to correct for

A. height of eye.
B. parallax.
C. index error.
D. refraction.

REFERENCE: Bowditch, Vol. I, 1977

2. A whistle signal of one prolonged, one short, one prolonged, and one short blast is sounded by a vessel

A. at anchor.
B. towing a submerged object.
C. being overtaken.
D. in distress.

REFERENCE: COMDINST M16672.2, Rule 34 (c) (ii)

3. Which of the following entries is NOT required to be made in the vessel's official logbook?

A. Inspections of cargo gear equipment
B. Operation of electric power-operated lifeboat winches
C. Drafts prior to the vessel's leaving port on a coastwise voyage
D. Inspections of oil transfer equipment

REFERENCE: 46 CFR 35.07-10

4. Hygroscopic cargoes should be ventilated when

A. the dew point of the outside air is greater than the dew point of the air in the hold.
B. a vessel is going from a warm to a cold climate.
C. the dew point of the air in the hold is very low.
D. the outside dew point is $60^{\circ}$ and the cargo temperature is $54^{\circ}$.

REFERENCE: Sauerbier, Marine Cargo Operations

5. If a portable fire extinguisher is classified as a "B-II," the letter "B" indicates

A. the internal volume of the extinguisher.
B. the specific type of extinguishing agent inside.
C. that the extinguisher is designated as "hand portable."
D. the type of fire the extinguisher is effective in fighting.

REFERENCE: Marad, Fire Prevention, Firefighting and Fire Safety Manual

ENGINEER

1. Coast Guard regulations stipulate that a report be made by the chief engineer to the Officer in Charge, Marine Inspection, immediately (or, if a vessel is at sea, immediately upon arrival in port) should a boiler, unfired pressure vessel, or machinery

I. suffer an accident which renders the item unsafe for use.
II. became unsafe through ordinary wear.

A. I only
B. II only
C. Either I or II
D. Neither I nor II

REFERENCE: 46 CFR 97.30-5

2. Calcium minerals in boiler water are precipitated by which of the following chemicals?

A. Sodium phosphate
B. Sodium hydroxide
C. Phenolphthalein
D. Caustic soda

REFERENCE: Latham, Introduction to Marine Engineering

3. The location of a vessel's frame stations may be obtained from which drawing?

A. Profile
B. Base line
C. Cross section
D. Buttock

REFERENCE: Baker, Introduction to Steel Shipbuilding

4. What device is used for reduced-voltage starting of AC motors?

I. An instrument transformer
II. An autotransformer

A. I only
B. II only
C. Either I or II
D. Neither I nor II

REFERENCE: Hubert, Preventive Maintenance of Electrical Equipment, 2nd Edition

5. If the manufacturer advises that the lube oil consumption of a 4,000-horsepower diesel engine is .0001 gal/Hp-hr, how much oil would the engine be expected to burn in one day if operated at full load?

A. 6.4 gallons
B. 9.6 gallons
C. 11.4 gallons
D. 14.4 gallons

REFERENCE: Any basic math book

ANSWERS

DECK
1.A;2.C;3.D;4.B;5.D
ENGINEER
1.C;2.A;3.A;4.B;5.B

**If you have any questions about the Nautical Queries, please contact Commanding Officer, U.S. Coast Guard Institute (mvp), P.O. Substation 18, Oklahoma City, Oklahoma 73169; tel.: (405) 686-4417.**

# Maritime Licensing, Certification, and Training

When the Regional Examination Center (REC) system was introduced in July 1982, the number of Coast Guard offices performing the licensing and certification function was reduced from 49 to 17 to cut costs and increase effectiveness. Since then, many suggestions for reducing office crowding and increasing public service have been considered. One suggested method was simple and cost-effective and could be implemented without further ado: expanding the opportunities for renewal by mail.

For many years, it was virtually impossible for a mariner to renew a license through the mail unless vessel movement prevented him or her from appearing at one of the licensing offices. Now almost every mariner has this option.

By renewing their licenses through the mail, mariners not only save themselves a trip to the REC and the time they would spend waiting for the transaction to take place, they also help the Coast Guard by freeing personnel to help applicants who can conduct their business only over the counter.

Licenses can be renewed through the mail as early as 90 days before they expire. Renewal must be done by the office that issued the license; if this office has closed, the mariner should contact the REC closest to the closed office.

Mariners wishing to renew their licenses through the mail should apply to the appropriate REC and include the following:

- a letter of transmittal stating that to the best of their knowledge no physical incapacity exists;

- a properly executed application on Coast Guard form CG-866 (rev. 6-82), License and Renewal Application;

- the license to be renewed or, if a mariner wants to continue working pending receipt of the new license, a photocopy;

- a valid first- or second-class radiotelegraph operator's license issued by the FCC or a photocopy (this applies to radio officers only);

- certification from a reputable physician that color sense is normal along with a statement of what type of test was used to establish this (deck officers only);

- documentary evidence of service under the authority of the license in the three years prior to application for renewal (deck officers only) (An example of this would be a certificate of discharge or a letter from the employer on company letterhead);

- a completed Rules of the Road open-book exercise (deck officers only); and

- a certificate of completion from an appropriate Coast Guard-approved Radar Observer course (deck officers who desire to receive or extend radar observer endorsement only).

Interested mariners should call the REC prior to the date they desire to renew by mail to have it forward the necessary form and Rules of the Road exercise. A complete listing of the U.S. Coast Guard Regional Examination Centers follows. The centers can answer any specific questions anyone might have regarding the renewal-by-mail program.

**Alaska**

U.S. Coast Guard, Marine Safety Office (REC), 701 C Street, Box 17, Anchorage, Alaska 99513; tel.: (907) 271-5137

U.S. Coast Guard, Marine Safety Office (REC), 612 Willoughby Avenue, Juneau, Alaska 99801; tel.: (907) 586-7325

**California**

U.S. Coast Guard, Marine Safety Office (REC), Building 14, Room 109, Government Island, Alameda, California 94501; tel.: (415) 437-3094

U.S. Coast Guard, Marine Safety Office (REC), 165 N. Pico Avenue, Long Beach, California 90802; tel.: (213) 590-2383

**Florida**

U.S. Coast Guard, Marine Safety Office (REC), 8120 NW 53rd Street, Miami, Florida 33166; tel.: (305) 594-4305 or 594-4220

**Hawaii**

U.S. Coast Guard, Marine Safety Office (REC), Room 1, 433 Ala Moana Boulevard, Honolulu, Hawaii 96813; tel.: (808) 546-7318

**Louisiana**

U.S. Coast Guard, Marine Inspection Office (REC), F. Edward Hebert Building, 600 South Street, New Orleans, Louisiana 70130; tel.: (504) 589-6183

**Maryland**

U.S. Coast Guard, Marine Safety Office (REC), U.S. Customhouse, Baltimore, Maryland 21202; tel.: (301) 962-5134/5

**Massachusetts**

U.S. Coast Guard, Marine Safety Office (REC), 447 Commercial Street, Boston, Massachusetts; 02114; tel.: (617) 523-0139/40

**Missouri**

U.S. Coast Guard, Marine Safety Office (REC), 210 N. Tucker Boulevard, Room 1128, St. Louis, Missouri 63101; tel.: (314) 425-4657

**New York**

U.S. Coast Guard, Marine Inspection Office (REC), Battery Park Building, New York, New York 10004; tel.: (212) 668-7864, 668-7492, 668-6395

**Ohio**

U.S. Coast Guard, Marine Safety Office (REC), Room 501, Federal Building, 234 Summit Street, Toledo, Ohio 43604; tel.: (419) 259-6394

**Oregon**

U.S. Coast Guard, Marine Safety Office, 6767 N. Basin Avenue, Portland, Oregon 97217; tel.: (503) 240-9346

**South Carolina**

U.S. Coast Guard, Marine Safety Office (REC), 196 Tradd Street, P.O. Box 724, Charleston, South Carolina 29402; tel.: (803) 724-4394

**Tennessee**

U.S. Coast Guard, Marine Safety Office (REC), 100 N. Main Street, Suite 1134, Memphis, Tennessee 38103; tel.: (901) 521-3297/8

**Texas**

U.S. Coast Guard, Marine Inspection Office (REC), 7300 Wingate Street, Houston, Texas 77011; tel.: (713) 229-3559

**Washington**

U.S. Coast Guard, Marine Safety Office (REC), 1519 Alaskan Way S., Building 1, Seattle, Washington 98134; tel.: (206) 442-4923 ‡



U.S. GOVERNMENT PRINTING OFFICE : 1984 O - 428-796 : QL 3