# Proceedings

of the Marine Safety Council

U.S. Department
of Transportation
United States
Coast Guard

Vol. 40, No. 1 January 1983 CG-129

# Proceedings
of the Marine Safety Council

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. 116)
A: aede(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

*Search and Rescue has long been one of the Coast Guard's primary missions. Increasingly sophisticated planning enables the Coast Guard to tailor the Search to the specific incident and make the Rescue more likely. "The Coast Guard and the Needles in the Haystack," beginning on page 8, explains all of the factors that go into figuring out Probability of Detection. Cover photo from an oil painting by Jay Scott Pike, a volunteer artist for the Coast Guard Art Program*

# Letters to the Editor

I write concerning the Letter from the Editor in the November 1982 *Proceedings* noting a certain confusion over the use of the word "inflammable" (which is synonymous with "flammable").

I believe the use of "inflammable" is with us today because it appears in the regulations annexed to the International Convention for the Safety of Life at Sea (SOLAS), 1960.

The SOLAS convention was revised and republished as SOLAS, 1974. "Inflammable" was still used but now with a footnote to indicate that "inflammable" had the same meaning as "flammable."

The Coast Guard and the U.S. Department of Transportation use "flammable" in their respective regulations, Titles 46 and 49 of the Code of Federal Regulations (why the Coast Guard Institute uses "inflammable," I don't know). However, the United Nations in its recommendations on the *Transport of Dangerous Goods* (the "Orange Book") uses the term "inflammable." This publication is concerned with the safe transportation of packaged hazardous materials. The work of the UN is used as guidance by the International Maritime Organization, which publishes the International Maritime Dangerous Goods (IMDG) Code. The IMDG Code also uses "inflammable" and has been widely adopted throughout the world as national regulations. Therefore, it appears "inflammable" was born of SOLAS, was nurtured by the UN, finds its strength in the IMDG Code, and will be with us so long as it appears in the IMDG Code.

The good news is that the United States is attempting to amend the international recommendations / regulations to substitute "flammable" for "inflammable," and the prospects for success are good.

Incidentally, one party, when presented with this situation, noted that "inflammable" is a perfectly good word and said we should just get rid of the people who don't know what it means.

LT D. A. Kremer
Cargo and Hazards Branch
U.S. Coast Guard

I am in complete agreement with your entire argument in regard to the word "inflammable" that appeared in the *Proceedings*, November 1982, p. 287.

I am pleased to see that current Coast Guard regulatory language uses the "flammable"/"nonflammable" word pairing.

In all of our publications we have consistently avoided any use of the word "inflammable" except to explain how it was used in the past.

I believe that it would be in everyone's best interest if the Coast Guard Institute also got the message and removed it from its examinations.

In this regard, I tried, without success, to have the Institute remove "points" from its Rules of the Road examinations earlier in the year.

I feel as strongly in favor of your statement "Perhaps safety would be better served if we dropped the word 'inflammable' from the English language" as I do about getting rid of the now superfluous term "points."

Richard A. Block
Marine Education Consultant
Marine Education Textbooks

RE: your letter on page 287 of the November *Proceedings*

In the mid-1960s the Coast Guard made formal (FEDERAL REGISTER) policy that "flammable" would be future terminology (46 CFR 30.10-22). To accommodate the fact that regulations in effect used "inflammable," 46 CFR 30.10-21 was introduced.

By definition, "combustible" stipulates "flash points," not vapor generation.

Incidentally, as regards the Rules of the Road note: by tradition seamen have "boxed the compass" by "points"—an arc of $11\frac{1}{4}^{\circ}$. Lawyers and other non-seafarers prefer degrees: thus two points = $22\frac{1}{2}^{\circ}$. The Rules tend to reflect this trend.

Paul M. Hammer
Director of Marine Affairs
American Institute of Merchant Shipping

RE: The flammable-inflammable flap

With all due respect to Mr. Hatton, who pointed out the preference of the majority for using "flammable" versus "inflammable," I cannot resist making the observation that inflamed loves, inflamed tempers, and inflammation in general when we discuss such ana-

tomical things as tissue, joints, tendons, muscles, etc., etc., all allude to an elevation of temperature.

So, while I, like Mr. Hatton would prefer to stay with "flammable" when talking about a tendency to burn, smolder, or break into flames, as the case may be, I don't think the public is being flimflammed whenever "inflammable" is used. The Coast Guard's use of "nonflammable" is a wise alternative. After all, we do say "nonflappable" rather than "inflappable"—or do we? Perhaps it's all just a case of flummery.

Harold D. Muth
Executive Vice President
American Waterways
Operators

# Maritime Sidelights

### Publishing of Personnel Statistics Delayed

Merchant Marine Personnel Statistics (licenses, documents, certificates of registry, and endorsements issued) have traditionally been published in the January issue of the *Proceedings*. These statistics have until now been computed on a fiscal year basis (October 1 to September 30). Starting with this year's statistics, they will be figured on a calendar year basis. The statistics are therefore scheduled for publication in the April issue.

### New Guide for Boaters Available

The Coast Guard's Office of Boating, Public, and Consumer Affairs has just released a new pamphlet, "Federal Requirements for Recreational Boats."

Among the subjects covered in the pamphlet are numbering requirements, law enforcement, Coast Guard-approved equipment, required lights, boating accident reports, water pollution and the recreational boater, and visual distress signals. Also included are helpful hints on such subjects as loading a boat, fuel management, and housekeeping, a metric conversion table, and a float plan to be filled out and left with a reliable person.

Copies of the pamphlet are available from local Coast Guard Auxiliary units or from Commandant (G-BPA), U.S. Coast Guard, Washington, DC 20593.

### Federal Approach to Coastal Issues Explored

*The Newest Federalism: A New Framework for Coastal Issues* is the name of the proceedings of the sixth annual conference of the University of Rhode Island's Center for Ocean Management Studies. This 300-page volume focuses on the impact of changes in Federal policy on the nation's shorelines, offshore regions, and inshore coastal areas in the 1980s as the Federal government returns powers and dollars to state and local governments.

Representatives of the public, private, and quasi-public sectors discuss the new or potential realities for coastal states, regions, and communities. The book also examines such key coastal issues as offshore oil and gas development, alternative funding sources for coastal and marine policy management, and the future status of environmental legislation.

The price of the volume is $19.95. Postage and handling charges are as follows:

United States: $1.50 for one copy; $.50 for each additional copy;
All other countries: $2.00 for one copy; $.50 for each additional copy.

Orders should be sent to the Center for Ocean Management Studies, University of Rhode Island, 19 Upper College Road, Kingston, Rhode Island 02881.

### TSAC Meeting Scheduled

The next meeting of the Towing Safety Advisory Committee (TSAC) is scheduled for February 9 - 10, 1983, in Room 3201 of U.S. Coast Guard Headquarters, 2100 Second St. SW, Washington, DC 20593. The meeting will be held from 9 a.m. to 4 p.m. each day. It is open to the public, and oral or written statements may be presented to the committee. For further information write Executive Secretary, Towing Safety Advisory Committee, (G-CMC/44) at the address listed above or phone (202) 426-1477. The agenda for the meeting will be published in the FEDERAL REGISTER in early January. ‡

The following items of general interest were published in the FEDERAL REGISTER between October 21, 1982, and November 18, 1982:

**Final rules:** CGD 07-82-10 Security Zone, Vicinity of Kennedy Space Center, Florida, October 21, 1982. CGD 82-080 First/Third District Boundary Readjustments, October 28, 1982. CGD 11-82-07 Safety Zone in Vicinity of National Steel and Shipbuilding Company Slipway Three, San Diego, California, October 28, 1982. CGD 82-086 Safety Approval of Cargo Containers, November 8, 1982. CGD 82-074 Applications for Processing Bridge Permits, November 18, 1982.

**Advance notice of proposed rulemaking (ANPRM):** CGD 82-103 Change in Interpretation of Section 2 of the Shipping Act of 1916 as Amended for Coastwise Trading Purposes, November 4, 1982.

**Notices of proposed rulemaking (NPRMs):** CGD 08-82-13 Anchorage Regulations, Lower Mississippi River, October 28, 1982. CGD 81-051 Charges for Coast Guard Aids to Navigation Work, October 28, 1982. CGD 80-009 Correction of Miscellaneous Disparities in 46 CFR Subchapter D, Tank Vessels, November 8, 1982. CGD 03-82-015 Drawbridge Operation Regulations, Hackensack River, New Jersey, November 12, 1982. CGD 03-82-20 Drawbridge Operation Regulations, Passaic River, New Jersey, November 12, 1982. CGD 82-100(a) Compatibility of Cargoes, November 12, 1982. CGD 13-82-11 Drawbridge Operation Regulations, Hoquiam and Wishkah Rivers, Washington, November 18, 1982. CGD 13-82-12 Drawbridge Operation Regulations, Youngs Bay, Lewis and Clark River, and Skipanon River, Oregon, November 18, 1982.

**Notices:** CGD 81-092 Electrical and Fuel System Standards, Correction to NPRM, October 28, 1982. CGD 82-104 Quarterly List of Safety/Security Zones, November 8, 1982.

Questions concerning regulatory dockets should be directed to Commandant (G-CMC), U.S. Coast Guard, Washington, DC 20593; tel.: (202) 426-1477.

* * *

### MARPOL 73/78 Enters into Force (CGD 82-099)

On October 1, 1982, Italy became the 15th country to ratify the International Convention for the Prevention of Pollution from Ships, 1973, as modified by the Protocol of 1978 relating thereto ("MARPOL 73/78"). With Italy's ratification, the requirements for both minimum number of signatories (15) and minimum gross tonnage of the world's merchant shipping represented (50 percent) are satisfied. The Convention will thus enter into force on October 2, 1983. Annex I (Regulations for the Prevention of Pollution by Oil) will also enter into force on that date. Annex II (Regulations for the Control of Pollution by Noxious Liquid Substances in Bulk) is presently scheduled to enter into force on October 2, 1986.

U.S. implementing legislation for MARPOL 73/78, the Act to Prevent Pollution from Ships (Public Law 96-478), will become effective with the entry into force of the Convention. The Coast Guard is the agency responsible for implementing and enforcing the requirements of MARPOL 73/78. The majority of the requirements of Annex I pertaining to tankers have already been implemented. The Coast Guard is currently in the process of developing regulations to implement the remaining provisions of the Convention and developing administrative procedures for issuing the International Oil Pollution Prevention (IOPP) Certificate to U.S.-flag vessels as required by Annex I.

For further information, contact LT J. R. Ditto, U.S. Coast Guard (G-WER-3), Washington, DC 20593; tel.: (202) 426-9573.

### Documentation of Vessels (CGD 82-105)

When it published a final rule on documentation of vessels on June 24, 1982, the Coast Guard pointed out two potential problems that might require further rulemaking. They are: 1) potential difficulty in determining when a vessel built using foreign materials should be considered "built in the United States" and 2) the definition of the term "controlling interest" for purposes of documentation of a vessel owned by a partnership. The first issue was addressed by CGD 82-085 *(see the Keynotes section in the December 1982 issue of the*

Proceedings). On November 12, 1982, the Coast Guard published an advance notice of proposed rulemaking asking for public comment on the second issue. Input from the public will be used in judging the need for further rulemaking and in deciding what form any regulation should take.

For further information, contact Phyllis D. Cornilla, U.S. Coast Guard (G-MVD-1), Washington, DC 20593; (tel.): (202) 426-1492.

---

**Actions of the Marine Safety Council**

**November 1982 Meeting**

The Marine Safety Council approved only one item at its November meeting, a work plan entitled **Barges Carrying Certain Bulk Dangerous Cargoes (CGD 82-069).** The work plan proposes two things:

First, the table in Part 151.05 of Title 46 of the Code of Federal Regulations would be updated and made more complete. This table includes the electrical hazard group and class for a variety of cargoes carried in bulk. However, this column is presently blank for about 64 of the cargoes listed in the chart.

Second, the work plan proposes that Part 111.105 of Title 46 be changed to make it clear that the electrical requirements applicable to tankships carrying inorganic acids also apply to tank barges. Inorganic acids react with many metals to produce hydrogen gas, which is highly explosive. As a result, vessels carrying inorganic acids should have electrical systems designed for use in explosive atmospheres. Historically, the barge industry has voluntarily cooperated with the Coast Guard to ensure that most barges were operating at the same level of safety as self-propelled vessels. The work plan proposes amending the regulations to make it clear that barges and self-propelled vessels are required to meet the same standards. ↕

# Jet Flies First Rescue

On September 15, 1982, the Coast Guard's new HU-25A Guardian was used for the first time in a Search and Rescue mission.

The pipeline barge CHEROKEE was lying about 90 miles off the Louisiana coast. The Coast Guard Operations Center in New Orleans received a call from the crew that William T. Ames of Pensacola, Florida, was missing. The center contacted the Coast Guard Aviation Training Center in Mobile and asked that a new HU-25A Guardian be sent to assist in the search the next morning.

After two hours, one of the Guardian's crewmen spotted the man afloat wearing a life preserver. The position was put into the plane's computer, which locked in the exact latitude and longitude. The position was then relayed to an HH-3 helicopter also searching in the area.

The motor vessel ELSIE D, which had joined the search the night before, picked up Ames. He was returned to the CHEROKEE, where he was evacuated by helicopter to a New Orleans hospital. He was released in good condition.

The Coast Guard plans to buy a total of 41 HU-25As. They are to replace the HU-16 Albatross and the HC-131 Samaritans.

The advanced electronics and aerodynamics of the airframe reduce pilot workload and crew fatigue, thus making the HU-25A a very efficient and safe aircraft to fly. The state-of-the-art avionics will play a key role in rescue missions. By enabling a crew to precisely record the position of a target, the HU-25A will make it possible to direct helicopters and surface vessels to that location. ↕

*The HU-25A Guardian*

# Alternative Sources

**by Bruce P. Novak**
**Deputy Executive Secretary**
**Marine Safety Council**

At one time, the Coast Guard was actively involved in an ambitious reprinting program. At that time, almost every Coast Guard item that went into the FEDERAL REGISTER was reprinted and distributed to individuals and companies on a special mailing list. However, budgetary constraints and the dramatic increase in publishing costs in the last several years have forced a drastic cutback in this service. At present, the Coast Guard's policy is to reprint only those proposed rules which have the greatest public interest and/or are likely to be controversial.

Unfortunately, this change in our reprinting policy means that many interested parties who need to keep up-to-date on Coast Guard proposals are left without their most readily available source of information. We have, of course, attempted to keep the public informed of our activities through press releases, but we cannot guarantee that our releases will ever see print or that they will reach their intended public. Certain trade magazines publish updates on Coast Guard regulatory activity, but they do not receive distribution outside of their usual constituency. Even the *Proceedings*, which does a good job of following regulatory activity, is not sufficient for many needs because it has a two-month lead time and often reaches readers only after public-comment periods for notices of proposed rulemaking have expired.

This office has been aware of the problem, but there seem to be no easy or quick solutions. Things aren't likely to get better in the foreseeable future, either. However, when the government stops providing a service, the private sector usually steps in. And so it is in this case. It has come to my attention that there are private concerns publishing reviews and digests of Federal rulemaking which can be of help to the general public. I am not endorsing their products, for I do not use them, but I do feel that those who need such services and have felt the loss of the Coast Guard's reprints should be aware of the organizations and what they produce. The two services listed below are the only ones that I know of at this time. Other vendors of similar services are invited to contact me through the *Proceedings*. If others come forward, I will compile a more comprehensive list for publication in a future issue. Again, our intent is not to recommend or endorse these products, but merely to let you know they exist.

***Marine Operations Reporter***

This publication is produced by Marine Information Services, Inc., One World Trade Center, Suite 3147, New York, New York 10048; (212) 432-0400. It comes out monthly and includes a digest of all material published in the FEDERAL REGISTER that is of interest to the marine community. That would include not only Coast Guard proposals and rules but also material published by the Maritime Administration, the Occupational Safety and Health Administration, and so on. A cumulative index is also provided, and an information service is available for any particular item of interest. The cost of the *Marine Operations Reporter* is $250 a year. *(This service was noted in the Maritime Sidelights section of the September/October issue of the* Proceedings.)

***Weekly Regulatory Monitor***

This publication is produced by the Washington Monitor, 499 National Press Building, Washington, DC 20045; (202) 347-7757. As is evident from its title, the publication comes out once a week. For those in the Washington area, Monday morning delivery is available. The Monitor provides a digest of everything of importance (not just maritime items) published in the daily FEDERAL REGISTER. Items of limited interest—Coast Guard announcements of regattas, for example—are not reported. An updated index is published each month. Cost as of this writing is $325 a year. ‡

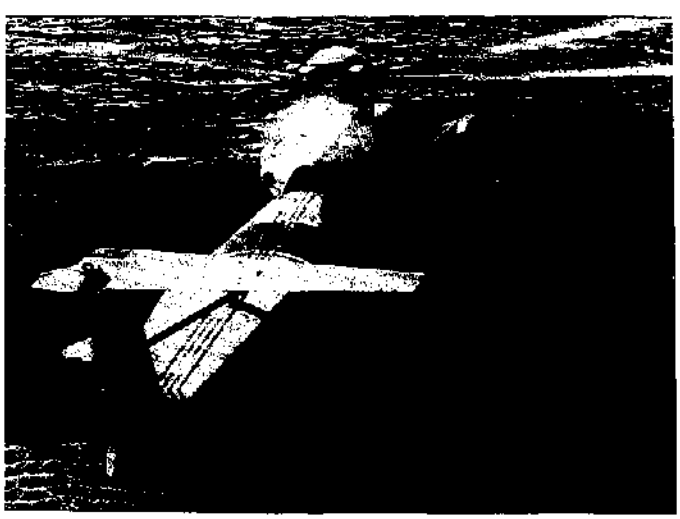
# The Coast Guard and the Needles in the Haystack

**by LTjg James Candee**
**Project Officer**
**Probability of Detection**

*Imagine for a moment that you are on a 40-foot sailboat about 100 miles off the coast of the U.S. The sun is setting, and you sit back to enjoy the spectacular colors. Suddenly, you realize something is not quite right. You look in the engine compartment and see water coming in--fast. Your boat is sinking.*

*On your way overboard, you send a "Mayday," calling out your approximate position. You have no Loran or radio beacon but you do have flares, a flag, and some dye markers. You take these with you.*

*It is dark and you are cold and wet, but, because you planned for such emergencies, your raft has the basic necessities for survival (food, water, and a blanket).*



*A Coast Guard helicopter lands on the water to pick up a victim of a boating mishap.*

*After a long night, you see the first signs of daybreak. As time goes on, morning stretches into afternoon. Late in the afternoon, you see an airplane going back and forth near the horizon, but it does not appear to be coming any closer. Night falls, and you sleep fitfully, angry that the pilot did not come in where he could have seen you.*

*Day two. About midmorning you once again see an airplane on the horizon. This time it is coming your way, you think. No, it is passing too far away, and the pilot will again miss you. Just as you think he is going to keep on going, he turns around. As he turns, he comes closer to you. The plane now passes you on its way back toward the horizon. As it reaches the horizon, it turns again.*

*"Why didn't I use a flare to attract his attention?" you say to yourself.*

*You load your flare gun, hold it over your head, and fire as he approaches your raft a few miles down range. The plane changes course and soon flies over your head. Shortly thereafter, it drops a smoke canister, which lands some distance from your raft. The plane passes over you a few more times. Several hours later, a boat appears over the horizon, and before long you are standing on its deck. You relax gratefully, never questioning the pilot's "uncanny" accuracy in knowing where to look for you.*

How did the pilot know where to look?

Pinpointing the area where someone in trouble is most likely to be requires many calculations. Many pieces of information must be taken into account: the type and size of the craft involved (sailboat, powerboat, life raft), the wind direction and duration, ocean currents, local currents, and anything else which would act on an object to move it or keep it from moving.

Coast Guard Search and Rescue personnel add up all of the above factors and others to derive what is called the "probability of detection" (POD). Search teams are not simply computing the odds of finding someone or something; rather, by using POD to determine how strong the likelihood is that certain targets will be in certain locations, they can decide where to send what resources.

Some outstanding initial work was done on POD by the U.S. Navy Operations Evaluation Group during World War II. Out of necessity, however, this work had to proceed on assumptions that did not prove to be true in actual searches. The Navy group assumed, for example, that a designated search area would be uniformly covered by a search platform (the plane, boat, or ship from which the search is conducted). We now know that slight navigational errors and errors made by the searchers in their visual scanning prevent an area from being covered with uniform thoroughness.

The methods developed by the Navy group were reliable enough that they are still used today. They are reliable, but they are not as accurate as they might be. Revisions were made to the Navy group's work in 1968 on the basis of data collected from actual searches conducted in 1956 and 1957.

The Coast Guard began its first controlled experiments on POD in 1978 at its Research and Development Center in Groton, Connecticut. The Coast Guard's purpose in conducting these experiments was to find ways of improving the effectiveness of its Search and Rescue operations. It decided to concentrate on five specific areas:

- improving visual search methods,
- developing POD figures which fit actual search conditions,
- investigating the use of electronic detection devices,
- improving drift predictions, and
- evaluating distress/locating devices.

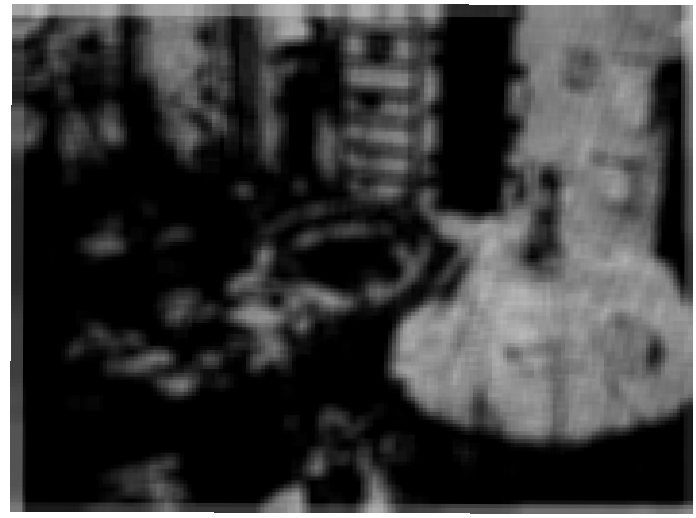
**Improving Visual Detection**

The R&D Center group has conducted six separate experiments, each lasting six to eight weeks. This major effort has allowed the group to collect data from hundreds of visual searches. These data have been used to create theoretical models of different types of searches.

The experimental searches, which consist of placing targets and observing the searchers' performance, enable the study group to assess the effectiveness of visual detection methods. Researchers monitoring the experiments know the exact position of the target (boat, float, or raft) anchored in a test range. Keeping track of the position of the moving search platform is a more difficult task. To solve this problem, the R&D Center uses a unique electronic ranging system, a microwave tracking system (MTS) called the mini-ranger II. This system is capable of tracking 16 targets at once and giving their positions with an accuracy of $\pm 3$ meters.

By noting at what point the searchers see the target, the research group can determine what effect such factors as the weather and the limitations of the human eye have on the searchers' capability. This will enable them to prescribe certain types of patterns for future searches. Searchers will know, for example, how much they have to reduce the distance between different legs of a search to compensate for fog.

The more such experimental searches the



*Life rafts equipped with microwave tracking system devices are readied on the buoy deck of the U.S. Coast Guard Cutter EVERGREEN. They will be anchored and used as targets for visual detection studies.*

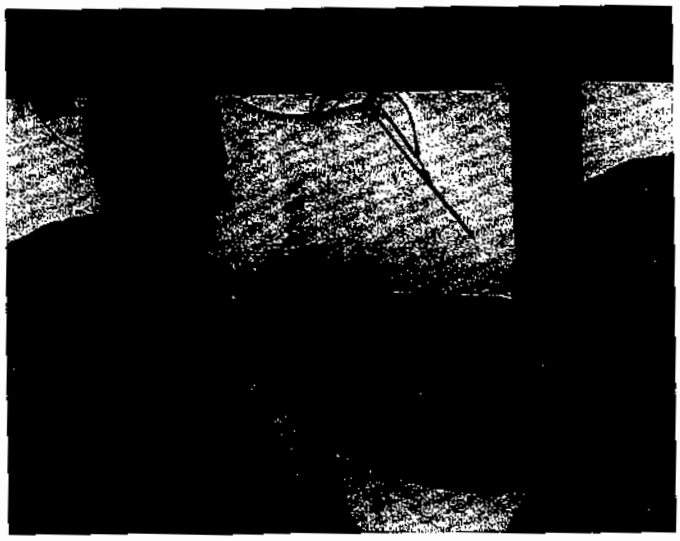
Coast Guard conducts, the more precise the models will become.

In addition to developing models for search patterns, the R&D Center group is looking at how people actually see—how the eye focuses on objects. This may eventually lead to the Coast Guard's retraining searchers to "see" or move their search platforms differently.

When all is said and done, the success of the system depends on the men or women doing the searching. The Coast Guard is studying the area of human factors to find out what effect such things as the amount of time searchers have been at a task, their experience levels, the sea conditions, the flight conditions, and even living conditions have. As the Coast Guard learns more about these factors, it may be able to increase searchers' effectiveness.

**Developing POD Calculations for Actual Search Conditions**

In doing their Probability of Detection calculations, Search and Rescue planners go beyond asking such expected questions as where the vessel in trouble was last known to be. All factors that might influence detection are taken into account. Some of these are related to the target itself—what material is it made of? What effect are winds and currents having on its location? Some are related to the searchers—how many search platforms do they have? What's the angle of the sun? What's the cloud cover? Searches can be organized in several different ways. Some focus on a point where the vessel was known to be, some on a line along which the vessel can be expected to float, and some on a square or circular area. By calculating POD, Search and Rescue teams can narrow down the area to be covered and decide what type of search would be most appropriate.



*The Coast Guard, concerned about human factors, is studying what effect the condition of the crew has on a search. From an oil painting by Catherine R. Brodeur, a volunteer artist for the Coast Guard Art Program (COGAP)*

*An "eyemark" system, which records eye movement, is used to study Coast Guard lookouts' visual scan patterns.*

The Coast Guard's Operations Analysis Branch on Governors Island, New York, has been working on this problem, incorporating data from experimental searches in its Computer-Assisted Search Planning (CASP) System. Information from the experiments was combined with predictions from the CASP programs and the results developed into a new chapter on search planning for the National SAR (Search and Rescue) Manual put out by the Coast Guard.

**The Use of Electronic Detection Devices**

The Coast Guard is increasing its search capabilities by taking advantage of the sophisticated electronic sensors now available. Sensors thus far examined by the Coast Guard are the Side-Looking Airborne Radar (SLAR), the Surface Vessel Radar (SVR), and the Forward-Looking Infrared (FLIR).

SLAR increases Search and Rescue teams' "lateral search range," i.e., their ability to detect objects on either side of them. The R&D Center group has made a preliminary assessment of SLAR and found that its ability to detect targets is affected by such things as precipitation, wind speed, target size, the com-

position of the target, and the altitude of the aircraft. Knowing the system's limitations will help its operators use the system to its fullest potential.

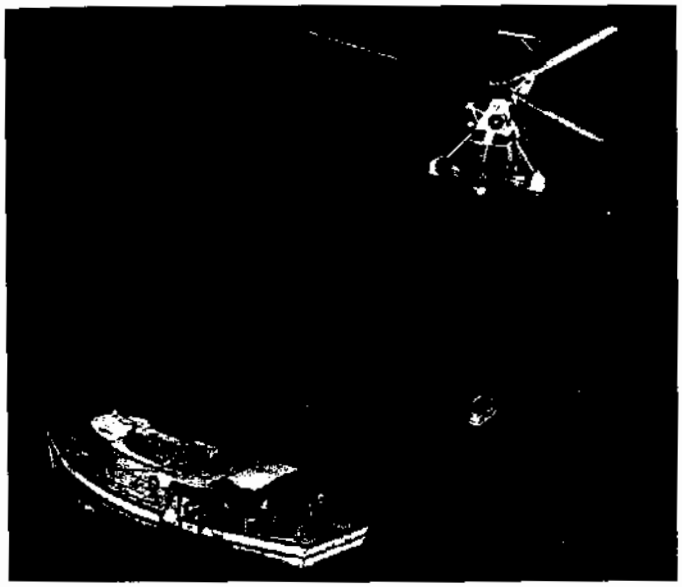
The SVR is a type of radar that has been around since World War II. What is new is its use as a search instrument. SVR will allow operators to spot objects at great distances.

FLIR is a sensor with exciting possibilities which will give its operators, in this case helicopter crews, the ability to search at night or during times of decreased visibility. FLIR does not use light as a source of illumination; instead, it uses the temperature of an object relative to its surroundings to form an image. It is this characteristic which makes FLIR so valuable when a crew is searching for a person in the water.

**Improving Drift Predictions**

The R&D Center has been working on improving drift predictions by using satellite-tracked drift buoys. In one experiment, the Coast Guard released 12 drift buoys off the coast of Florida in 1979. The daily progress of the buoys was monitored by the Coast Guard Oceanographic Unit. Forecasts of the buoy movement over 24-hour periods were made each day using the Atlantic Area's Search and Rescue Planning (SARP) system. Over the five-month span of the experiment, operators using the SARP system were able to accurately predict movement only 10 percent of the time. This indicates that our means of predicting drift need to be examined. There is much we don't know about the forces that collectively cause an object to drift in one direction or another. (The SARP system has since been replaced by the CASP system. The SARP system was cumbersome to use because it took a long time for search planners to get back information from the search data fed in. The CASP system, in contrast, gives search planners almost instantaneous results.)

The people at the R&D Center are conducting experiments designed to give the Coast Guard a better understanding of the dynamics of drift. In their test range in Block Island Sound, off the coast of Rhode Island, they have discovered an area where many different types of current (wind, tidal, and ocean) come together. By setting up a test range using the mini-ranger MTS system and recording the movement of experimental targets, they hope to learn more about the behavior of objects drifting in the open ocean. From this information they hope to make improvements in the drift prediction model.



*The helicopter plays an important role in Search and Rescue because of its ability to search large areas and respond quickly to victims' needs.*

**Distress/Locating Devices**

Lastly, the R&D Center group has been asked to examine distress/locating devices. There are many devices of this sort on the market, ranging from flags to flares to electronic signaling devices. The Coast Guard requires most boats to carry such devices in one form or another.

The R&D Center will evaluate the detection ranges of the different devices. For signaling devices, researchers will be evaluating the effectiveness of the devices in getting searchers' attention.

*Our friend in the sailboat is now warm and dry. He is just beginning to wonder "How did they know where to look? It's a pretty big ocean, and I wasn't staying in one place."*

*If we are to find better Search and Rescue methods, we need groups like the one at the Coast Guard's R&D Center to continually question the way we conduct searches. Also, as the Coast Guard acquires new Search and Rescue equipment, it is important that there be a group like the R&D Center POD team to examine it so that it can be used to its fullest potential. It looks like there will be plenty for this group to do in the years to come.* ⚓

# The 1969 International Tonnage Convention

## *A New System for Calculating Vessel Tonnages*

**by Joseph T. Lewis**
**Chief, Admeasurement Branch**
**Merchant Vessel Inspection Division**

A new system for tonnage measurement of ships is being introduced as a result of the International Convention on Tonnage Measurement of Ships, 1969. This Convention goes into effect in the United States on February 10, 1983.

The Convention requires that all vessels of 24 meters (79 feet) or more which engage on international voyages carry on board an International Tonnage Certificate for presentation at ports of other Convention nations. Fifty-one nations, including all major maritime countries, are parties to this Convention.

The Convention will not apply to vessels that do not engage on international voyages, nor will it apply to vessels of less than 24 meters, to ships of war (combatant vessels), or to U.S. vessels which navigate solely on the Great Lakes.

**Ship Tonnage**

Most people in the maritime industry are aware that a vessel must be assigned a gross and a net tonnage before it can be documented under the laws of the United States. Laymen frequently read about old vessels having "500 tons burden" or "10,000 gross tons." Such tonnages are determined through a process called "admeasurement" (a more specific term than "measurement" in that it means taking internal measurements of something).

Gross tonnage is intended to be a reasonably accurate reflection of a vessel's size. Under current measurement systems, it is determined by calculating the internal capacities of the vessel's hull and deck structures (with certain spaces excluded). Net tonnage is intended to be a reflection of the vessel's earning capacity and

is an adjusted measurement of the gross tonnage, with allowances being made for spaces set aside for the crew, the engine room, and working the ship. These tonnages are generally calculated in accordance with a system initiated by George Moorsom for the British Board of Trade in 1854 (the "Moorsom system"). This system has been employed, in one form or another, by all major maritime nations.

**Use of Tonnage**

Gross tonnage is used by most national and international authorities as a guide for regulating vessels. In the United States it has particular relevancy in regulations concerning vessel safety and manning and licensed personnel requirements. It is used in a similar way internationally. Net tonnage, on the other hand, is more often used to determine what tonnage taxes are to be collected and for the imposition of charges for drydocking, canal tolls, and the like.

**Perceived Need for Change**

Although the Moorsom system provides an effective method for deriving vessel tonnages, it has never been applied uniformly. Major maritime nations use differing interpretations when measuring vessels. For instance, the English initiated the exclusion from gross tonnage measurement of space located within shelter decks. The United States does not include the capacities within double bottoms or measure into tonnage the spaces allocated to passengers. Our exempting water ballast from the gross tonnage calculation has long been a source of international controversy. Numerous nations have employed so-called tonnage openings to exclude volumes within deck structures.

These and other unilateral interpretations of the Moorsom system permit vessels to be measured with astonishingly different results. Adding to the confusion are construction techniques employed to reduce tonnage. Therefore, the credibility of tonnages assigned to vessels has been seriously undermined throughout the world maritime community.

**International Attempts at Uniformity**

Participants in a conference on tonnage measurement held in Constantinople in the 1870s recommended international adoption of the Moorsom-derived Suez Canal rules. The effort failed because some nations objected to the loss of their particular tonnage advantages.

Another attempt at international tonnage reform emanated from the League of Nations, whose tonnage committee recommended in 1925 that modified Moorsom rules be used as the basis for a new system. This led ultimately to the scheduling of an international tonnage conference in 1939, but the Second World War prevented its convening.

A conference was finally held in Oslo, Norway, in 1947, where participants adopted, for the most part, the League of Nations system. These rules, subsequently known as the Oslo Rules, took effect in 1954. However, the failure of many major maritime nations (including the United States) to adopt this system doomed it to ineffectiveness. This failure was based partly on the Oslo Rules' stipulation that unanimous consent be obtained before any of its regulations could be altered and partly to the perception that certain economic advantages enjoyed by some maritime nations would be thrown over merely for the sake of tonnage uniformity. The quest for universal tonnage reform continued.

During the 1950s there was a resurgence of interest in reforming maritime tonnage. The newly-formed Inter-Governmental Maritime Consultative Organization (since renamed the International Maritime Organization) agreed, as a matter of priority, to seek solutions for the uniform assignment of tonnages to vessels operating in international trade. Its goal was to establish a new, easy-to-administer and uniformly-applied international system. It wasn't until 1969 that an international conference was convened in London. A number of different solutions were discussed: some nations advocated using displacement tonnage, others recommended the assignment of a single tonnage. It was finally agreed that a successful tonnage system should incorporate the following features:

1. Gross and net tonnages should be as close as possible to tonnages determined under existing systems (provided sophisticated techniques for tonnage reduction were not employed in the original admeasurement).

2. The system should avoid undue dependence on construction details, and it should not influence vessel design.

3. Tonnages should be directly and simply calculated at the earliest stage of con-

struction.

4. Any new system should not directly affect the economics of vessels.

5. Spaces exempted from inclusion in tonnage should be severely limited.

6. Gross tonnage should reflect a reasonable and consistent index to the vessel's size, and net tonnage should be a reasonably accurate reflection of the vessel's revenue-earning capacity.

**Ratification**

The framers of the Tonnage Convention believed they had largely achieved these principal goals. Nevertheless, it has taken 13 years for a sufficient number of nations representing at least 65 percent of the world's merchant tonnage to ratify the Convention. On July 18, 1980, Japan acceded to the Convention; this triggered the Convention's coming into force two years later.

On July 18, 1982, the International Convention on Tonnage Measurement of Ships, 1969, went into effect in 50 maritime nations. The United States was not one of them. In September 1982, however, the U.S. Senate gave its advice and consent to ratify the Convention, and the President signed the treaty on October 28, 1982. The Convention, as stated at the beginning of this article, goes into effect in the United States on February 10, 1983.

**Advantages of the Convention System**

The Convention system is an improvement over former systems in that it is far easier to administer and is a far simpler system for calculating tonnages. The Convention system eliminates all references to vessel construction features, such as frames and floors. It does not recognize tonnage openings or take into account excessive ballasting. It clearly limits open spaces which are not included in the ship's measurement.

In the net tonnage calculation, only spaces allocated for cargo and passengers are included. Significant increases in gross tonnage will be recalculated immediately. Frequent changes to net tonnage are discouraged and may be made only once a year.

Under the new system, tonnages may readily be calculated by using lines plans, offsets, stability calculations, or any other available volumetric data. Physical measurement of vessels subject to Convention measurement will, for the most part, be eliminated.

**Anticipated Impact for Some Vessels**

For most large vessels there is little likelihood of significant tonnage changes, but ships such as shelter-deckers and others with large exempted spaces could end up with considerably higher international tonnages. In general, reductions in net tonnages are expected for vessels of less than 500 gross tons and for larger ships which carry high-density cargoes. Considerable increases in both gross and net tonnages are anticipated for roll on/roll off ships and car ferries.

**Calculating International Tonnages**

As is presently the case under our national systems, the Convention provides for a gross tonnage and a net tonnage. The gross tonnage is calculated on the basis of the molded volume of the hull of the vessel and the molded volumes of the deck structures. A coefficient is applied to that combined volume, thereby adjusting the gross volume to a figure somewhat similar to the tonnages reached under present methods.

The net tonnage is based on cargo volumes and passengers carried, further modified by a coefficient (net tonnages calculated under the Convention system will never be less than 30 percent of the vessel's gross tonnage).

**Vessels Subject to Convention Measurement**

The Tonnage Convention applies to all ships of 24 meters (79 feet) and more, including barges and yachts, which engage on international voyages. This includes ships of that size and larger which request a Certificate of Registry under U.S. documentation laws, ships registered in U.S. territories, state-numbered vessels, and unnumbered vessels.

Vessels subject to Convention admeasurement are required to present a valid International Tonnage Certificate when entering the ports of other contracting governments in accordance with the following compliance schedule:

- new vessels: immediately

- existing vessels that have undergone substantial alterations or modifications on or

after July 18, 1982: immediately

- all other existing vessels: by July 18, 1994, or

- existing vessels (at the owner's option): any time before July 18, 1994

**Vessels Not Subject to Convention Measurement**

The Tonnage Convention does not apply to vessels of 24 meters (79 feet) or more that do not engage on international voyages, to vessels less than 24 meters (79 feet) in length, to ships of war, or to U.S. vessels of any size which navigate solely on the Great Lakes.

**New Vessel**

A new vessel is described as one for which the keel has been laid or one that is at a similar stage of construction on or after July 18, 1982. For instance, if a new vessel's construction commenced on July 25, it would be subject to Convention measurement.

**Existing Vessels**

It follows that an existing vessel is one which was constructed before July 18, 1982. Such a vessel is not immediately subject to admeasurement under the Convention (it is "grandfathered"). Existing vessels must be measured under the Convention system before July 18, 1994.

Even then, however, an existing vessel will retain its "old" tonnages for purposes of regulation under other international conventions. It is true that a grandfathered vessel will have a competitive advantage over an identical ship constructed after the Convention enters into force. Because this advantage will be temporary and because the framers of the Convention recognized the potentially substantial impact of a new system on existing vessels, however, they believed it would be unfair to impose additional regulatory requirements on these vessels.

**Reconstructed Vessels**

The goal of attaining a universal and uniform system is best served by bringing as many vessels as possible under the Convention system as soon as possible. Although the Convention provides a 12-year grace period for existing vessels, it also states that reconstructed vessels are immediately subject to Convention measurement.

The Convention establishes no firm criteria on reconstruction but states that an existing vessel which has undergone modifications resulting in a substantial change to its existing gross tonnage will lose its grandfathering privileges and be immediately subject to Convention measurement.

Since each administration decides what reconstructed vessels are subject to Convention measurement, the Coast Guard will determine, on a case-by-case basis, when a reconstructed existing vessel must be measured under the new system.

**Separate Tonnages for International Voyages**

The Convention system and the national systems employed in the United States are not compatible. The gross and net register tonnages used in documenting a vessel are presently determined on the basis of the U.S. systems. The International Tonnage Certificate, 1969, on the other hand, is an additional certificate which must be carried on board vessels subject to Convention measurement. For the present, this will entail a separate measurement.

**Potential Solution to Dual Measurement**

The Department of Transportation has submitted a legislative proposal to implement the Tonnage Convention. The proposal also provides for replacing the present U.S. admeasurement systems with the Convention system; under the proposal, all vessels of 24 meters or more which are required to be documented, whether or not they engage on international voyages, would be admeasured under the Convention system. Provision will be made for a "regulatory tonnage," discussed later in this article.

If this legislative proposal is accepted, vessels would need to be admeasured only once to meet the tonnage requirement for documented vessels and to satisfy the Convention requirement for vessels which engage on international voyages.

**International Voyages**

The Convention defines an international voyage as a sea voyage from a country party to the Convention to a port or place outside such country (or the reverse). Every territory "for the international relations of which a Contracting Government is responsible or for which the

United Nations are the administering authority" is regarded as a separate country. The following are examples of international voyages:

- A vessel departing from Seattle and touching at Yokohama
- A vessel departing from Miami and touching at St. Thomas, U.S. Virgin Islands
- A vessel departing from Hamburg and touching at Philadelphia
- A vessel departing from San Juan, Puerto Rico, and touching at New York
- A vessel departing from Guam and touching at Honolulu
- A vessel departing from London and touching at Rotterdam

**International Regulatory Relief**

A number of nations and international shipping organizations felt that the Convention, when it came into force, would have a substantial regulatory impact on their vessels. Therefore, in 1977, the United States, together with these nations, recommended that the Inter-Governmental Maritime Consultative Organization consider some form of regulatory relief for such vessels. The result was an IMCO Resolution (A. 389 (X)) which permits the additional measurement under the existing national systems of any vessel which is also required to be measured under the Convention. These national tonnages would be used when regulations under the Safety of Life at Sea (SOLAS) Convention are applied to the vessel. This accommodation, known as the "Interim Tonnage Measurement Scheme," expires on December 31, 1985.

**Extension of the Interim Scheme**

The Coast Guard recognizes that many smaller vessels subject to this Convention have been specially designed to keep gross tonnages under 100, 200, 300, or 500 gross tons. Under the Convention system, these domestic tonnage assignments will convert to substantially higher tonnages for new, yet identical, vessels. At a meeting the Coast Guard held in 1981, attended by vessel owners, operators, industry organizations, and other government representatives, it was agreed that the United States should seek further relief at the Inter-Governmental Maritime Consultative Organization for smaller vessels required to be measured under the Convention.

IMCO (now IMO) agreed, at the behest of the petitioning nations, to revise the original interim scheme. The revised Resolution, A. 494 (XII), restates that all vessels which are required to be measured under the Convention may also be measured under the national systems for SOLAS applications until December 31, 1985. It also provides that cargo vessels which measure less than 1,600 gross tons under the existing national systems (but which are still required to be Convention-measured) may use those national tonnages for SOLAS applications until July 18, 1994.

**Domestic Regulatory Relief**

Since 1969 the Coast Guard has stated that it is not its intention to bring more vessels under inspection, licensing, and manning regulations merely because of a new Convention system. Because we recognize that strict adherence to Convention tonnages might have severe economic impact on a number of vessels, we are recommending in legislation that a "regulatory tonnage" be accepted for domestic regulation. The regulatory tonnage system will employ the systems of measurement presently used, and, if the owner elects, such tonnages will be used when regulations are applied to the vessel domestically.

**Conclusions**

It has been generally agreed that the present systems for measuring ships are archaic. Traditionalists have argued in favor of maintaining the status quo. Modernists have recommended single tonnage or displacement tonnage. Pragmatists have carried the day.

In the future, no one nation's vessels will have a tonnage advantage over another nation's. It will not be so easy to design vessels around tonnage. To further lessen the regulatory impact of tonnage assignments, studies are now under way to examine the use of criteria other than tonnage for regulating vessels, both domestically and internationally.

International uniformity will essentially be achieved but not at the expense of worldwide disruption. Impact on vessel owners and operators has been minimized as much as possible, both internationally and domestically. A new system has arrived . . . not an ideal system but potentially a better one. ⚓

**Rear Admiral Norman C. Venzke**
**Chief, Office of Operations**

Rear Admiral Norman C. Venzke was born in Baltimore, Maryland, on December 8, 1927. He graduated from the Coast Guard Academy in New London, Connecticut, on June 2, 1950, with a B.S. in Engineering. He subsequently attended the U.S. Naval Postgraduate School, where he studied Ordnance Engineering and received a B.S. in Electrical Engineering, the Industrial College of the Armed Forces, and The George Washington University, where he earned an M.S. in Administration. He also holds a Merchant Marine License as Master of Steam or Motor Vessels of Any Gross Tons Upon Oceans.

His past assignments at sea include the following: Deck Watch Officer on the INGHAM and the CHINCOTEAGUE, Executive Officer on the PANDORA, Operations Officer on the WESTWIND, Executive Officer on the EDISTO, and Commanding Officer on the NORTHWIND and the POLAR STAR. The latter four ships are icebreakers participating in Arctic and Antarctic operations. From April 1967 to April 1968, Rear Admiral Venzke served simultaneously as Commander of Coast Guard Division Eleven, Commander of the Gulf of Thailand Surveillance Group, and Fourth Coastal Zone Advisor in Vietnam.

Rear Admiral Venzke's shore assignments include a past stint as Chief of the Office of Operations. He has also seen duty as Chief of the Office of Public and International Affairs at Coast Guard Headquarters, Chief of the Weapons Section and an Instructor in the Department of Professional Studies at the Coast Guard Academy, and Ship Operations Officer on the staff of the Commander of the U.S. Naval Support Force Antarctica.

Rear Admiral Venzke, formerly Commander of the Second Coast Guard District, assumed his present post in June 1982. As Chief of the Office of Operations, he oversees such Coast Guard tasks as search and rescue, enforcement of laws and treaties, polar and domestic icebreaking operations, operational and military readiness, marine science, ocean operations, and intelligence and security.

The Admiral's awards include the Legion of Merit with Combat V, the Meritorious Service Medal, the Navy Commendation Medal, and the Republic of Vietnam Honor Medal First Class.

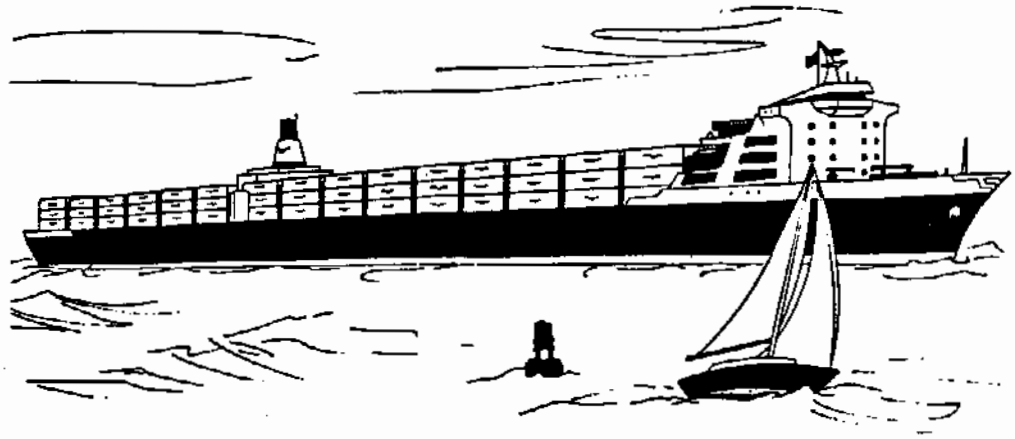
The Admiral and his late wife, Dee, have a daughter, Erica, now attending college. ‡

U.S. Department of Transportation
United States Coast Guard

# NAVIGATION RULES

INTERNATIONAL—INLAND

COMDTINST M16672.2



NAVIGATION RULES: INTERNATIONAL-INLAND A new version of this publication (formerly numbered CG-169 and dated May 1, 1977) is now available to the public. The new book (numbered COMDTINST M16672.2) contains both the International and Inland Navigation Rules. These rules cover all vessels in all areas except the Great Lakes, where the new Inland Rules will take effect on March 1, 1983. The new volume incorporates all amendments to the International Rules, which will take effect June 1, 1983, and gives the replacement versions of all rules which became obsolete when the Inland Navigational Rules Act of 1980 went into effect.

HOW TO ORDER THE NEW BOOK: The book may be ordered in two ways — by telephone or mail. To order by telephone, call (202) 783-3238, ask for the book by name, and give the stock number (#050-012-00192-8). You may pay using your VISA or MasterCard. To order by mail, fill out the order form below and mail it to the address listed.

**STOCK NO. 050-012-00192-8**

| QUANTITY | VOLUME | PRICE | AMOUNT |
|---|---|---|---|
| _____ | NAVIGATION RULES: INTERNATIONAL-INLAND (COMDTINST M16672.2) | $6.50 | _____ |

*Please do not detach*

---

## Order Form

**Mail to:** Superintendent of Documents, U.S. Government Printing Office, Washington, D.C. 20402

Enclosed find $_____. Make check or money order payable to Superintendent of Documents. (Please do not send cash or stamps). Include an additional 25% for foreign mailing.

**Charge to my Deposit Account No.**

☐☐☐☐☐☐-☐

Order No._____

VISA

MasterCard

**Credit Card Orders Only**

Total charges $_____ Fill in the boxes below.

Credit Card No. ☐☐☐☐☐☐☐☐☐☐☐☐☐☐☐☐

Expiration Date Month/Year ☐☐☐☐

**Name—First, Last**

**Street address**

**Company name or additional address line**

**City** **State** **ZIP Code**

**(or Country)**

**PLEASE PRINT OR TYPE**

**For Office Use Only.**

| | Quantity | Charges |
|---|---|---|
| Enclosed | | |
| To be mailed | | |
| Subscriptions | | |
| Postage | | |
| Foreign handling | | |
| MMOB | | |
| OPNR | | |
| UPNS | | |
| Discount | | |
| Refund | | |

# Ethyl Ether:

## $CH_3-CH_2-O-CH_2-CH_3$

| | |
|---|---|
| Synonyms: | diethyl ether<br>ether<br>1,1'-oxibis ethane<br>anesthetic ether |
| **Physical Properties** | |
| boiling point: | 35°C (94°F) |
| freezing point: | -116°C (-178°F) |
| vapor pressure at 20°C (68°F): | 440 mm Hg |
| vapor pressure at 38°C (100°F): | 703 mm Hg |
| **Threshold Limit Values (TLV)** | |
| time weighted average: | 400 ppm; 1,200 mg/m$^3$ |
| short term exposure limit: | 500 ppm; 1,500 mg/m$^3$ |
| **Flammability Limits in Air** | |
| lower flammability limit: | 1.85% by vol. |
| upper flammability limit: | 36.5% by vol. |
| **Combustion Properties** | |
| flash point (c.c.): | -45°C (-49°F) |
| autoignition temperature: | 180°C (356°F) |
| **Densities** | |
| liquid (water = 1.0) | 0.713 |
| vapor (air = 1.0): | 3.45 |
| **Identifiers** | |
| U.N. Number: | 1155 |
| CHRIS Code: | EET |
| Cargo Compatibility Group: | 41 (ethers) |

*The year is 1844. Chemist Charles Thomas Jackson, his wife, and two friends have just finished dinner. For their after-dinner entertainment, Jackson gets some ether from his laboratory and begins sniffing (or "experimenting," as he puts it). He soon breathes himself into insensibility.*

Although by today's standards Jackson's method was a dangerous way of doing research, the work of such early chemists and physicians opened a new chapter in medicine. They made it possible for patients to undergo surgery with minimal discomfort. Actually, ether was used as an anesthetic two years before Jackson's experiments. On March 30, 1842, Crawford Williamson Long, a physician from Georgia, used ether to render a patient insensitive to pain while he removed a tumor from the man's neck.

In the most recent government records, the use of ethyl ether broke down as follows: about 65 percent was used as an industrial solvent, 25 percent was used in chemical synthesis, a mere 3 percent was used as an anesthetic, and the remaining 7 percent was used for miscellaneous purposes. This is quite a change from the 1840s, when ethyl ether was used primarily for anesthetic purposes. The change is due in part to its replacement by other types of anesthetics (ether is limited by the fact that it can be used only for general, as opposed to local, anesthesia) and in larger part to the chemical's versatility and the expansion of the chemical process industries. Today ethyl ether is routinely used in industry as a solvent for waxes, fats, oils, perfumes, dyes, raw rubber, and the smokeless powder that goes into ammunition. It is also used as a refrigerant, a diesel fuel additive, and a dry-cleaning fluid.

In spite of ethyl ether's history as an anesthetic, we know today that there are many hazards connected with use of this chemical. First, ethyl ether has a low flash point and wide flammable limits (in other words, its vapor is flammable over a wide range of concentrations). Ethyl ether will also autoignite at a relatively low temperature. Second, air and sunlight can cause peroxide compounds to form in ethyl ether; these are extremely flammable in their own right. To prevent it from being exposed to light, ethyl ether shipped in small (laboratory) quantities is packaged in bottles or cans made of opaque materials. Since ethyl ether has a high vapor pressure, i.e., will rapid-

ly evaporate and saturate the air, laboratories generally keep their supplies in refrigeration storage facilities.

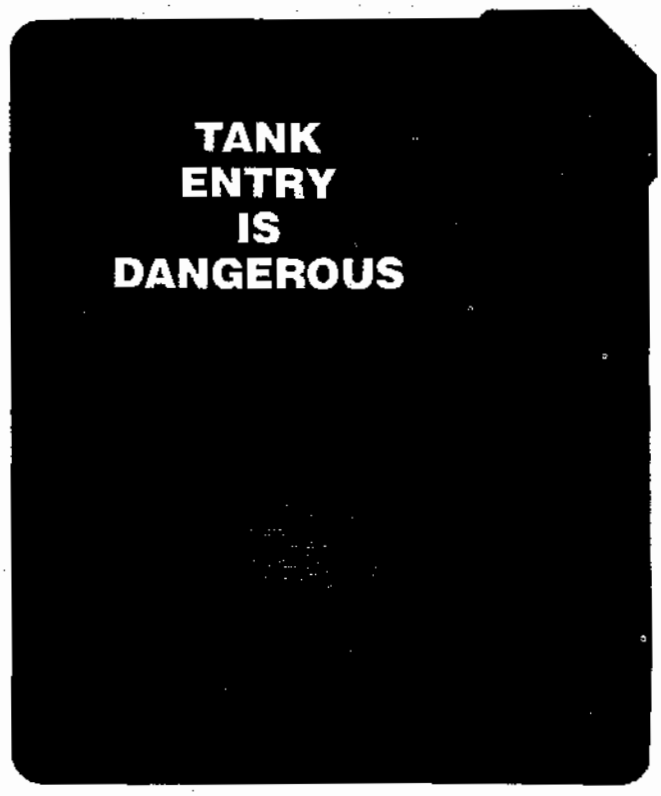
As if fire and peroxide formation weren't enough, ethyl ether also poses severe health hazards. The most obvious one is its anesthetic properties--too much ethyl ether will depress the central nervous system to the point where life ceases. Ethyl ether vapor is mildly irritating to the eyes, nose, and throat. Liquid ethyl ether will remove natural oils from the skin and may result in dry, scaly, fissured dermatitis. Repeated exposure to relatively low amounts of ethyl ether may result in anorexia, exhaustion, headaches, dizziness, mental agitation, and mild psychic disturbances. Such chronic exposure may also increase a person's susceptibility to alcoholism; conversely, a history of alcoholism may lead an employee to become addicted to the ethyl ether at his workplace.

Ethyl ether is hard to miss; the odor threshold is a mere 1 ppm (part per million). A concentration as low as 200 ppm has been found to cause irritation of the eyes. For an anesthesia, a concentration between 36,000 ppm (3.6%) and 65,000 (6.5%) is used. Concentrations between 70,000 and 100,000 ppm (7% and 10%) will cause respiratory arrest. Higher concentrations are usually fatal.

Since ethyl ether vaporizes so rapidly, industrial plants have been designed to contain and recycle the vapors. Loading requirements for vessels have also been designed to minimize the escape of liquid and vapor. If employees are exposed to a spill or must enter a tank that has just been emptied of ethyl ether, however, they must know how to protect themselves. Provided the ethyl ether concentration is low (500 ppm), a suitable organic-vapor cartridge respirator will afford adequate respiratory protection. (A full face piece would provide a better fit and minimize exposure to the eyes.) If the concentration exceeds 1,000 pmm, air-supplied systems should be used, and, if the concentration reaches 19,000 ppm (the point at which ethyl ether becomes IDLH--"immediately dangerous to life and health"), only a self-contained breathing apparatus of positive-pressure type will provide protection. This may seem restrictive, but the concentration of ethyl ether at 20°C (68°F) that has saturated the air is an astounding 579,000 ppm (57.9%). A self-contained breathing apparatus is therefore necessary for tank entry; a second possibility is dilution ventilation, which, if adequately performed, will reduce the concentration of ethyl ether vapors to a safe level.

The U.S. Coast Guard regulates ethyl ether as a Subchapter O commodity in Title 46 of the Code of Federal Regulations (Part 151 for tank barges and Part 153 for tankships). The International Maritime Organization (IMO) regulates it for bulk shipment in Chapter 6 of the Chemical Code and, for packaged shipments, includes it in the IMDG (International Maritime Dangerous Goods) Code (Class 3.1). The U.S. Department of Transportation classifies ethyl ether as a flammable liquid. IMO considers it a Category D Pollutant, and the U.S. Environmental Protection Agency has assigned waste ethyl ether the ID Number U117.

*The author of this article, LT K. W. Blackman, is currently working in the Marine Safety Technology Branch of the Coast Guard's Office of Research and Development. He was formerly assigned to the Cargo and Hazards Branch, the office which usually brings you Chemical of the Month. In his new assignment, LT Blackman will be serving as the Project Officer for the Maritime Occupational Safety and Health Studies.*



# Capsized by a Mudslide?

by **John A. Crawford**
**Analyst, Marine Investigation Division**

On an August day in 1980, a mobile offshore drilling unit (MODU) capsized in the Main Pass area off the mouth of the Mississippi River in the Gulf of Mexico. The crew had jacked up the 2,970-gross-ton vessel on its 263- by 170-foot mat for the drilling of a wildcat gas well. Since everyone had been evacuated because of an approaching hurricane, nobody was aboard when the casualty occurred. Hurricane Allen was an extremely intense storm when it entered the Gulf, but it moderated as it traveled north. The hurricane went ashore near Brownsville, Texas.

The general sea and weather conditions in the Main Pass area did not become very severe as a result of Hurricane Allen. However, there is always the possibility of severe local conditions such as thunder squalls and tornadoes as a result of hurricanes, even at significant distances from the center of the storm. When the members of the crew returned to the MODU, they couldn't find it. The mat was found floating inverted, and, later, the wreckage of the rig was located with side-scan sonar. It was on the bottom and also upside down.

Perhaps a tornado knocked this MODU over. A more likely possibility is that it was the victim of a subaqueous (underwater) mud slide. The area in question is known as the upper front slope of the river delta, characterized by underconsolidated (soft) clay and silt with a high water content and an accumulation of sedimentary gases from bacterial degradation of fine organic materials. Water depth extends from 30 feet to 450 feet, the bottom slopes at angles generally between $0.7^{\circ}$ and $1.5^{\circ}$, and the area is known for mudslides which, according to surveys, can advance 3,000 feet down the slope in a year. Mudslides are believed by many authorities to be triggered by high seas and tides that accompany storms.

Before the crew jacked the mat down and began operations, the site and the immediately surrounding area were surveyed by a move and warranty surveying company. Water depth was 171 feet, the bottom was essentially flat silt and clay, and a 300-foot-radius magnetometer sweep by a diver revealed no obstructions such as abandoned steel pipes. Corings to determine the nature of the soil beneath the surface of the seabed were not taken. When the platform was jacked up, the mat penetrated 9 to 9.5 feet into the mud, but it was level and appeared stable. Prior to the hurricane evacuation, the derrick was skidded inboard for stability and the variable load was reduced. The bottom-bearing pressure was estimated to be 463.8 pounds per square foot, which was consistent with the 451-pounds-per-square-foot average for hurricane season operations (range: 150 to 750 pounds per square foot). The 42-foot air gap (clearance above the water) was also as recommended. These preparations were for storm conditions much more severe than those that actually developed (assuming there was no tornado . . .).

After the casualty, an engineering firm performed a soil coring analysis of the drilling site. From the mud line to a depth of 86 feet, the soil consisted of underconsolidated, water-saturated, very soft clays. Sheer strengths of these clays were extremely weak down to 50 feet below the mud line. At a depth of 40 feet, the firm found a layer with an extremely high water content. A representative of the engineering firm theorized that this layer could have functioned as a bearing surface for a mass movement of the soils above (i.e., a mudslide).

To continue drilling, the production company contracted for a semi-submersible rig. This was positioned with eight anchors in a spread mooring. Before drilling started, a subsea structure with a well head and blowout-preventer stack was installed at the well site. By early November, the drilling was finished and the well was being perforated and tested. All operations were normal. About a week later, Hurricane Jeane entered the Gulf and

moderated to a tropical storm. Conditions at the well site were 35-knot winds (maximum) and 10- to 15-foot seas (maximum). There were no evacuations of the petroleum facilities off the Louisiana coast.

At the peak of the storm, the rig was experiencing a $2\frac{1}{2}^{o}$ roll and a $1\frac{1}{2}^{o}$ pitch with a 9-second period. Winds were 30 - 35 knots, seas 14 - 16 feet. Personnel on board noticed that the guideline wires which ran from the drill floor of the rig down to the subsea structure shifted from their normal vertical position to an angle to the east. They assumed that the rig had dragged anchor and shifted. The telescoping joint on the drill pipe riser was run all the way out, and the anchor lines were checked. All the anchor lines were at the correct tension, indicating that none of them had slipped.

The drill pipe riser was then disconnected from the subsea structure, and the anchor lines were adjusted to bring the rig back over the subsea structure. The rig had to be moved about 50 feet to get the guide wires to tend straight down again. Attempts to reattach the riser pipe to the subsea structure at that time were unsuccessful, and divers were called in to see why. The subsea structure was found almost totally below the mud line and tilted at a $40^{o}$ angle. Recovery efforts were only partially successful, and most of the subsea structure and its equipment—worth several million dollars—were lost. It is believed that a mudslide was the cause of the collapse of the subsea structure.

The experience with the second drilling rig is the best indication of what happened to the first one. An 8-inch pipeline that passed within 3,200 feet of the drilling site also had to be abandoned after several breaks. It was found to have moved 420 - 720 feet downslope. There is a history of other casualties to platforms and pipelines on the unstable soils of the upper front slope. Several pile-supported structures were lost in Hurricane Camille in 1969 as a result of a mudslide (see "The Failure of the South Pass 70 Platform B in Hurricane Camille" by Sterling and Strohbeck, *Journal of Petroleum Technology*, Vol. 27). The U.S. Bureau of Land Management has information on this subject in its Open File Report #80-02 "Environmental Information on Hurricanes, Deep Water Technology and Mississippi Delta Mudslides in the Gulf of Mexico." Considerable information about the unstable Mississippi River Delta soils is available, including Bureau of Land Management Open File Report #80-01, "Subaqueous Sediment Instabilities in the Offshore Mississippi River Delta."

The Investigating Officer recommended a ban against the use of all bottom-bearing mobile drilling units (including mat-supported units, semisubmersibles in bottom-bearing mode, and leg-supported units, usually called Marathon-Letourneau jack-ups) on all mudslide formations on the subaqueous lobe of the Mississippi River Delta. He also recommended that detailed soil analysis be required at any delta site with weak soils and that operations with bottom-bearing units in those areas be restricted to the non-hurricane season (December to June). Regardless of whether new regulations emerge from this casualty, it appears that there is a very serious safety problem for operations on the unstable delta soils. ‡

# 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. On vessels equipped with electric power-operated lifeboat winches, the Master is responsible for seeing that such winches and associated equipment are examined at least once every

A. two months.
B. three months.
C. four months.
D. five months.

REFERENCE: 46 CFR 97.15-40(a)

2. How many rockets are required for each impulse-projected, rocket-type line-throwing appliance aboard ship?

A. Two, one of which shall be buoyant type
B. Three, one of which shall be buoyant type
C. Four, two of which shall be buoyant type
D. Five, two of which shall be buoyant type

REFERENCE: 46 CFR 94.45-15

3. What is the International Code Signal (flashing light) for a decimal point between figures?

A. AAA
B. TTT
C. EEEEE
D. AS

REFERENCE: H.O. 102

4. As used on the Pilot Charts, small green arrows indicate the general monthly stream and drift currents that may be expected. What does the numeral appearing above the arrow denote?

A. The mean speed in nautical miles per day
B. The mean speed in nautical miles per hour
C. The number of observations made to determine the average direction
D. The percentage of time during which the current will be flowing in the direction indicated by the arrow

REFERENCE: Pilot Chart North Pacific Ocean

5. Which portable extinguisher should not be kept in the cold?

A. Foam
B. $CO_2$
C. Dry chemical
D. All of the above

REFERENCE: CG-329, Sec. 3-8-2

## ENGINEER

1. The ignition quality of diesel fuel is indicated by its

A. higher heating value.
B. cetane number.
C. viscosity.
D. pour point.

REFERENCE: Stinson

2. A defective injector nozzle in a propulsion diesel engine can cause which of the following?

A. Engine power losses
B. Smoking without overload
C. High exhaust temperature readings
D. Any of the above

REFERENCE: Maleev

3. The operating speed at which excessive engine vibrations are created is the

A. non-harmonic speed.
B. critical speed.
C. maximum speed.
D. design maximum speed.

REFERENCE: Engineman 3&2

4. Which is a proper precaution if a crankcase explosion has occurred in a diesel engine and the crankcase remains intact?

A. The crankcase ventilation system should be started immediately.
B. The sump lube oil scavenge pump should be secured immediately.
C. The explosion relief valves should be manually opened.
D. The crankcase should remain unopened until the engine has cooled.

REFERENCE: Pounder

5. The Bendix-drive spring in a Bendix starter drive

A. absorbs shock when the pinion engages the ring gear.
B. disengages the pinion from the flywheel ring gear.
C. engages the pinion with the flywheel ring gear.
D. prevents the pinion from overrunning on the starter shaft.

REFERENCE: Elect Mate - 3&2

## ANSWERS

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

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

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.



U.S. GOVERNMENT PRINTING OFFICE : 1982 0 - 394-195

U.S. Department
of Transportation

**United States
Coast Guard**

2100 Second St., S.W.
Washington, D.C. 20593

Official Business
Penalty for Private Use $300

Postage and Fees Paid
United States
Coast Guard
DOT 514

**THIRD CLASS**