# Proceedings

## of the Marine Safety Council


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of the Marine Safety Council

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

## Contents



## Cover

*An Air Station San Francisco helicopter hovers near the burning tanker PUERTO RICAN, which exploded on October 31, 1984. Official Coast Guard photo by PA3 Gail Williams, 12th Coast Guard District.*

# Inerted Product Carrier Tanks -- A Newly Discovered Problem

*This article is based on a Chevron report entitled "Oxygen Liberation Aboard Inerted Product Carriers," dated March 1984.*

Chevron Shipping Company recently alerted the Coast Guard to a potential problem involving inerted ullage spaces on petroleum tankships. The ullage spaces were found to contain increased oxygen concentrations several days after a petroleum product had been loaded. Chevron believes that the major source of this oxygen is the petroleum product itself. The product contains dissolved oxygen when it is loaded. After loading the oxygen-containing petroleum product into an inerted tank, the oxygen in the liquid gradually enters the inerted ullage space until equilibrium is reached. Apparently, the dissolved oxygen problem arises only some of the time and only with some petroleum products; crude oil, for example, does not seem to exhibit this problem. Nevertheless, ship operators should be aware of the possibility that inerted ullage spaces may not remain in the safe condition established at the time of loading, and they should periodically measure the oxygen concentration in the ullage spaces of their product carriers.

*Typical U.S.-flag product carriers which may need to monitor oxygen levels in their cargo tanks.*

**Background**

Tankships require greater attention to certain safety aspects than many other types of merchant ships, due primarily to their cargo's flammability. Of course, some petroleum products and some crude oils are carried at temperatures significantly below their flash points, so that the risk of fire or explosion is limited as long as the cargo temperature remains well below the flash point. An important safety measure implemented by the Coast Guard is the requirement that tankships carrying flammable cargoes near or above their flash points, in large or medium-sized tankships, must have and use an inert gas system. Introducing an inert gas into the vapor space reduces the oxygen concentration to a level (8 percent or less) where combustion is no longer possible. As long

as no additional oxygen is added to the vapor space, neither fire nor explosion can occur.

As prescribed in 46 CFR 32.53, petroleum products or crude oil carried in tankships must be carried in inerted tanks, with the exception of Grade E cargoes carried at a temperature at least 5°C below their flash points. Certain relatively small tankships are not now required to have inert gas systems, and these requirements do not apply to ships of any size carrying liquified gases. In practice, inert gas is added to the ship's tanks as the ship is offloaded so that the hydrocarbon vapors left behind in the tank cannot burn. Later, when the tank is loaded, the ullage space contains less than 8 percent oxygen and should remain in that condition throughout the voyage. Regulations require that the inert gas system be designed and operated to ensure low oxygen concentrations throughout the tankship's voyage. If the oxygen concentration rises as a result of normal tank breathing, more inert gas is added to bring the oxygen concentration below 8 percent. There is normally no need to add more inert gas during a voyage. However, if the problem with dissolved oxygen reported by Chevron is widespread, careful attention to oxygen concentration becomes especially important.

**Oxygen in Petroleum Products**

As Chevron reports, petroleum products such as jet fuels, diesel oils, and heavier gas oils can contain significant amounts of dissolved oxygen. The dissolved oxygen can come from various sources. Some products are treated by having air bubbled through them. Sometimes products are stored on land in uninerted fixed-roof tanks, and the oxygen in the noninerted vapor space can dissolve into the petroleum product.

When they are in an inerted tank, such cargoes with dissolved oxygen may release the dissolved oxygen, raising the oxygen level in the ullage space to unsafe levels. In laboratory tests, some of these products have raised the oxygen concetration to as much as 14.8 percent, which is clearly too high for an inerted tank. Chevron found that jet fuels from one refinery had an oxygen solubility of 70 ppm; diesel oils and heavier gas oils were estimated by Chevron to have oxygen solubilities of 20 to 40 ppm. If a saturated jet fuel were loaded into a tank whose inerted atmosphere contained no oxygen and the tank were 95 percent full, the oxygen concentration in the supposedly inert gas could rise to 16 percent at equilibrium.

Chevron also found a second, although much less serious, contributor to the problem of increased oxygen concentration. Carbon dioxide is a major constituent of inert gas, usually making up 12 to 15 percent of the gas. The other two major constituents of inert gas, oxygen and nitrogen, are less soluble in petroleum products than is the carbon dioxide. The carbon dioxide may thus dissolve in the product, leaving the oxygen and nitrogen in the inert gas at a higher concentration.

**What the Operator Should Do**

The ship operator cannot control the amount of oxygen dissolved in the products carried, nor can the operator prevent carbon dioxide from dissolving out of the inert gas while in the vessel's tanks. The operator can, and should, however, measure the oxygen concentration in the inerted vapor space periodically to ensure that it has not climbed into the danger range. If it has, then inert gas must be added to the vapor space, with the oxygen-laden inert gas being "swept out" by fresh inert gas. However, this is possible only if the tank openings to the inert gas inlet and the tank vent are located at some distance from one another (regulations require that all tank openings be closed when a tank is inerted). Any addition of inert gas to a tank will displace an equal volume of gas through the tank vent. If the inert gas inlet is located close to the tank vent, then adding inert gas may not succeed in reducing the oxygen concentration; the inert gas will merely escape through the vent without either mixing with the oxygen-rich inert gas or sweeping out the oxygen-rich inert gas. If the tank vent and the inert gas inlet share the same

tank opening, it will not be possible to add inert gas and, at the same time, avoid overpressurizing the tank.

If it is impossible to reduce the oxygen concentration of the oxygen-laden inert gas, then the inert gas system does not meet Coast Guard and Safety of Life at Sea (SOLAS) requirements. Prior to loading a cargo that can release oxygen, the inert gas system should be modified to permit adding inert gas to cargo tanks while at sea. This may include relocating the inert gas inlets and the tank vent outlets to permit "sweeping out" the oxygen-laden inert gas (improper operation or any modification of the inert gas system should be promptly brought to the attention of the Coast Guard). Before beginning cargo transfer, the ship operator can take certain precautions. The International Maritime Organization's "Guidelines for Inert Gas Systems," Maritime Safety Committee Circular 282, provides guidance and should be followed. This circular is available from the International Maritime Organization, 4 Albert Embankment, London SE1 7SR England.

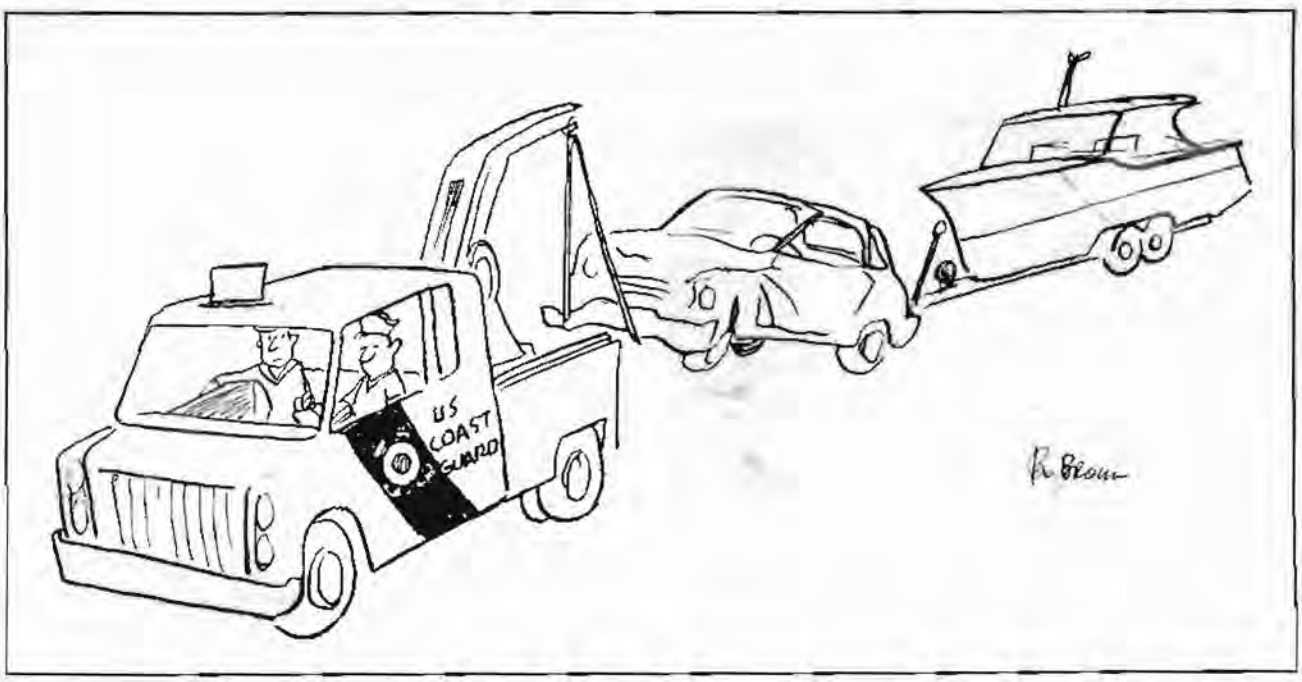
We wish to thank the Chevron Shipping Company for investigating this problem and sharing its findings with the Coast Guard and the private sector.

## New Book Published

Cornell Maritime Press has recently published an updated edition of **Tanker Operations, a Handbook for the Ship's Officer**, by G. S. Marton. Originally published in 1978, it is now widely used as a textbook at maritime academies and schools in the United States, Great Britain, and Western Europe.

The second edition, revised throughout, reflects recent changes in tanker design and equipment. A chapter on inert gas systems (now required equipment on many tankers) has been added. Recent developments in crude oil washing and closed ullaging systems are described and illustrated. In addition, an appendix of conversion factors — listing in detail the various units of measure employed on tankers in the world today — is included. A detailed index is also provided.

**Tanker Operations** is available at maritime bookstores in most major ports throughout the world. It can also be ordered, postpaid, directly from the publisher for $18 (U.S.). For further information, contact Cornell Maritime Press, P.O. Box 456, Centreville, Maryland 21617, U.S.A.



# FIRE ON BOARD!

## What Can You Do?

LCDR Michael B. Slack
First Coast Guard District
Boston, Massachusetts

"It can't happen to me."

"I run a safe ship."

Sound familiar? The most recent statistics show that in 1981, there were a total of 199 vessels involved in fires and/or explosions which were reported to the Coast Guard. These accidents resulted in 10 deaths, 23 injuries, 72 vessels totally lost, and an estimated $58,364,000 in damages to vessels, cargo, and other property.

### Who Is Responsible for Action?

At sea, the responsibility for action relating to a fire or any casualty aboard ship rests with the master and his operating management. However, within port limits or territorial seas, the national authority and/or port authority become involved, and the master's and his operating management's freedom of action may be constrained.

When a ship is berthed alongside a cargo terminal, the responsibilities for action are more complex. The terminal management must also be involved. There are also more fire-fighting resources available.

### What Can You Do?

The best method of controlling a fire on board is to know in advance what part you must play in any contingency plans established for a fire emergency. Contingency planning is done throughout the Coast Guard in conjunction with other federal, state, local, and private entities to prepare for virtually any type of emergency. The keys to successful contingency planning are based on an understanding of

- the types of accidents that may occur,
- the possible consequences of accidents,
- the actions that can be taken practically, and
- the responsibilities and capabilities of the parties who will be involved.


Successful contingency planning involves communication, training, and planned exercises centered on possible types of accidents. By the very nature of the incident, the master of the vessel has a major role to play in the event of a fire on board. The master provides resources to combat the fire and provides information about the vessel and any cargo. The importance of vessel and cargo information cannot be understated. Armed with this information, firefighters can adequately prepare for possible hazardous conditions on board and can determine the best techniques and equipment to use.

*Smoke billows from the tanker PUERTO RICAN. Official Coast Guard photo by PA3 Gail Williams.*

For any fire on board, immediately alerting local firefighting organizations is of utmost importance. The following information should be provided to the fire department:

- Name and telephone number of the person reporting the fire,
- Nature of the fire (what is burning),
- Location of the fire (name of the facility, name of the vessel, and a description of the location of the fire on board),
- Whether anyone is trapped or injured,
- Number of persons on board,
- Nature of cargoes on board,
- Description of any hazardous cargoes involved or in the area,
- The vessel's capability to get underway,
- The firefighting efforts that are already in progress.

Remember, it is imperative to notify the fire department quickly. If you cannot give fire personnel all the necessary information initially, report the fire and try to gather the information for their arrival. When the fire department arrives, be prepared to participate and cooperate in the firefighting efforts as directed by the fire chief in charge. Also, if possible, have the vessel's firefighting plan, an up-to-date cargo manifest, and the vessel's trim and stability book ready for examination by fire officials.

What about a fire on board while laying at anchor? You, the master, have responsibilities, and you have resources. There are also resources ashore that would be of tremendous help to you. How can these resources be brought together? Most shoreside fire departments do not have fire boats. Should you bring your burning ship to them? If you have any suggestions in this area, write to:

Commander (mps)
First Coast Guard District
150 Causeway Street
Boston, MA 0214

Let's share our thoughts.

## Remember These Important Points

**Plan for the accident.**

**Practice what to do.**

**Know whom to contact.**

**Have information available.**

# It Takes A Good Tug . . .

Everybody needs a little help from their friends, and Navy ships are no exception. Aircraft carriers, battleships, cruisers, and destroyers all need help from their good friends the tugs. Small in size but heavy on power, tugs can push, pull, and nudge many times their own weight.

"We're here to service the fleet," says Lt. Donald Price. He's in charge of the Navy's four medium tugs, five large tugs, and three yard oilers in San Diego harbor.

All in all, the Navy has about 135 harbor tugs which are used to help ships in mooring, docking, and getting underway. Crews work about 70 hours a week, and many of the tasks require brute force and strong backs.

But the Navy isn't the only military department with tugs. The Air Force owns two contractor-operated tugs that work out of Thule, Greenland. They are used to maneuver the U.S. and Danish ships that bring supplies to Thule Air Base and move icebergs to keep the harbor channels open.

The Army has 42 tugs ranging in length from 65 to 100 feet. A spokesman for the U.S. Army Transportation Center at Fort Eustis, Virginia, says the Army tugs are used primarily for pushing oceangoing cargo ships and various non-powered barges.

The Coast Guard has 28 ships it classifies as tugs, some as long as 140 feet. Their typical missions are search and rescue and fire protection.

*Chief Petty Officer Paul Murphy, craftsmaster of the harbor tug WENATCHEE, radios the USS KITTY HAWK in preparation for berthing the 70,000 ton carrier. Photo by Jesus Diaz, USN.*


*The USCGC MAHONING, a 110-ft. harbor tug built in 1939.*

How many tugboats does it take to dock an aircraft carrier? That depends on where the carrier is being docked. In Norfolk, Virginia, because of winds and current, it could take as many as eight. In San Diego, it could be done with as few as four.

Either way, a few small, 100-foot, 300-ton tugboats can make a 90,000-ton aircraft carrier do whatever they want it to. Senior Navy Harbor Pilot Stephen G. Cooke, of the Naval Amphibious Base, Little Creek, Virginia, says it's because the tugboats are highly maneuverable and capable of producing tremendous amounts of power.

Most tugs have 2,000-horsepower engines (the average family-sized car has about 140), and 12-foot screws (the propeller that sits underwater). "Tugs also provide an infinite range of movement," says Cooke. They can operate at easy, half, two-thirds, or full power to help maneuver the carrier wherever it wants."

Cooke says that because carriers have propellers of their own aft, the tugs usually work on the sides and bow of the ship. However, if necessary, a carrier could be brought in and successfully docked by tugboats alone.

The job of "parking" an aircraft carrier usually begins several miles out to sea. Cooke says a harbor pilot is flown out to the carrier to confer with the officers on board and determine if there are engineering or other problems with the ship. On carriers, the job of docking is usually left up to the harbor pilot because of the complexity of the operation and the size of the ship. Once the carrier enters port, getting alongside the pier usually takes anywhere from 45 minutes to 2 hours, depending on conditions. ↓

# Ship and Equipment Design

*How well are mariners' requirements taken into account when ships are designed and fitted out? On the premise that feedback from professionals could forestall future problems, a London-based organization solicited the views of its seafaring members.*

## Part VI
## Lifesaving Appliances

**Compiled by E. J. Riley**
**from responses to the**
**Nautical Institute questionnaire**

Major dissatisfaction was expressed with current lifesaving appliance arrangements. The main suggestion was to rethink the whole system of abandoning ship -- to replace lifeboats/rafts with free-fall "survival capsules" fitted with powerful EPIRBS and which can steer clear of burning oil and other hazards. In addition, there should be a fully enclosed, powerful motor launch to act as "mothership" and for search and rescue. More emphasis should be placed on staying in the vicinity of the ship.

This section contains a number of opposing views and indicates the need for a comprehensive study.

**1. Buoyancy aids**

**Problem:** Facilities for personnel working on deck during heavy weather are lacking; there is danger of slipping on the deck and being washed overboard.

**Remedy.** There should be easy-to-use buoyancy aids designed for use by all personnel, and these should not hinder or interfere with work.

**2. Enclosed lifeboats**

**Problem:** Launching and recovering of enclosed boats highlights several problem areas, particularly the lack of maneuverability on the lifeboat deck. Other main faults include the following:

A. It is necessary to climb out of the boat to release the painter, which may allow the bow to bury itself in the sea and possibly flood the craft.

B. Fall hooks are very sensitive. They will not release with weight on the hook. During most drills, the fore hatch must be opened to release the fall manually.

C. Davit head manropes foul the access flap door handles, hinge assemblies, and retaining trapdoor hooks.

D. The fore and aft fall access hatch doors foul the fall block.

**Remedy.** The design needs rethinking, particularly with regard to launching and recovering enclosed boats. Greater room for maneuverability on board the boat is required.

**3. Launching boats/rafts**

**Problem:** Rafts and boats are stowed high above sea level; therefore, launching is time-consuming. Heavy weather makes the entire operation hazardous. Time is wasted with personnel entering boats prior to swinging out. Gravity davits currently require personnel to remain aboard the vessel to operate the davit brake. Enclosed lifeboats have little room for maneuverability when launching and handling. Liferafts -- non-davit launched -- frequently must be thrown over railings, which requires a minimum of two crew.

**Remedy.** Launching, recovering, and boarding boats/rafts should be designed for extreme weather conditions, with personnel wearing emergency apparatus, e.g., a breathing apparatus if necessary. Toggle painter and bowsing-in tackles should be permanently rigged with the loose end of the toggle painter stowed on board ship. Boats/rafts should be stowed as close to the water line as possible to avoid wasting time when launching. Launching of boats/rafts should be via davits that do not require personnel to remain on board.

There is greater preference for stern-launching boats rather than side-launching; they are less likely to receive damage from fire, heavy weather, or collision. Boats for stern launching should be mounted over the stern on a telescopic, inertia-controlled, gravity-activated trackway. They can also be designed for radial capability for alignment to lower side.

**4. Lifeboats**

**Problem:** General construction and equipment is very basic, due to (it is hoped) infrequency of use. Not all boats have motors. Siting of boats is too far aft and therefore close to propeller aperture.

**Remedy.** Boats should be designed to be hard-wearing, with engines in addition to oars in all boats. Siting of boats ought to be well clear of propeller aperature and closer to main deck level.

**5. Lifeboat equipment**

**Problem:** Galvanized steel water tanks are still in use, and the cap frequently jams. Drainage holes are very narrow, and thoroughly cleaning tanks is impossible. Stowage lockers are prone to rusting and are difficult to open. Lifeboat equipment is very vulnerable to theft, particularly when in port. First aid kits are therefore kept out of boats in the third officer's cabin or in the wheelhouse. In "open" lifeboats, all equipment is open to the elements.

**Remedy.** Water tanks should be made of heavy-duty plastic; water-tight caps should be easy to open and close. Larger diameter drain holes should be provided. All lockers require more satisifactory openings. **All** equipment, including first aid kits, should be kept stored in boats at all times, but should be designed for minimum pilferage. Enclosed lifeboats protect equipment.

**6. Lifebuoys**

**Problem:** Cork/canvas-type lifebuoys are labor-

intensive to maintain. The fo'c'sle sited buoy frequently washes away.

**Remedy.** The "Perrybuoy" type of lifebuoy is preferred. Housing brackets should be designed of wood or plastic to enable easy and quick release. Siting of fo'c'sle lifebuoy should be in a sheltered position but with easy access.

**7. Lifejacket**

**Problem:** The Department of Trade (United Kingdom) lifejacket is cumbersome, impractical, and greatly restricts movement. It is potentially dangerous in many circumstances, particularly when trying to climb into a lifeboat prior to swinging out. It is difficult to pass two abreast in alleyways when wearing lifejackets.

**Remedy.** The design needs rethinking. A lifejacket capable of the existing requirements, but easier to move in, should be provided.

**8. Lifejacket stowage**

**Problem:** Currently, lifejackets are stowed in each cabin. Little regard is paid to "extra" personnel, e.g., additional loading masters, Customs personnel, and extra pilots. It is not always possible to reach one's cabin in an emergency.

**Remedy.** Store an additional dozen or more lifejackets in watertight lockers at each emergency/lifeboat station, and keep extra lifejackets for the wheelhouse.

**9. Liferafts**

**Problem:** Raft launching is frequently carried out by manhandling the raft drum over railings, which requires a minimum of two crew. For'd sited raft on fo'c'sle head frequently receives damage from heavy seas. There is no means of propelling or steering raft away from wrecks, burning oil, rocky shores, or other hazards.

**Remedy.** Provide a gateway in bulwarks/railings close to raft stowage positions with one-man launching cradles designed for all rafts. For'd liferaft would be sited in a sheltered position to aid in protection from heavy seas, etc. There should be a more efficient means for clearing away from dangerous hazards.

**10. Maintenance**

**Problem:** Access to stowed boats is unsatisfactory. Ladders constructed by the side of davits produce a large gap to heave oneself over to enter boats. Lifebuoy gear suffers from exposure to the elements.

**Remedy.** Provide safer and easier access to stowed boats with fixed ladders and no awkward turns. Enclosed boats help to protect lifeboat equipment. Where "open" boats cannot be sited sheltered by accommodation, an easy-to-discard protective cover to clip over the boat should be designed. ‡

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The Coast Guard Captain of the Port, New York, is sponsoring a 1-day seminar on Hazardous Materials/Dangerous Goods Regulation Compliance on March 27, 1985, at Governors Island, New York. Topics to be covered include Documentation, Marking, Labeling, Placarding, Stowage, Segregation, Securing Cargo in Freight Containers, and Requirements on the Use of Portable Tanks. Registration will close on March 8, 1985. Acceptance notices will be mailed out on March 11. The cost of the 1-day seminar is $25.00 per person, which includes reference materials, refreshments, and lunch.

To obtain more information on the seminar, contact Hazardous Materials Branch, USCG Captain of the Port—NY, Bldg. 109, Governors Island, New York, NY 10004, Attn: Seminar Registration. If you have questions, please call the Captain of the Port, New York, Hazardous Materials Branch, (212) 668-7909.

# Keynotes

## Notice of Proposed Rulemaking

CGD 84-058 — River Service Dry Cargo Barges; Load Line Regulations — (Dec 14)

The Coast Guard proposed to amend 40 CFR Part 45 to exempt dry cargo river service barges operating on short voyages in Lake Michigan from Calumet Harbor in Chicago, Illinois to Burns Harbor, Indiana from the requirements to obtain a load line certificate. This will eliminate the need for plan review, inspection or survey, drydockings, and periodic inspections that are typically a part of normal load line assignments. It will require that each barge owner certify to the Coast Guard that each barge making this voyage is structurally sound and will be operated in accordance with certain safety requirements.

CGD 83-005 — Sailing School Vessel Regulations — (Dec 27)

**Abstract:** The Coast Guard is proposing a new set of inspection regulations for sailing school vessels, as mandated by the Sailing School Vessel Act of 1982, Pub. L. 97-322. The new regulations would take into account special characteristics, operating methods, and service of these vessels and would establish minimum inspection standards necessary for the safe operation of sailing school vessels.

## Advance Notice of Proposed Rulemaking

CGD 84-069 — Lifesaving Equipment — (Dec 31)

The Coast Guard is considering proposing a complete revision of the lifesaving equipment regulations for tank vessels, mobile offshore drilling units, passenger vessels, nautical school ships, and oceanographic research vessels, as well as the specification regulations for approved lifesaving equipment. This advance notice of proposed rulemaking describes the major contemplated changes and provides an early opportunity for public participation in the development of the revised regulations.

**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)**

## Notice

CGD 84-092 — Simplified Tonnage Measurement of Certain Small Vessels and Barges — (Dec 20)

**Abstract:** This notice announces the centralization of the simplified tonnage measurement process at Coast Guard Headquarters.

CGD 84-097 — Aquatic Resources Trust Fund: Availability of Financial Assistance — (Dec 28)

**Abstract:** The Coast Guard has fiscal year 1985 funds available to provide financial assistance to national nonprofit public service organizations to help them conduct boating safety activities. This announcement seeks proposals for all types of projects that will promote boating safety on a national level. Innovative approaches are welcome. Three areas of special interest this year are:

a. means of dealing with the problem of alcohol abuse in boating;

b. education of persons participating in canoeing, kayaking, hunting, fishing, and other recreational activities involving use of small boats; and

c. investigation and analysis of causes of boat fires and explosions to determine effects of federal fuel and electrical systems regulations.

Specific information on organization eligibility, proposal requirements, award procedures and application forms (SF424) can be obtained by writing Commandant (G-BP/42), U. S. Coast Guard, Washington, DC 20593 or calling Mr. Ladd Hakes at (202) 426-1052.

Proposals must be received by March 28, 1985.

## Final Rule

CGD 84-090 — Exposure Suits: Requirements for Mobile Offshore Drilling Units — (Dec 31)

**Abstract:** These rules revise the areas where exposure suits are required for personnel on board mobile offshore drilling units, including foreign flag units, engaged in activities on the Outer Continental Shelf of the United States.

**The Marine Safety Council office, Room 2110 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.**

## Chemical of the Month

Nancy D. Jasinski

# Carbon Tetrachloride

Carbon tetrachloride, a heavy, clear, colorless, nonflammable liquid, was one of the first organic chemicals to be produced on a large scale. It was used extensively as a spotting (cleaning) agent, a grain fumigant, and in fire extinguishers. Just after World War II, its use as the starting material for chlorofluoromethanes used in refrigeration, aerosol propellant, and blowing agent markets increased rapidly. Yet now the supply far exceeds the demand for the chemical that once was the most extensively used chlorinated solvent in degreasing and dry cleaning. Proportionately less is being used as a solvent, and its use in fire extinguishers has virtually disappeared, although it is still actively used as a fumigant mixture and insecticide.

Potential damage to the ozone layer from chlorofluoromethanes and other chlorine compounds caused much concern and may be a reason why demand for $CCl_4$ has decreased. For more than 20 years the principal use of carbon tetrachloride was the production of the fluorocarbon gases, trichloromonofluoromethane (F-11) and dichlorodifluoromethane (F-12). Use of fluorocarbon gases as spray-can propellants, though, was banned in December 1978.

The banning of such aerosols is just one factor accounting for the reduced demand for this chemical. Its narcotic and toxic properties have been the subject of much investigation. Careful investigations have repeatedly shown carbon tetrachloride to be one of the most harmful of the common solvents, toxic by both inhalation and oral intake. The National Institute for Occupational Safety and Health (NIOSH) has recommended it be regulated as an occupational carcinogen. The American Conference of Governmental Industrial Hygienists in its publication of Threshold Limit Values also lists it as a suspected human carcinogen. In 1970, it was banned from all consumer goods in the United States.

In a fire with a limited amount of water, "carbon tet" decomposes to form the toxic product phosgene. With larger quantities of water, carbon tet slowly decomposes to yield carbon dioxide and hydrochloric acid. Chloromethanes, hexachloroethane, and perchloroethylene, all toxic to various degrees, are formed with steam at high temperatures. Carbon tetrachloride is the most toxic of the chloromethanes and the most unstable when undergoing oxidation; for this reason stabilizers are added in the commercial product. It is reactive with aluminum (sometimes violently), particularly in the presence of moisture, and also with chemically active metals such as sodium, potassium, and magnesium when they are on fire, and will attack forms of plastic, rubber, and coatings. Carbon tetrachloride is miscible in many organic liquids, such as alcohol, ether, chloroform, benzene, solvent naptha, petroleum ether, and most of the fixed and volatile oils. As previously stated, this chemical was at one time used extensively in fire extinguishers due to the extinctive effect $CCl_4$ has on a flame. Its cooling action comes about from its high thermal capacity.

Carbon tetrachloride has a sweet, pungent odor which may cause nausea in some with even the faintest smell. Exposure to high concentrations results in depression of the central nervous system. Lesser concentrations induce dizziness, vertigo, headache, depression, lack of coordination, and mental confusion. Although acute exposure to carbon tetrachloride may cause severe problems to the liver and kidneys, damage usually occurs after repeated ex-

posures. Interestingly, the consumption of alcohol along with exposure to carbon tetrachloride increases the probability of injury. Numerous accounts of injury and death following acute or chronic exposure of humans to carbon tetrachloride have been reported.

In handling the chemical, special care must be taken to protect against physical damage to the containers. Carbon tetrachloride should be stored in a cool, dry, well-ventilated place away from any fire hazards. For the same reason, it should be protected from direct sunlight. Polyvinyl gloves, chemical goggles, and a chemical cartridge respirator should be worn when handling the chemical. In case of a spill or leak, only properly protected personnel should remain in the area. Leaking containers should be removed outside or to a well-ventilated area. Rags or mops used for cleanup should be placed in a closed container until they can be dried safely, as should clothing saturated with $CCl_4$. Clothing should be removed immediately and the body should be washed to remove any carbon tetrachloride coming in contact with the skin. This will prevent dryness because of the removal of the skin's natural oils. Severe cases could result in dermatitis and cracking of the skin with its danger of secondary infections.

Carbon tetrachloride is regulated by the Coast Guard as a Subchapter O commodity for shipment by tank barge and tank ship. The International Maritime Organization on (IMO) includes it in Chapter VI of its Chemical Code (chemicals to which the Code applies). The U.S. Department of Transportation classifies it as an ORM-A material, and the IMO assigns it a Hazard Class of 6.1. It is regulated by the Environmental Protection Agency as a Category D pollutant. However, the IMO considers it a Category B pollutant. The International Maritime Dangerous Goods (IMDG) Code entry can be found on page 6046. ‡

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*Nancy D. Jasinski was a Third-Class Cadet at the time she wrote this article. It was written under the direction of LCDR Thomas Haas for a class on hazardous materials transportation. Technical assistance was provided by the Cargo and Hazards Branch, Coast Guard Headquarters.*

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| | |
|---|---|
| Formula: | $CCl_4$ |
| Synonyms: | carbon tet<br>perchloromethane<br>tetrachloromethane |
| Physical Properties: | |
| boiling point: | 76.5°C (170 °F) |
| freezing point: | -23°C (-9°F) |
| vapor pressure: | |
| 20°C (68°F) | 91 mm Hg |
| 10°C (50°F) | 56 mm Hg |
| Threshold Limit Values (TLV) | |
| time weighted average: | 5 ppm; 30 $mg/m^3$ |
| short term exposure limit: | 20 ppm; 125 $mg/m^3$ |
| Flammability Limits in Air | |
| lower flammability limit: | not flammable |
| upper flammability limit: | not flammable |
| Combustion Properties | |
| flash point: | none |
| autoignition temperature: | none |
| Densities | |
| liquid (water=1): | 1.59 |
| vapor (air=1): | 5.3 |
| U.N. Number: | 1846 |
| CHRIS Code: | CBT |
| Cargo compatibility group: | 36 (Halogenated Hydrocarbons) |

# Inflatable Liferafts to the Rescue

*Having inflatable liferafts on board can mean the difference between life and death. Do you know where the liferafts are stored on your vessel? In an emergency, would you be able to free and inflate them within minutes?*

## Case 1

### Vessel fire

Vessel A was proceeding to the fishing grounds under adverse weather conditions and limited visibility. The wind was from the SW at 30 knots with increasing seas at 10 to 12 feet. The engineer had joined the captain on the bridge in the early evening, reporting everything in order and running normally. A short time later, he noticed black smoke coming from the engine room. Upon investigation, he saw flames emerging from underneath the deck planks on the starboard side of the engine room. The engineer was unable to stay in the area to fight the fire, and the room was flooded with $CO_2$ by remote control. Additional $CO_2$ and dry chemical fire extinguishers were used by the crew to no avail.

A short time later, due to the heavy, acrid smoke, the crew proceeded to abandon the dragger. They attempted to use the wooden dory, but when the dory was put over the side, it immediately capsized in the rough water. The crew then inflated two six-man liferafts and used them to escape the vessel. The crew was immediately picked up by a nearby fishing boat. Before any further action could be taken, the burning vessel swamped and sank.

## Case 2

### Flooding - cause unknown

Vessel B left port on its first trip after a 3-week repair period for drydocking and overhaul. The trawler arrived at the grounds and commenced fishing in good weather. By evening, the weather conditions had become adverse, and the captain decided to return to port at half speed due to 30-knot NW winds and 8- to 10-foot seas.

Sometime later, the cook, who was forward checking the galley range, heard water sloshing about and discovered water in the lower forecastle. He notified the captain, who stopped the vessel and ordered all hands to investigate. At this same time, the engineer, who had been asleep in his bunk aft of the engine room, was awakened by an object striking the hull somewhere forward of the engine room. He went directly to the engine room and found 6 inches of water under the engine foundation. The dewatering capabilities of the vessel consisted of four mechanical pumps in addition to a manually operated pump on deck.

It soon became apparent that, even with all pumps running, the condition of the vessel was getting worse. When the water had risen to a height of 4 feet in the engine room and 8 feet

in the fish hold, the captain ordered the crew to abandon ship. By this time, another fishing boat was standing by to assist. After an unsuccessful attempt to launch a skiff in the heavy seas, a small inflatable liferaft was put over the side and used to shuttle the crew to the nearby vessel. All members of the crew were transferred without injury, and the abandoned trawler soon sank.

## Case 3

## Flooding - clogged bilge strainers

Vessel C was a conventional dragger nearly 40 years old. She had a history of hull leakage and bilge strainers clogging. During the year before this incident, pumps had been airdropped to the vessel on two separate occasions. Since that time, however, she had been hauled, and her transom was rebuilt. Later additional repairs were made to her hull while on drydock, but she continued to leak moderately.

The vessel proceeded to the fishing grounds and arrived there in a 20-knot SSW wind with 10-to 15-foot seas. During the early morning, the engineer noticed that the homemade automatic electric bilge pump had been laboring for unusually long periods, but he did not investigate at this time. Some 2 hours later, while dragging, the engineer noticed more than the "normal" 9 to 10 inches of water in the bilges. Later in the morning, the engines had to be stopped for well over an hour to clean the bilge strainers. By this time, the engineer had three bilge pumps discharging water. Dragging continued for a short time until the nets hung up on the bottom. After freeing the nets, it was determined that several hours of work would be required to make the necessary repairs. The engineer left the deck and went to stop the engine preparatory to fixing the nets. He then noticed 2½ feet of water in the bilges, and the pumps were having difficulty in continuing suction since the bilge strainers were again plugged.

The captain decided to head toward another fishing vessel which was about 15 miles away. That vessel was contacted, and her skipper agreed to proceed toward the troubled dragger. During the time the two vessels were steaming toward one another, the engine had to be stopped several more times to clean the bilge strainers.

The assisting fishing boat was soon sighted. The dory was put over the side, but the heavy sea slammed the dory against the vessel, damaging and sinking it. An inflatable liferaft was immediately put to use, and the captain and crew abandoned the sinking dragger. Five minutes after the assisting vessel had rescued the crew, the abandoned vessel plunged by the head.

While the above cases all include fishing vessel casualties, they do, nevertheless, indicate the merits of having inflatable liferafts on board all seagoing vessels. In each instance, there was a vessel nearby for assistance, but conditions were such that maneuvering alongside would have endangered the rescuing boat as well as both crews. Two of the incidents occured in midwinter, and the possibilities of drowning, injury, or exposure would have been greatly increased if the men had been forced into the water. ⚓

*This "Lessons from Casualties" was reprinted from the August 1966 issue of the* ***Proceedings.*** *The value of having inflatable liferafts aboard has not diminished in the intervening years.*

# 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:

**ENGINEER**

1. In an AC synchronous motor turboelectric power plant, propeller speed is controlled by varying the

A. turbine speed.
B. generator field strength.
C. electric coupling field strength.
D. number of energized main motor poles.

**Reference:** Harrington, Marine Engineering

2. A boiler is being secured in port. After the burners are secured, the forced draft fans and air registers should be secured

A. immediately.
B. after any oil on the furnace floor is completely burned and furnace is cleared of combustion gas.
C. after 30 minutes have elapsed.
D. after at least 1 hour has elapsed.

**Reference:** Latham, Naval Boilers

3. After closing the circuit breaker to parallel two alternators, the next step is to balance the

A. power factor.
B. voltage loads.
C. kilowatt loads.
D. ampere loads.

**Reference:** Hubert, Preventive Maintenance of Electrical Equipment

4. In the event of a power failure to the salinity panel on a flash-type evaporator, the three-way solenoid valve will

A. be frozen in its last position.
B. direct distillate to the freshwater tank.
C. dump distillate to the bilge.
D. dump distillate to the makeup feed tank.

**Reference:** Harrington, Marine Engineering

5. If the jacket water temperature in a diesel engine cooling system is below normal, you should check for

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

**Reference:** Stinson, Diesel Engineering Handbook

**DECK**

1. You are in sight of another vessel on International Waters. You are in a crossing situation, and the other vessel sounds one short blast. You are going to hold course and speed. You should

A. answer with one short blast.
B. answer with two short blasts.
C. sound the danger signal.
D. sound no whistle signal.

**Reference:** COMDINST M16672.2

2. A tide which occurs when the sun and moon are at right angles in relation to the earth and which results in approximately 20% smaller than average tidal range is called a (an)

A. Equatorial Tide.
B. Neap Tide.
C. Spring Tide.
D. Tropic Tide.

**Reference:** Bowditch, American Practical Navigator, Vol. I

3. Which of the following groups of procedures best protects rope against chafing?

A. Parceling, faking, serving.
B. Serving, seizing, whipping.
C. Worming, parceling, serving.
D. Worming, serving, seizing.

**Reference:** Knight's Modern Seamanship, 16th Ed.

4. A carbon dioxide ($CO_2$) fire extinguisher must be recharged when, after weighing the cylinder, weight loss exceeds ___ of weight of charge.

A. 5%
B. 10%
C. 15%
D. 25%

**Reference:** 46 CFR 31.10-18(c)

5. The designations A, B, C, D, and E grades of cargo refer to the various

A. degrees of quality of petroleum products.
B. grades of crude oil.
C. pour points, colors, and viscosity indexes of petroleum products.
D. flash point ranges and Reid Vapor pressure indexes of the products.

**Reference:** CIM 16616.6 -- Chemical Data Guide for Bulk Shipment by Water

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

ANSWERS

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

## New Marine Fire Training Facilities in Washington State

The Washington marine fire safety and protection seminars will resume in 1985, starting with four 2-day workshops in March. Others may be offered later if demand warrants. In autumn, the state will initiate intensive marine firefighting classes at the recently opened Washington State Fire Training Center.

The March seminars will cover subjects such as pre-fire planning and strategies, damage control, ship stability considerations, marine fire protection systems, and firefighting tactics. Two sessions will be offered in Tacoma, and one each in Everett and Grays Harbor. They are open to all ship and port personnel and to ship insurers. Training cosponsors are the Washington State Fire Training Center and a number of Washington's deepwater ports.

The new firefighting center, on 47 acres at the foot of the Cascade Mountains, will offer a 124-foot ship for training purposes. It will have eight sections, each offering special fire and damage control conditions. A mid-ship section, for example, will provide a mixture of steam and diesel engine room operations. Training in this section will concentrate on bilge fires, fuel line failure fires, boiler and fuel tank overflow fires, and engine room access procedures.

The ship is being outfitted with gifts from ships before salvage. An entire ship's engine will be moved as a unit to the site this spring. Any company wishing to donate material or equipment to the program may contact Mr. Hal Schuyler at (800) 426-4152.

John Anderson, director of the Training Center, has also asked shipping companies for suggestions on structuring the most useful curriculum and addressing the fire safety problems of ships coming on stream as well as the older vessels. Mr. Anderson can be reached at (800) 562-6138, or at Building 17, MS-10, Olympia, Washington 98504.

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