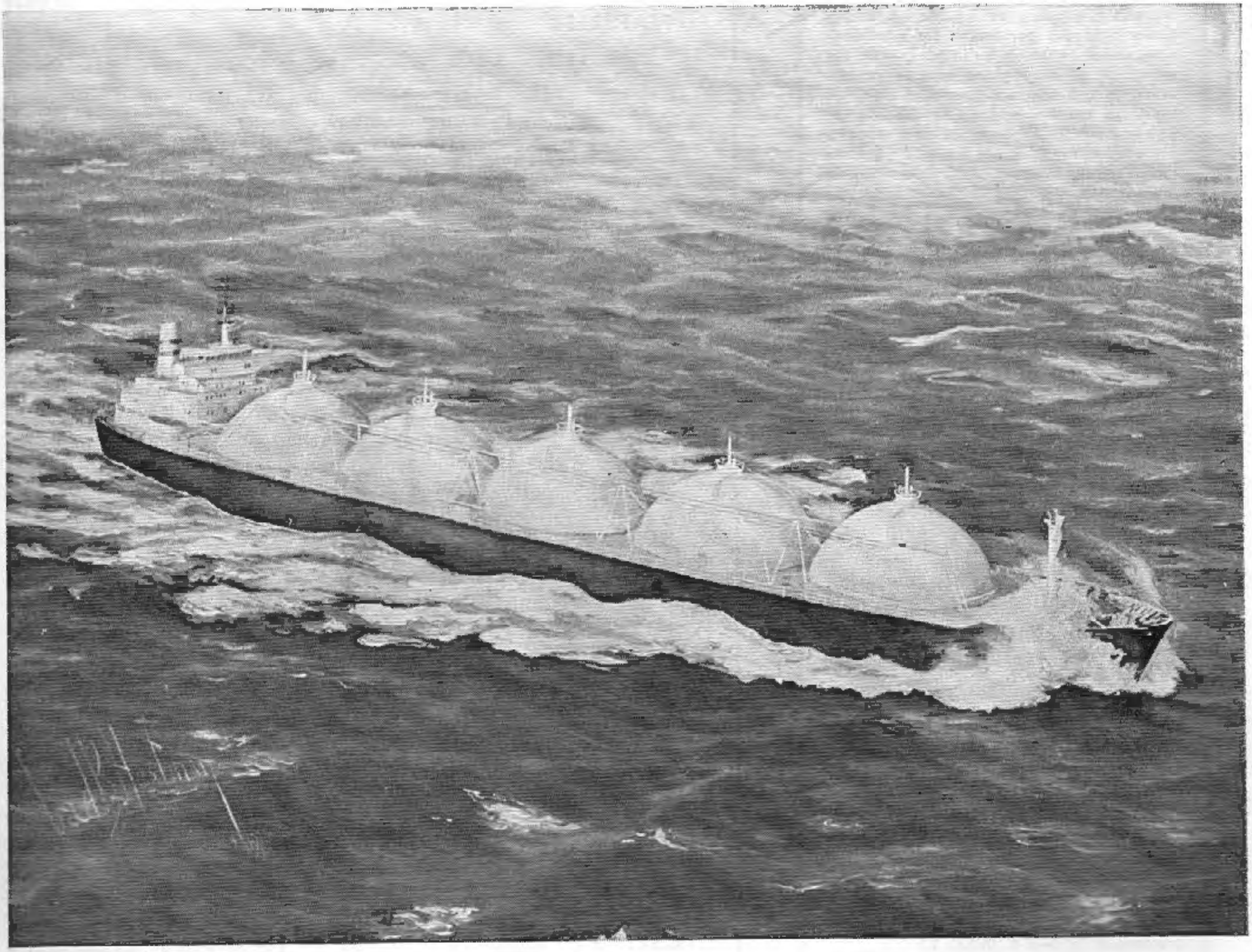
PROCEEDINGS
OF THE MARINE SAFETY COUNCIL



DEPARTMENT OF TRANSPORTATION UNITED STATES COAST GUARD

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PROCEEDINGS

OF THE MARINE SAFETY COUNCIL

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DEPARTMENTS

FRONT COVER

Additions to the world's liquefied gas carrier fleet which are contracted for after 31 October 1976 will be affected by the new IMCO Code for the Construction and Equipment of Ships Carrying Liquefied Gases in Bulk. The new international standards are being used as the basis for revising the U.S. national regulations.

BACK COVER

Picturesquely located at the top of an imposing rock jutting out from the Minnesota shore of Lake Superior is Split Rock Lighthouse. Built in 1910, the 54-foot octagonal brick tower put the lamp 168 feet above the level of the lake. Because of its location, Split Rock is one of the most frequently visited lighthouses in the United States. Its operation was discontinued in 1969, and the property later passed to the State for inclusion in a 1,000 acre tract of parkland.

DIST. (SDL No. 102)
A: acde(2); fghklmntuv(1)
B: n(40); c(16); e(5); f(4); ghj(3); r(2); bkipq(1)
C: egmp(1)
D: i(5); adgklm(1)
E: mn(1)
F: kp(1)
Lists TCG–06, CG–13, CG–20

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

maritime sidelights

NFPA

The National Fire Protection Association (NFPA) recently announced the availability in pamphlet form of new editions of 35 NFPA standards and codes. Revised and updated, these documents were officially adopted in their present form at the NFPA Fall Meeting.

NFPA standards and codes, numbering about 225 in all, are widely used at Federal, State, and local levels as public ordinances and regulations relating to fire safety. They are used voluntarily by commerce and industry and are referenced extensively in the Federal Occupational Safety and Health Act (OSHA) regulations.

Orders for pamphlet editions of standards should be placed through the NFPA Publications Sales Department, 470 Atlantic Avenue, Boston, Mass. 02210.

Among the pamphlets available are:

NFPA 10—"Standard for Portable Fire Extinguishers." Standard criteria for selection, installation, inspection, maintenance and testing of portable fire extinguishing equipment. 76 pages. $3.25.

NFPA 17—"Standard for Dry Chemical Extinguishing Systems." Total flooding, local application and hand hose line systems. 40 pages. $2.50.

NFPA 327—"Standard Procedures for Cleaning or Safeguarding Small Tanks and Containers." Safe removal of flammable vapors, liquids, gases or solids from small tanks or containers that cannot be entered. Such procedures are to safely permit welding, cutting or other work which might create a potential fire or explosion hazard. 16 pages. $2.

NFPA 37—"Standard for the Installation and Use of Stationary Combustion Engines and Gas Turbines." Location, protective devices, fuel supply, exhaust piping. 24 pages. $2.50.

NFPA 43A—"Code for the Storage of Liquid and Solid Oxidizing Materials." Reducing hazards from fires and explosions when liquid and solid oxidizing materials are in storage. Establishes four classes of oxidizing materials and storage requirements. 24 pages. $2.50.

NFPA 493—"Standard for Intrinsically Safe Apparatus for Use in Class I Hazardous Locations and Its Associated Apparatus." Construction and evaluation of equipment of limited energy for use in hazardous locations. 40 pages. $3.

NFPA 59A—"Standard for the Production, Storage and Handling of Liquefied Natural Gas (LNG)." Construction and operation of LNG equipment. 64 pages. $3.25.

NFPA 306—"Standard for the Control of Gas Hazards on Vessels." Minimum cleaning conditions required by Marine Chemists and Federal regulatory agencies before either cold or hot work may be started within the enclosed spaces of marine vessels. 24 pages. $2.50.

ANCHORING

The bow of any boat hull has one main purpose, either to ride over or to cut through waves. Although the importance of anchoring by the bow may seem quite obvious to most boat operators, some recently reported boating accidents and fatalities occurred while boats were anchored by the stern.

Owners and operators of small boats with low freeboard, particularly those powered by outboard motors, are urged to refrain from anchoring by the stern. The pull of the anchor, the weight of the outboard (if one is installed), and the weight of anyone seated in the stern, considerably lower a boat's freeboard, and increase the danger of waves coming over the transom and into the boat. If the waves are large enough they may swamp or even capsize the boat. Anchor by the bow. The pull of the anchor from the bow will counterbalance the weight of the engine and the weight of any passengers. Anchoring by the bow also permits the boat to ride the waves in the manner for which its design was intended.

WELL DONE!

Recently, personnel from MIO, Jacksonville, completed inspection for certification of the SS *Wilmington Getty* concurrent with a drydock examination, while the vessel was in Jacksonville Shipyards, Inc. for annual upkeep. Inspection revealed this 30-year-old vessel and its equipment to be well-maintained and further, the cooperation and enthusiasm displayed by crew members and their supervisors was considered to be outstanding.

The OCMI, Jacksonville, after the inspection was completed, followed up with a "well done" letter to the President, Eastern Operations, of the Getty Oil Company with copies to the vessel's master and the Commandant. This recognition was given to acknowledge the extra effort put forth by all hands aboard the *Wilmington Getty* to comply with the vessel inspection regulations.

FEDERAL REGISTER SCHEDULE

The Coast Guard is taking part in an experiment by the Office of the Federal Register in which Coast Guard regulatory actions will be published only on Mondays and Thursdays. The trial period began 1 February and will continue until 1 August of this year. There may be rare exceptions to this policy, however, when it is considered that delaying publication of an item would not be in the public interest.

NEW IMCO CODE

by Robert J. Lakey

The following article is from a paper presented at the 63d Annual Meeting of the Compressed Gas Association in Houston, Tex., 25–27 January 1976. The opinions expressed here are those of the author and not necessarily those of the Coast Guard.

Last November, the ninth Assembly of the Inter-Governmental Maritime Consultative Organization (IMCO) adopted the Code for the Construction and Equipment of Ships Carrying Liquefied Gases in Bulk (Resolution A.328(IX)) and recommended its incorporation into national regulations as soon as possible. This action culminated an intensive, cooperative effort on the part of 15 nations that participated in the detailed development of the Code.

The purpose of the new Code is to provide internationally agreed standards on design, construction, and operation for the safe carriage of liquefied gases in bulk: safe not only from the standpoint of the crew that operates the vessel but also safe from the standpoint of the ports where the vessels load and discharge.

The need for international standards was recognized by IMCO in 1967 when it began the current program of developing codes for ships such as chemical tankers and gas tankers. The need arose from a realization of the hazard such vessels present to the ports they visit and the fact that ships used to transport the products often are of foreign registry, foreign to both the producing and receiving countries. In the interest of protecting their valuable port resources and attendant populations, countries began developing unilateral control programs such as the Letter of Compliance program in the United States. Such unilateral actions pointed to the need for internationally agreed standards because they can facilitate the acceptance of foreign flag ships in ports as they provide a common basis for vessel design and equipment.

Development of the Code

The new Code was prepared by the IMCO Subcommittee on Ship Design and Equipment Ad Hoc Working Group on Bulk Chemicals. The working group's members were Belgium, Canada, Federal Republic of Germany, Finland, France, Italy, Japan, Netherlands, Norway, Poland, Sweden, Union of Soviet Socialist Republics, United Kingdom, and the United States. Observers from the International Electrotechnical Commission (IEC), International Chamber of Shipping (ICS), International Association of Classification Societies (IACS), and the International Superphosphates Manufacturing Association/European Nitrogen Producers' Association (IMSA/ENPA) also participated in its preparation. The size of the working group is a good measure of the importance IMCO members gave to the effort. The group's mandate was to prepare a comprehensive code, similar to the IMCO Bulk Chemical Code,[1] to cover products having a reid vapor pressure greater than 40 psia.

The work was accomplished by first agreeing upon a basic outline then assigning portions of the outline to participants to develop basic drafts. The draft of each portion of the outline was considered by the working group as a whole and during these considerations the final drafts emerged.

In order to more effectively participate in the development of this new IMCO Code, the Coast Guard formed a special task group under the Chemical Transportation Industry Advisory Committee. Members of this task group, whose chairman is Mr. R. D. Goldbach, are representatives of the American Gas Association (AGA), the American Petroleum Institute (API), the American Institute of Merchant Shipping (AIMS), the American Waterways Operators (AWO), the American Bureau of Shipping (ABS), the Compressed Gas Association (CGA), the Coast Guard, the Shipbuilders Council of America (SCA), and the Society of Naval Architects and Marine Engineers (SNAME). This task group has met innumerable times to review and develop U.S. inputs to the IMCO work, and several of its members have participated along with Coast Guard personnel at the IMCO meetings. The project has

[1] IMCO Code for the Construction and Equipment of Ships Carrying Dangerous Chemicals in Bulk (Res. A.212(VII))

CONSTRUCTION and EQUIPMENT of SHIPS CARRYING LIQUEFIED GAS in BULK

been approached by the task group by first developing drafts of new U.S. regulations then comparing those drafts with proposals from the other countries. This proved to be a most effective method.

The Code for Gas Tankers is separate and distinct from the Bulk Chemical Code, although it is similar in scope and format. It has been based upon sound naval architectural and engineering principles together with our best understanding of the hazards of the various liquefied gases covered.

It has been well recognized during the development of this Code that in order to ensure the safe transport of liquefied gases the total transportation system must be appraised. Safety is dependent not only upon having a properly designed ship, but also upon the ship being manned and operated by a properly qualified crew. The new Code addresses the vessel's design, construction, and, to a limited extent, its operation. The other facets of the system are being or will be addressed in other IMCO activities. The following is a brief description of each chapter.

Chapter I—General

Chapter I contains the administrative provisions of the Code as well as definitions of terms used throughout. The Code is intended to apply to vessels which transport liquefied gases and certain other products as listed in Table 1. It is to be applied to vessels as follows:

(a) to ships for which the building contract is placed after 31 October 1976; or

(b) in the absence of a building contract, to ships the keel of which is laid or which is at a similar stage of construction after 31 December 1976; or

(c) to ships the delivery of which is after 30 June 1980; or

(d) to ships which have undergone a major conversion:

(1) for which the contract is placed after 31 October 1976; or

(2) in the absence of a contract the conversion of which is begun after 31 December 1976; or

(3) which is completed after 30 June 1980.

Early during the drafting of the Code it was discovered that certain commonly used terms in the gas tanker industry had very different meanings in different parts of the world. Therefore, major emphasis was given to the development of an agreed set of definitions. The importance of the definition section of Chapter I cannot be overemphasized as the terms are used throughout the Code and in many cases actually set the limits of application of a specific requirement. For example, "cargo area" is defined as "that part of the ship which contains the cargo containment system and cargo pump and compressor rooms and includes deck areas over the full beam and length of the ship above the foregoing." The term "cargo area" is used throughout the Code to state, for example, where accommodation spaces may be located.

Chapter I concludes with provisions for certification and inspection of the ship. A model certificate is included. The model certificate has been designed especially from the point of view of providing important information on the design of the vessel, *e.g.*, ship type, cargo tank design information, and exceptions.

Chapter II—Ship Survival Capability and Cargo Tank Location

In developing the Code, a major concern has been the possibility of a cargo release spreading a hazard over a wide area. While most gases do not present a water pollution hazard, other potential hazards such as flammability, toxicity, and low temperature call for special attention to cargo containment under both normal and emergency conditions. The Code specifies design criteria which provide a level of protection commensurate with these hazards both for personnel on the ship and in the ports. The Code aims to achieve a high level of safety by specifying criteria for ship survivability after damage, tank location, and cargo containment standards for each cargo.

For the most dangerous gases, such as chlorine, the ship should provide maximum survival and containment features including an ability to survive a major collision or stranding and still remain afloat in a stable condition without release of cargo. For gases which present a minimal hazard, lesser requirements for survivability and cargo containment should be provided in the vessel design. For gases whose hazards are between the two extremes, intermediate standards should be specified. The intermediate standards provide that the vessel be able to sustain a stranding or minor side damage without loss of cargo and without loss of its ability to navigate; however, in a major collision loss of cargo would be expected to occur. An example of cargoes which would fall into the intermediate category are LNG, LPG, and NH_3. These ship survival standards are known as ship types, Ship Type I being the maximum, Ship Type II the intermediate, and Ship Type III the minimum.

TABLE 1.—*Products covered in the code for the construction and equipment of ships carrying liquefied gases in bulk*

Acetaldehyde
Anhydrous Ammonia
Butadiene
Butane
Butane/Propane mixture (LPG)
Butylenes
1-Butene
2-Butene-cis
2-Butene-trans
Isobutylene
Chlorine
Dimethylamine
Ethylchloride
Ethane
Ethylene
Ethylene Oxide
Methane
Methyl Bromide
Methylchloride
Propane
Propylene
Vinyl Chloride
Hydrogen Chloride
Hydrogen Fluoride
Nitrogen
Oxygen
Refrigerant Gases (Halogenated Hydrocarbon)

This chapter embraces all of the philosophy and many of the principles used in defining ship type requirements in the Chemical Code. However, in recognition of the densities of the cargoes and configuration used in gas ship design, certain deviations from the Chemical Code are necessary. These deviations include limiting the height of the bottom penetration damage assumption to two meters and permitting a final angle of heel in the damage condition of up to 30°. The chapter also requires that:

(a) the lifesaving appliances be capable of operating at the maximum angle of heel from the lower side of the vessel;

(b) the emergency power be operable at the maximum angle of heel; and

(c) that under local damage, *i.e.*, not exceeding a depth of 760 millimeters, the maximum angle of heel should not exceed that angle that would permit restoration of at least partial propulsion and steering engine power and that would permit the use of the ballast system.

The damage assumptions used in Chapter II are given in Table 2. The application of these to the three types of ships is given below:

Ship Type I. A ship should be capable of sustaining damage anywhere in her length.

Ship Type II. A ship greater than 150 meters in length should be capable of sustaining the damage anywhere in her length.

A ship of 150 meters or less in length should be capable of sustaining damage anywhere in her length except involving either of the bulkheads bounding an aft machinery space. Alternatively, the smaller Type II ship (150 meters or less) need only meet a one-compartment standard of subdivision provided it is fitted with full pressure vessel cargo tanks of at least 7 kp/cm² design pressure and its cargo design temperature is not below —55°C. This is specially designated as a Type II PG ship standard recognizing the inherent strength of the pressure vessel.

Ship Type III. A ship of greater than 125 meters in length should be capable of sustaining damage anywhere in her length except at transverse bulkheads spaced further apart than the longitudinal extent of damage specified in Table 2. A ship of 125 meters or less should be capable of sustaining damage anywhere in her length except at transverse bulkheads spaced further apart than the longitudinal extent of damage and except involving damage to the machinery space. Standards governing the ability to survive flooding of the machinery space in this instance is left to the Administration.

Further, because of practical limitation, the application of the gas ship type standards were developed with only new construction in mind.

As can be imagined, this difficult and complex subject of hull type has received very careful consideration by all participants as it is one of the most important parts of the Code. It is clear that protection of the valuable port resources is paramount in everyone's mind.

Chapter III—Ship Arrangements

This chapter outlines the segregation standards for the vessels in the following manner:

(a) The degree of segregation of cargo hold spaces from other parts of the vessel is described. It is required that cargo piping systems be segregated from other ship systems and enter tanks directly from the open deck.

(b) Accommodation spaces must be located outside the cargo tank area. There are restrictions on the positioning of doors leading directly from accommodation spaces and non-fixed portlights in relation to the cargo tank and cargo handling areas.

(c) Cargo pump and compressor rooms may not generally be situated below the weather deck and must be within the cargo tank area.

(d) Cargo tanks and potentially gas dangerous spaces are required to have access suitable for personnel wearing protective clothing and equipment. Means of detecting and removing water or leaked cargo from hold spaces are described.

Chapter IV—Cargo Containment

Chapter IV of the Code lists requirements for the cargo containment systems. Included are specific provisions for design loads, structural analysis, allowable design stress, secondary barriers, insulation, thermal calculations, materials, construction and testing.

Various types of cargo containment systems are defined in this chapter and can be summarized as follows:

(a) *Integral tanks* form a structural part of the ship's hull and are influenced in the same manner and by the same loads which stress the adjacent hull structure.

(b) *Membrane tanks* are non-self-supporting tanks which consist of a thin layer (membrane) supported through insulation by the adjacent hull structure. The membrane is designed in such a way that thermal and other expansion or contraction is accommodated without unduly stressing the membrane. This category of tank does include the various internal insulation systems currently being developed.

(c) *Semi-membrane tanks* are self-supporting tanks when empty. When loaded, the top, bottom, and sides must be supported by the adjacent hull structures.

(d) *Independent tanks* are self-supporting; they do not form part of the ship hull and are not essential for hull strength. Three categories of independent tanks are considered:

(1) *Independent tanks type A* which are designed primarily using Classification Society classical structural analysis procedures.

(2) *Independent tanks type B* which are designed using model tests, refined analytical tools and analysis methods to determine stress levels, fatigue, life and propagation characteristics.

(3) *Independent tanks type C* (also referred to as pressure tanks) are tanks meeting pressure vessel criteria where the dominant stress producing load is design vapor pressure.

All categories of tanks except independent type C are generally restricted to a maximum design vapor pressure of 0.25 kp/cm^2, with an increase to 0.7 kp/cm^2 permitted by special consideration of the Administration. In addition, integral tanks are generally limited to the carriage of cargoes having a temperature of $-10°C$ or higher at atmospheric pressure.

TABLE 2.—*Maximum extent of damage*

Side Damage:		
Longitudinal Extent:	$\frac{1}{3}L^{2/3}$ or 14.5 m (0.495 $L^{2/3}$ or 47.6 ft) whichever is less.	
Transverse Extent: (inboard from the ship's side at right angles to the center line at the level of the summer load line)	$\frac{B}{5}$ or 11.5 m (37.7 ft) whichever is less.	
Vertical Extent:	from the base line upwards without limit	
Bottom Damage:	*For 0.3 L from the forward perpendicular of the ship*	*Any other part of the ship*
Longitudinal Extent:	$\frac{1}{3}L^{2/3}$ or 14.5 m (0.495 $L^{2/3}$ or 47.6 ft) whichever is less.	$\frac{L}{10}$ or 5 m (16.4 ft) whichever is less.
Transverse Extent:	$\frac{B}{6}$ or 10.0 m (32.8 ft) whichever is less.	$\frac{B}{6}$ or 5 m (16.4 ft) whichever is less.
Vertical Extent:	$\frac{B}{15}$ or 2 m (6.6 ft) whichever is less, measured from the molded line of the shell at the center line.	$\frac{B}{15}$ or 2 m (6.6 ft) whichever is less, measured from the molded line of the shell at the center line.

NOTE: If any damage of a lesser extent than the maximum specified would result in a more severe condition, such damage should be considered.

Chapter V—Cargo Liquid, Vapor and Process Piping

This chapter sets forth requirements for the design, construction, and testing of cargo piping systems. Also included are the important requirements for the piping system arrangement including the specification of the numbers and locations of valving systems necessary for the safe control of the cargo operations.

Chapter VI—Materials of Construction

This chapter gives the requirements for plates, sections, pipes, forgings, castings, and weldments used in the construction of cargo tanks, cargo process tanks, cargo and processing piping, secondary barriers, and contiguous hull structures.

Requirements for cargo tank design and construction design of piping systems, and materials of construction traditionally have been found in Classification Society rules. Therefore, in developing these three chapters IMCO has worked very closely with the International Association of Classification Societies (IACS). At IMCO request, IACS has provided their recently completed "Unified Rules for Gas Tankers" upon which Chapters IV, V, and VI of the Code are based. During the preparation of the IACS' Unified Rules, the IMCO Working Group was afforded many opportunities to review and provide comments on the work. Without the assistance of IACS, the IMCO Working Group would have been unable to complete its task.

Chapter VII—Cargo Pressure/Temperature Control

This chapter addresses the equipment and arrangements necessary for containment when the cargo is carried at a pressure below that corresponding to the ambient temperature. Means are discussed of preventing boil-off by cargo refrigeration and of handling boil-off gas re-liquefaction, or by combustion in boilers, engines and smaller equipment.

Chapter VIII—Cargo Vent Systems

Requirements are given for pressure relief systems serving cargo tanks, spaces surrounding cargo tanks, and cargo piping and include the capacity and arangement of relief valves. Each cargo tank is required to be fitted with two pressure relief valves unless the tank is very small. These valves must be sized according to an agreed formula. In sizing the valve, credit is given to the type and location of the cargo tank aboard the ship.

The pressure relief valves must be connected to a venting system which must discharge into the atmosphere at a height of at least one-third the beam of the vessel or six meters, whichever is greater.

This chapter also includes requirements for vacuum protection systems.

Chapter IX—Environmental Control for Cargo Containment Systems

This chapter provides standards for the environmental control of:

(a) cargo tanks and piping systems;

(b) interbarrier spaces and void spaces;

(c) vapor spaces of loaded cargo tanks; and

(d) holds when inerting is not required.

Chapter X—Electrical Arrangements

This chapter contains the standards for use of electrical equipment on board the vessel. Specifically addressed are the various types of equipment that may be located in gas dangerous spaces and zones. Chapter I defines gas dangerous spaces or zones as:

> (a) a space in the cargo area which is not equipped with approved arrangements to ensure that its atmosphere is at all times maintained in a safe condition;
>
> (b) an enclosed space outside the cargo area through which any piping, which may contain liquid or gaseous products, passes, or within which such piping terminates, unless approved arrangements are installed to prevent any escape of product vapor into the atmosphere of that space;
>
> (c) a cargo containment system and cargo piping;
>
> (d)(i) a hold space where cargo is carried in a cargo containment system requiring a secondary barrier;
>
> (d)(ii) a hold space where cargo is carried in a cargo containment system not requiring a secondary barrier;
>
> (e) a space separated from a hold space described in subparagraph (d)(i) of this paragraph by a single gastight steel boundary;
>
> (f) a cargo pump room and cargo compressor room;
>
> (g) a zone on the open deck, or semi-enclosed space on the open deck, within 3 m of any cargo tank outlet, gas or vapor outlet, cargo pipe flange, cargo valve or of entrances and ventilation openings to cargo pump rooms and cargo compressor rooms;
>
> (h) the open deck over the cargo area and 3 m forward and aft of the cargo area on the open deck up to a height of 2.4 m above the weather deck;
>
> (i) a zone within 2.4 m of the outer surface of a cargo containment system where such surface is exposed to the weather;
>
> (j) an enclosed or semi-enclosed space in which pipes containing products are located. A space which contains gas detection equipment complying with 13.6.5 and a space utilizing boil-off gas as fuel and complying with Chapter XVI are not considered gas dangerous spaces in this context;
>
> (k) a compartment for cargo hoses; and
>
> (l) an enclosed or semi-enclosed space having a direct opening into any gas dangerous space or zone.

A governing principle in Chapter X is to minimize the installation of electrical devices and/or wiring in gas dangerous spaces and thus minimize the risk of fire and explosion. Where electrical equipment is permitted it must be certified for operation in the specific flammable atmosphere.

Chapter X has been based upon the relevant provisions of Recommendations published by the International Electrotechnical Commission (IEC). Further specific reference is made to their publication 92–5, Chapter XX, Tankers. Throughout the drafting of this chapter, IMCO collaborated very closely with a special working party of the IEC.

Chapter XI—Fire Protection

Fire protection on future liquefied gas carriers will consist of the following parts:

(a) Structural fire protection must be provided for all gas tankers. The standards are based upon IMCO Resolution A.271(VII) which was just adopted as a part of SOLAS in November 1975.

(b) Fire water main equipment must be provided for all gas tankers regardless of their size.

(c) Gas tankers which transport toxic or flammable gases must provide a water spray system for cooling, fire prevention and crew protection. This spray system should cover:

(1) *exposed cargo tank domes* and any *exposed parts of cargo tanks,*

(2) exposed *on-deck storage vessels for flammable or toxic gases,*

(3) cargo liquid and vapor manifolds and control valves,

(4) boundaries of superstructures, deckhouses, and cargo control rooms facing the cargo areas.

(d) If the ship transports flammable gases, a fixed dry chemical powder extinguishing system must be provided. The system should normally consist of at least two independent self-contained dry powder units, and it should be capable of delivering powder from at least *two hand lines* or a combination of fixed monitor/hand lines to any part of the above-deck exposed cargo area including above-deck piping. A quantity that will provide a minimum of 45 seconds full operation must be stoved in each dry powder container.

Chapter XII—Mechanical Ventilation in Cargo Tank Areas

This chapter covers spaces normally entered during cargo handling operations and spaces not normally entered. Location of intakes and exhausts, number of air changes, and materials of construction for fans are also covered.

Chapter XIII—Instrumentation (Gauging, Vapor Detection, etc.)

Requirements are given for cargo tank level indicators and alarms, pressure gauges, and temperature indicators in cargo systems and vapor detection equipment.

Chapter XIV—Personnel Protection

This chapter discusses requirements for protective clothing, gas masks and breathing apparatus, first aid and resuscitation equipment, decontamination showers and eye wash facilities, and personnel rescue equipment.

Chapter XV—Tank Filling Limits

Filling limits are specified in order to prevent a tank's becoming liquid full by thermal expansion after loading. The basic philosophy addressed in this chapter is to prevent the discharge of liquid cargo through the vent system as a result of fire exposure.

Chapter XVI—Use of Cargo as Fuel

This chapter describes the conditions under which LNG boil-off gas may be used as fuel. The necessary arrangements of piping, valves, and gas detecting equipment for safe delivery of the gas to the machinery spaces is specified, as are the necessary ventilation systems to ensure no accumulation of hazardous vapors.

Chapter XVII—Special Requirements

The Code incorporates special requirements for certain cargoes that have unusual characteristics. These special requirements are in addition to the general requirements found in other chapters of the Code. For example, Chapter XVII permits the use of only indirect refrigeration systems for unusually reactive cargoes.

Chapter XVIII—Operating Requirements

Chapter XVIII of the Code deals with the operation of a gas tanker. It is not intended that this chapter be a treatise on proper gas ship operation; rather, it highlights the regulations in other chapters that are operational in nature and includes other requirements unique to gas ship operation.

The International Chamber of Shipping is preparing an operating guide, "Tanker Safety Guide—Liquefied Gas Tankers," which in intended to provide more detailed guidance on proper gas ship operations.

Chapter XIX—Summary of Minimum Requirements

This chapter links together the product hazards to the vessel design. For example, in determining the applicable ship type requirement, products were categorized (or characterized) as high hazard, medium hazard, or low hazard.

(a) *High hazard* is used to describe substances which pose a substantial threat to human life and cannot be tolerated even at low concentration; or which possess unusual flammability characteristics such as a very wide flammable range with a low flammable limit (LFL), a tendency towards explosive decomposition, or self-reaction and ignition; or which have strong oxidizing potential; or a combination of these characteristics. Ship Type I is required for this category.

(b) *Medium hazard* is used to describe substances which can cause injury or irritation at moderate concentrations; or whose vapors are flammable, have low flash points, and have normal ignition temperatures. Ship Type II is required for this category.

(c) *Low hazard* is used to describe substances that have only a cryogenic hazard or a health hazard at very high concentrations. Ship Type III is required for this category.

Existing Ships

As is mentioned under the foregoing discussion of Chapter I, the Code is at present applicable to new ships. In approving the Code for submission to the Assembly, IMCO's Maritime Safety Committee directed that work continue as a matter of priority on developing recommendations for existing ships. At the time of this writing it is anticipated that the work on existing ships will be completed during the first session of the new Subcommittee on Bulk Chemicals (recently formed to take over the function of the Subcommittee on Ship Design and Equipment with respect to bulk chemicals and liquefied gases). Therefore, it is somewhat premature to deal with existing ships extensively in the paper.

Thus far it has been agreed that a separate code should be developed for these vessels. The following is the draft preamble for the code:

> 1. This Code has been developed to provide international standards for the safe carriage of liquefied gases in bulk by ships which are presently in service or otherwise fall outside the scope of the more extensive standards contained in Resolution A.328(IX).
>
> 2. The standards contained in this Code have been derived from those contained in Resolution A.328(IX) and many of the standards are common to both. This Code recommends that certain of the standards be applied immediately. In order to improve the safety of the vessels, other

standards are recommended for application in 2 or 6 years depending upon the difficulty in modifying the subject vessels. Upon evaluation, it has been found that some of the standards contained in Resolution A.328(VII) cannot be applied because their application would entail major structural modification and/or rebuilding of the vessel.

3. This Code has been developed to provide a common basis for evaluating vessels already in the trade which have been built to differing individual Administrations' standards and operated with an excellent safety record. It is not meant to replace any controls which may already be in operation in certain countries. Neither is it intended to degrade any Administration's standards which were in existence when a vessel was built.

4. This Code, because of the definition of the ships it covers, is interim in nature. Ships which are contracted for after 31 October 1976 are to be built in conformance with the standards contained in Resolution A.328 (IX).

During the work thus far it has also been generally agreed that there are two categories of existing ships. One category would include all those liquefied gas tankers which are sailing today including those which have been delivered but are for some reason waiting to actually enter into service. The other category would include those ships under construction or contract but whose delivery will fall outside the application dates of the Code for new ships. The IMCO Assembly specifically addressed the latter category of ships by urging the governments concerned to apply the new ship standards in so far as is reasonable and practical. This resolution was adopted in anticipation of the Organization work on existing ships being completed very soon.

The development of a Code for Existing Liquefied Gas Tankers is a very difficult task. The mere fact that, by definition, "existing ships" includes such a large spectrum of ships built to varying standards during an explosive technological expansion era illustrates the complexity of the task.

Implementation of the Code

At the present time, the Coast Guard is working to transform the IMCO Code into our regulations. For the most part, the proposed new regulations will parallel the IMCO Code; however, in many instances amplifying requirements must be added where the IMCO Code leaves matters to the discretion of the Administration or is not specific enough for our regulatory purposes.

In addition to preparing the proposed new regulation, the Coast Guard is also conducting the required economic and environment assessments of our planned action. It is felt that all of the necessary work will be concluded and the proposed regulation published in the Federal Register later this year.

Conclusion

The new Code has been developed to provide international standards for ships which transport liquefied gases in bulk. The new standards are very comprehensive, covering ship design, construction and, in a limited manner, operations; and they have been based upon the latest gas ship technology. It has been recognized from the outset, however, that gas ship technology is rapidly evolving and from that point of view the Code must be kept under constant review.

In order to ensure the safe transport of liquefied gases the total system must be appraised. The new Code speaks only to three parts of the system: ship design, construction, and, in a limited manner, ship operations. Other parts of the system such as crew training and qualifications are being examined within the IMCO family.

The successful development of the new Code has been accomplished through the cooperative efforts of all involved in the detailed drafting. What will be the impact of the new Code? Throughout its development ship designers and prospective owners have been apprised of the latest draft and it is already being used as many ships currently under contract or under construction will fulfill its requirements. Further, governments such as the United States and certain classification societies have already begun the process of amending their rules to take account of the new Code. Finally, all new ships will meet these new standards.

The Coast Guard has been actively involved in developing standards for the safe transportation of liquefied gases for several decades. As a result, the benefits of having an international standard for the design, construction and operation of liquefied gas ships were recognized. The new international standards are being used as the basis for revising the United States' national regulations. In doing so, the Coast Guard provides for the safe containment and transportation of liquefied gases in U.S. ports.

APPENDIX A.—*Table of contents to the Code for the Construction and Equipment of Ships Carrying Liquefied Gases in Bulk*

COAST GUARD RULEMAKING

(Status as of 1 February 1976)

	Notice of proposed rulemaking	Public hearing	Deadline for comments	Awaiting final action	Withdrawn	Published as rule	Effective date
BOATING SAFETY							
Lifesaving devices on white water canoes & kayaks (CGD 74–159) comment period extended 6–12–75	2–4–75		7–15–75	×			
Safe loading and safe powering standards (CGD 73–250)	3–6–75		4–21–75			9–23–75	3–23–76
Inboard safe loading standard (CGD 74–83)	3–6–75		4–21–75			8–13–75 Corrected 11–5–75	2–9–76
Boats and associated equipment (CGD 75–110)	9–19–75		11–5–75	×			
BRIDGE REGULATIONS							
Chicago River, IL (CGD 74–137)	6–3–74		7–16–74	×			
Matanzas River, FL (CGD 75–024)	1–29–75		3–4–75	×			
Fox River, WI (CGD 75–035)	2–6–75		3–7–75	×			
Mystic River, MA (CGD 75–053)	3–27–75		4–29–75	×			
West Palm Beach Canal, FL (CGD 75–070)	3–27–75		4–29–75	×			
Illinois River, IL (CGD 75–060)	4–1–75		5–6–75	×			
Passaic River, NJ (CGD 75–052)	4–4–75		5–6–75			12–19–75	1–19–76
Snake R. & Clearwater R., Lewiston ID & Clarkston, WA (CGD 75–099); revoked 1–16–76	4–30–75		6–10–75			12–3–75	1–5–76
Duwamish Waterway, WA (CGD 75–097)	5–13–75		6–30–75	×			
Gulf Intracoastal Waterway, LA (CGD 75–131)	6–18–75		7–22–75			1–16–76	2–20–76
Tombigbee River, AL (CGD 75–153)	8–5–75		9–5–75	×			
Clearwater Pass, FL (CGD 74–299)	8–12–75		9–12–75	×			
Harlem R., East R., & Gowanus Canal, NY (CGD 75–181); effective date amended 1–27–76	10–1–75		10–31–75			1–16–76	2–20–76
AIWW Hallendale, FL (CGD 74–257)	10–15–75		11–14–75			1–5–76	2–2–76
Indian River, FL (CGD 75–180)	10–30–75		12–2–75	×			
Chehalis River, WA (CGD 75–179)	11–4–75		12–9–75	×			
Bayou Grosse Tete, LA (CGD 75–215)	11–21–75		12–31–75	×			
Old Fort Bayou, MS (CGD 75–214)	11–21–75		12–31–75	×			
Norwalk River, CT (CGD 75–216)	11–21–75		12–31–75	×			
St. Lucie River, FL (CGD 72–168)	11–21–75		12–31–75	×			
Tacoma Harbor, WA (CGD 75–195)	11–21–75		12–31–75	×			
Lake Champlain, VT (CGD 75–222)	12–8–75		1–9–76	×			
Dutch Kills, NY (CGD 75–231)	12–22–75		2–5–76				
Shrewsbury, NJ (CGD 75–241)	2–2–76		2–20–76				
Missouri R. IA (CGD 75–244)	2–26–76		3–12–76				
HAZARDOUS MATERIALS							
Sodium sulfide solution and sulfur dioxide (CGD 73–275)	7–16–74 Corrected 9–5–74		12–5–74			1–21–76	1–20–76
Dangerous cargo labeliug (CGD 75–050)	6–18–75	7–16–75	7–31–75	×			

COAST GUARD RULEMAKING—Continued

	Notice of proposed rulemaking	Public hearing	Deadline for comments	Awaiting final action	Withdrawn	Published as rule	Effective date
MARINE ENVIRONMENT AND SYSTEMS (GENERAL)							
Pipelines, lights to be displayed (CGD 73–216)	9–19–74 Corrected 10–18–74	10–21–74	11–4–74	×	...	...	...
Oil and hazardous substance liability (CGD 73–185)	12–4–74	...	1–16–75	×	...	...	...
Mooring barges on the Mississippi (CGD 74–185)	2–4–75	2–19–75 New Orleans	3–17–75	...	...	12–3–75	1–2–76
Demarcation line, Guayanilla Bay, PR (CGD 73–287)	6–18–75	...	8–4–75	×	...	...	...
Demarkation line, San Carlos Bay, FL (CGD 75–235)	1–2–76	...	2–18–76	...	...	...	...
MERCHANT MARINE SAFETY (GENERAL)							
Bulk Dangerous Cargoes, Inspection of Barges (CGD 73–271)	3–11–74	4–15–74	4–30–74	×	...	...	...
First Aid Certificates (CGD 73–272)	4–2–74	...	6–15–74	...	...	...	...
	Supp. Notice 12–1–75	...	1–16–76	×	...	...	...
Carriage of Solid Hazardous Materials in Bulk (CGD 74–13)	5–15–74	7–16–74	8–31–74	×	...	...	...
Load line regulations rail height adjustment (CGD 74–164)	10–4–74	...	11–15–74	...	...	1–8–76	2–9–76
Construction and equipment of tank vessels (CGD 74–127); advance notice 9–5–74	4–21–75	5–21–75	6–5–75	...	...	1–26–76	2–26–76
Licensing and certificating; apprentice mate endorsement (CGD 74–226); Comment period extended 3–7–75	1–23–75	...	4–9–75	×	...	...	...
Specifications for inflatable life rafts (CGD 75–040)	8–1–75	...	9–15–75	...	...	12–17–75	1–19–76
Metal borings, shavings, turnings, and cuttings (CGD 75–133)	8–1–75	...	9–15–75	×	...	...	...
Marine occupational safety and health standards (CGD 75–101); Advance notice; comment deadline extended 12–11–75	8–11–75	...	1–15–76	×	...	...	...
Tank vessels; air compressors, cargo handling room bilges CGD 75–017)	8–13–75	...	9–29–75	×	...	...	...
Load line fee schedule (CGD 75–139)	8–15–75	...	9–29–75	...	...	12–8–75	1–8–76
Civil penalty procedures (CGD 75–123)	9–11–75	...	10–27–75	×	...	...	...
Vessel inspection regulations (CGD 75–074)	9–16–75	...	10–31–75	×	...	...	...
Fire hydrants and hose (CGD 74–60)	9–23–75	...	11–10–75	×	...	...	...
Electrical cable splicing (CGD 74–305)	10–8–75	...	11–24–75	×	...	...	...
Tank vessels in domestic trade (CGD 75–201); corrected 10–22–75; comment deadline extended 11–20–75	10–14–75	...	12–1–75	...	...	1–8–76	1–8–76
Great Lakes pilotage rates (CGD 75–175)	10–31–75	...	12–1–75	×	...	...	...
Fire and boat drills on passenger vessels (CGD 75–009)	12–17–75	...	1–26–76	×	...	...	...
Structural fire protection (CGD 75–032)	12–22–75	...	2–5–76	...	...	...	...

NOTE: This table which will be continued in future issues of the Proceedings is designed to provide the maritime public with better information on the status of changes to the Code of Federal Regulations made under authority granted the Coast Guard. Only those proposals which have appeared in the Federal Register as Notices of Proposed Rulemaking, and as rules will be recorded. Proposed changes which have not been placed formally before the public will not be included.

Flame Screens —Necessity or Nuisance?

by LCDR F. H. Halvorsen

A small tank barge was loading aviation gasoline at a remote location. The temperature was about 85° F and there was little wind. The barge was about half loaded with four tanks being loaded simultaneously at a high loading rate. The ullage holes were opened with flame screens removed in order for the tankerman to sight the liquid level. At about noon, a small yard towboat maneuvered close alongside in order to pick up another barge which had just finished topping-off. As the towboat moved past, a loud whooshing noise was heard by the tankerman.

The tankerman watched helplessly as a visible flame front proceeded from the towboat toward the barge he was loading. At the edge of the barge the flame front separated into four distinct trails and approached the four open ullage holes. The tankerman was able to replace the flame screen in the tank nearest him, but the flame front entered the three other tanks. The tanks exploded immediately, and the tankerman was catapulted into the water. About 20 seconds later the fourth tank exploded. Burning gasoline covered the surface of the water and the barge sank in the shallow river alongside the dock. The tankerman survived although he was badly burned and suffered a broken leg.

Although this story is a complete fabrication, it does indicate the necessity for flame screens and has hopefully aroused the interest of the reader.

A Friendly Discussion

A recent discussion held at Coast Guard Headquarters centered around the necessity for use of flame screens aboard tank vessels.

46 CFR 35.30–10 specifies that "No cargo tank hatches, ullage holes or Butterworth plates shall be opened or shall remain open without flame screens, except under the supervision of the senior member of the crew on duty. . . ." The basic question under consideration was how to determine the number of flame screens which could safely be removed during cargo transfer operations of flammable cargoes. It is common practice, especially aboard tank barges, for any number of flame screens to be removed during critical gauging operations.

Participants in the discussion held widely varying viewpoints as to how many flame screens could be safely removed. At one extreme, some persons maintained that only *one* flame screen could be safely removed, and then only under the direct personal supervision of a competent senior crewmember or tankerman. At the other extreme, some persons maintained that more than a single flame screen could be removed depending on the ability of the crewmembers, or tankerman, to replace the screens in the event of an accident.

All persons agreed that the regulation was difficult to enforce and at best was an "endorsement of motherhood" which we hoped to have practiced by industry. To say the least, the discussion was not completed and the issue was not resolved. Since the problem exists and since the stated difficulty with enforcement continues, this writer would like to discuss the rationale for requiring and using flame screens.

Why Use a Flame Screen?

The purpose of a flame screen is to momentarily prevent a *low energy* flame front from passing into a cargo tank and igniting flammable vapors which are present above the liquid. We must recognize that if a flame screen is not in place, or is torn, it cannot perform the safety function. A flame screen left on deck is nothing better than a tripping hazard. A flame screen that is torn is useless.

How Does a Flame Screen Work?

A flame screen prevents passage of a flame front by cooling. Consider a low energy flame front progressing through a flammable vapor mixture; the heat from the hot reacted gases in the flame front diffuses to the adjacent unreacted gases. This transfer of energy increases the temperature of the unreacted gases to that necessary for reaction.

The flame screen works by conducting the heat of reaction away from the flame front. The heat produced by the exothermic oxidation of the vapor is radially (from the direction of the movement of the flame front) conducted away by the metal in the flame screen. The size of the mesh in the flame screen (actually—the amount of cooling surface available) determines how rapidly a given burning gas mixture can be cooled below the ignition temperature. In other words, if the mesh is too big, not enough cooling surface is available and the flame front can progress through the screen. Since the heat capacity of the metal is much greater than the gas, the temperature of the gas can be reduced hundreds of degrees and only cause a few degrees rise of temperature in the screen. In other words, the metal screen acts as a heat sink and absorbs energy. This prevents the heat from being transferred from the hot reacted gases to the cool unreacted gases and prevents propagation of the reaction through the screen.

When Does a Flame Screen Not Work?

1. Flame screens do not work when they are not installed or are torn.

2. Flame screens do not prevent high energy flame fronts from entering cargo tanks. For example, the two crude oil tankers which exploded in Philadelphia (MC *Elias* April 74; MV *Corinthos* January 75) reportedly had flame screens in place on all tanks when the initial explosions occurred. The flame screens on these vessels permitted the high energy flame fronts (high temperature, high velocity) to pass unchecked into cargo tanks. Once an explosion has occurred, flame screens are of little benefit.

3. Flame screens do not work if engulfed by fire. If a flame screen is surrounded by fire for any appreciable amount of time, the temperature of the screen will increase. Once the temperature increases past a certain value the cooling properties are negated and the flame front can pass through the screen.

Grade of Cargo and Use of Flame Screens

The compunction to properly use flame screens increases with the volatility of the cargo. The more volatile the product, the greater the ignition potential and the greater the need for flame screens. As in the hypothetical example, a hazard exists from vapor trails during loading when cargo vapors are being evolved through tank openings at a high rate. A vapor trail is a continuous flammable mixture of flammable gas in air produced by evolution of gases during loading or from the evaporation of a flammable liquid. The "trail" extends downwind from the source. The distance the vapor trail can reach is determined by the volatility of the cargo as well as existing weather conditions. The greater the volatility, the farther a potential vapor trail can reach. Since volatility increases with the grade of a cargo, the higher the grade, the greater the potential length of a vapor trail.

Vapor trails can also be formed by evaporation of volatile cargo spilled on deck. For example, the fire and explosion aboard tank barge MOS 106 on 12 May 1969, in Lagrange, Missouri, occurred when gasoline spilled on deck was remotely ignited by a galley fire on a towboat moored alongside. Apparently, the gasoline spilled on the deck of the barge vaporized and the flammable vapor flowed approximately 80–100 feet to the towboat, where it was ignited. A 6-knot wind assisted movement of the vapor over the water. In this accident, the tanks involved in the explosion and fire had hatch covers closed but not dogged down. The flame screens were apparently in place, but the presence of large quantities of gasoline on the deck caused a fire which ostensibly heated the screens and negated the cooling effects.

Burning Velocity of a Flame Front

The velocity of a gasoline flame front burning under atmosphere condition is only about *one* mile per hour. However, if the flame front develops only a slight overpressure, this velocity can increase greatly. The limiting velocity of a flame front in air is the sonic velocity—1100 ft/sec—which is associated with a detonation. If in our hypothetical accident, the flame front velocity was only the standard burning velocity in air of 0.8 miles/hour, our tankerman would have had plenty of time to replace the flame screens. We can never be sure, though, what the velocity of the flame front will be. The velocity of the flame front depends on meteorological conditions, flammable vapor concentration and the source of ignition.

In summary, flame screens are useful only if in place. Admittedly, this writer knows of no instance where removal of a flame screen caused an accident. However, this is not the rationale by which the efficacy of the flame screen should be judged. A more logical approach is to say this writer does not know how many accidents were prevented because a flame screen was present. Until something better comes along, flame screens must be used. ⚓

lessons

from casualties

I

The failure to follow recognized safety practices will often end in tragedy. The following narrative is an example of what consequences may result when safety precautions are not adhered to while working in cargo tanks.

At 1005 the chief mate called the master to the bridge and explained that preparations had been made to enter the No. 10 center cargo tank, which contained 800 to 1,000 barrels of gasoline, for the purpose of checking the position of the portable pneumatic diaphragm pump and to reattach the line used to lower and retrieve it. The pump was being used to transfer motor gasoline from the No. 10 center cargo tank to the No. 3 center cargo tank. It was further explained by the chief mate that the work to be performed, using a Fresh Air Breathing Apparatus (FABA), could be accomplished in a few minutes.

The master instructed the chief officer to assure that the FABA was working properly, that the lifeline and air hose be properly attended and kept clean, and that the person entering the tank was cautioned to immediately exit if any trouble or doubt was encountered.

The equipment brought to the scene was one complete fresh air breathing apparatus, in a box-like container. The container housed the manual driven air pump and held the facemask with attached leather harness, two 150 foot lengths of steel wire rope lifelines, and two 25 foot lengths of airhose. In addition, two 25 foot lengths of airhose of the same type were removed from the second (standby) FABA container, brought to the scene and included in the assembled equipment. The air pump was placed 20 feet from the tank opening and connected to the four lengths of airhose and the facemask.

The boatswain apprised the chief officer that the equipment had been assembled, using the two additional sections of airhose from the second FABA, and that there was no spare hose in the event of an emergency. The mate acknowledged and asked to use the rubber boots the boatswain was wearing. Upon donning the boots he was assisted by the boatswain in putting on the harness and facemask. He tested the operation of the equipment by having the air pump actuated. He then tested the facemask for proper operation and indicated to the able seaman, the pump operator, to increase the speed. After a few moments he advanced to the tank opening where the boatswain asked the chief officer if he wanted a lifeline. The chief mate declined the use of the lifeline and did not make any arrangements for emergency signals or other communications.

At 1010, the chief officer entered the tank. His air hose was being tended by the boatswain, who was assisted by an able seaman and an oiler, who was acting as standby in the event of an emergency. The chief officer descended directly to the bottom ladder landing, turned to the portside, went aft, and stepped onto a pipe running athwartships; he went under the ladder, inboard, until he reached a pipe running fore and aft. He proceeded aft of that pipe and was lost from view from the observers on deck when he passed under a ladder platform. His air hose could be seen tending straight down with a bend at the bottom. The bend was in the direction which he had been last seen. After a few minutes, the mate was seen walking hurriedly forward on the pipe to the inboard (starboard) side of the ladder; he mounted the ladder from the opposite side from which he had descended. He climbed the ladder to the first platform, took a few staggering steps on the platform, removed the facemask and yelled to the men on deck for assistance. He fell backwards onto the platform without the facemask being replaced.

The men on deck acknowledged the chief officer's call by directing him to replace the facemask. The boatswain reacted immediately by entering the tank and descending the ladders in an attempt to aid him. Upon reaching the platform where the chief officer lay, the boatswain found that the effect of the fumes were too much for him to withstand and he returned to the hatch opening where, due to his affected condition, he had to be pulled out onto the deck.

The master, observing from the bridge, noted the increased activity at the scene and dispatched the third officer to investigate. After an inquiry, the third officer reported from the scene that the chief officer had removed the facemask and was laying in the tank. The master ordered the third mate to obtain the second FABA from the emergency gear locker.

The second FABA was brought to the scene. Two lengths of airhose were pulled from the tank, disconnected and reconnected to the second FABA. An able seaman donned the harness and facemask and with a steel wire rope lifeline entered the tank. He descended to where the chief officer lay and attached the lifeline to the harness the mate was wearing. An attempt to extract the mate was made, using the lifeline, but it became fouled and the attempt failed.

Other crewmembers, having heard of the peril of the chief officer, arrived at the scene. Among these men was the second assistant engineer, who volunteered to attempt the rescue. He relieved the able seaman of the harness and facemask, confirmed its proper operation, and entered the tank. He descended to where the chief officer lay and attempted to free him by disconnecting the airhose couplings from the harness. The second assistant found that tools were required to accomplish the task and went to the hatch opening and obtained a channel-lock pliers and a nylon rope. He returned to the platform and disconnected the airhose and the previously attached lifeline. He secured the nylon line around the chief mate. The men on deck heaved around on the line and, with the second assistant engineer assisting by lifting and guiding, they removed the chief officer from the tank.

Upon the chief officer's removal from the tank, a radio message was sent advising that the vessel required immediate assistance. The vessel's course was altered to intercept the requested rescue helicopter.

At 1613, upon arrival of the rescue helicopter, the chief officer was evacuated from the vessel to the nearest hospital. He was pronounced dead upon his arrival at 1930 hours. The cause of death was recorded as gasoline fume inhalation.

The following factors were found to contribute to the loss of life.

1. There was no standby equipment at the scene prior to the occurrence and the use of that equipment was delayed due to the airhose already being in use.

2. That each fresh-air-breathing apparatus did not contain sufficient airhose to reach from the open deck, well clear of the hatch opening, to any part of the tank.

3. There was lack of prudence in that recognized safety procedures for entering a tank were not followed.

4. The occurrence may have been preventable had emergency signals or communications been established with the on-deck attendants prior to entering the tank.

II

At 1900 on August 1975 the Tug *Major General H. L. Rogers* with three persons on board was being intentionally scuttled some 0.4 mile northeast of Coki Point, St. Thomas, U.S. Virgin Islands, over an artificial reef site. In the final stages before sinking, the vessel took a heavy surge of water over the starboard quarter which swept the three persons into the interior of the vessel. Two of the persons surfaced shortly thereafter; the other person lost his life as a result of the casualty.

The subject vessel was an uninspected, undocumented, and unnumbered former U.S. Army Corps of Engineers Tug. She had lain beached in St. Thomas for several years until purchased by the present owner on 26 March 1974. She was subsequently floated and the superstructure and deck appurtenances were removed with the intention of selling the vessel for scrap. Unable to sell the vessel, the owner made arrangements to donate the vessel to the Department of Conservation and Cultural Affairs, Government of the Virgin Islands of the United States. In addition to superstructure removal, the owner had cut various sized holes in the main deck in preparation for scuttling.

The weather at the time of the casualty was clear with 10- to 15-mile visability. The wind was from the east at 10 knots. The seas were calm with a 3-foot ground swell also from the East. There was a 2-knot westerly current. Air and water temperatures were 85 and 74 degrees respectively. The weather was not a factor in the casualty.

The artificial reef project had been originally conceived in 1972. The proposal was channeled through the various U.S. Government agencies and a permit was issued through the Department of the Interior and Army Corps of Engineers authorizing the establishment of the reef site. In 1973 the permit was amended to relocate the site to its present location off Coki Point, St. Thomas. The Division of Natural Resources Management, Bureau of Fish and Wildlife under the Department of Conservation and Cultural Affairs manages the program for the Virgin Islands Government. The bulk of the funds used to finance the project are obtained from the U.S. Department of Interior. Prior to the incident, two vessel bodies and approximately 150 tire units had been placed on the site. The artificial reef is intended to provide a fish haven, promote fish population and indirectly assist tourism by providing a fishing area relatively close to shore for recreational boats and small passenger-carrying vessels. At about 0900 on 20 August 1975, the tug departed St. Thomas Harbor under tow of the British-registered tug *Captain Sam*. The vessel's main hold had previously been wired with a dynamite charge to be detonated on scene for scuttling. They arrived on scene at the artificial reef site at about 1130 and commenced drifting. At 1300 an 18-foot outboard arrived on scene with the three men aboard. Inasmuch as the vessel was being donated for community benefit, all vessels and personnel involved were donating their services. Also on scene at this time was another small boat containing three Department of Conservation and Cultural Affairs employees who were acting as V.I. Government observers to ensure that the vessel was scuttled in the appropriate position.

Shortly after 1300, wire was strung out from the vessel and an attempt was made to detonate the dynamite charge. This attempt was unsuccessful. Sometime between 1430 and 1500, a second attempt was made from a 13-foot rowboat borrowed from the *Captain Sam*. The detonation was successful this time; however, the rowboat was partially swamped by the detonation wave action and the Department of Conservation boat had to then tow the rowboat back to the *Captain Sam*. An inspection was then made which revealed that the blast apparently had not accomplished its purpose. A skin diver then attached a 4-inch towing hawser to a previously sunken vessel, mooring the vessel at the site. At about 1500 the *Captain Sam* departed the scene to proceed with normal business. The three men in the 18-foot outboard then departed for Saphire Bay, St. Thomas, where they obtained a 3-inch capacity pump and then returned to the scene, arriving at about 1600. The outboard was tied off the stern of the hulk and the three men boarded it. At this time they were the only persons remaining on scene with the exception of the Department of Conservation small boat and personnel.

The pump was engaged and commenced pumping water into the main hold of the vessel aft where the superstructure had been removed. As the vessel filled with sea water in the aft section, she began to slowly settle by the stern. At about 1830, one of the Department of Conservation people became concerned about the safety of the operation, came alongside the vessel and suggested that the three men board and continue to pump from their small boat. Shortly thereafter he also suggested that all three men don their life preserves which were stowed in the small boat. They declined both suggestions. At about 1900, the vessel went down by the stern and a heavy surge of water came over the starboard quarter sweeping two of the men into the main hold interior of the vessel. The third man was swept into an open hatch on the starboard side just forward of the main hold. The small boat rode over the gunwale and was also swept into the main hold, then immediately surfaced and rode up along the port side to the forward part of the vessel.

The hulk then began to fill with water and slowly sink down by the stern. One man worked his way out through an open hatch on the port side and another came up out through the main hold. Both surfaced in the immediate vicinity of their small boat some 100 yards down current from the sinking position. Both individuals climbed into the boat. The Department of Conservation personnel came alongside, checked their condition and commenced circling the debris searching for the third man. At about 1915 they departed the scene. They proceeded to Pineapple Beach, alerted the authorities and returned to the scene. At 2015 the Coast Guard was notified of the casualty. At 2207 a Coast Guard helicopter arrived on scene, followed at 2217 by an 82-foot patrol boat. Both vessels conducted a night search until 2346 with negative results, and then departed. At 0200 on 21 August 1975, local police, assisted by Civil Defense and local diver personnel, completed a beach search with negative results. At 0710 the 82-foot patrol boat returned to the scene and commenced searching. At 1030 volunteer divers on scene recovered the body from the interior of the scuttled vessel's main hold.

The Coast Guard Marine Board of Investigation concluded:

1. That the cause of the death was asphyxia due to drowning. It is further concluded that after being swept into the interior of the vessel the deceased became trapped inside which resulted in his drowning.

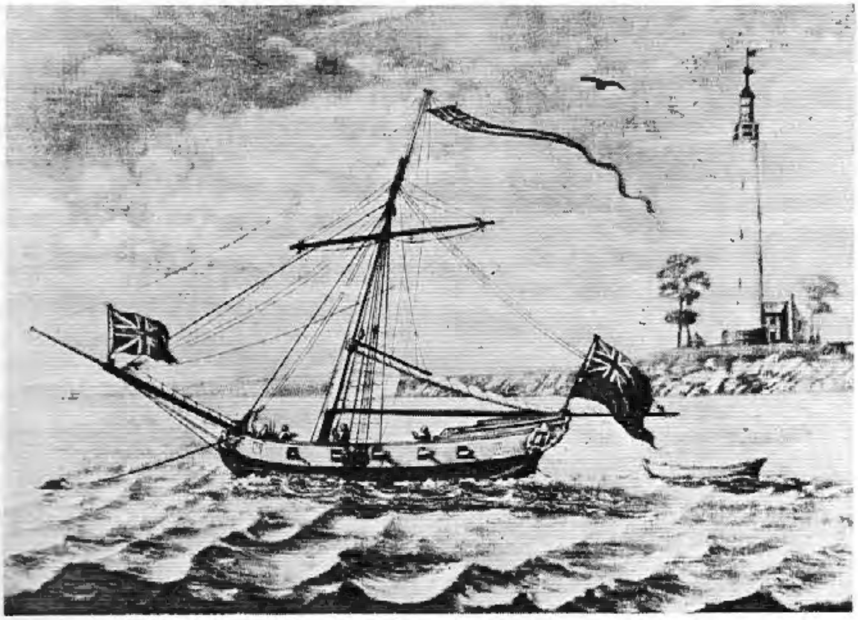
2. That the cause of the casualty was lack of experience on the part of the scuttling personnel. It is further concluded that general carelessness and disregard for safety along with excessive drinking contributed very heavily to the casualty.

3. That had the deceased been wearing a lifesaving device his death might have been avoided.

4. That there is no evidence of violation of Federal law or regulation nor that personnel from the Coast Guard or any other Government agency caused or contributed to the casualty.

The Virgin Islands Government is now developing a Plan of Operation containing guidelines and requirements relative to anchoring, positioning, methods of scuttling, etc., to which they will require all parties concerned to agree prior to vessel scuttling over the site in the future.

Heritage



The modern-day Coast Guard has acquired many diverse functions—and a rich history—through the merging of various early, more specialized agencies. The name "Coast Guard" is of relatively recent origin (1915), but its heritage is that of its forebears, primarily the Revenue Cutter Service, hut also the Lighthouse, Steamboat Inspection, and Lifesaving Services, and the Bureau of Navigation. Actually there was always a close relationship among these organizations, since the Revenue Cutter Service to some degree either augmented or enforced the activities of the others.

Although the maintenance of the nation's lighthouses is one of the Coast Guard's most recently acquired responsibilities (1939), it is one of the *oldest* of the federal government's functions. In fact the ninth Act of Congress, August 7, 1789, which provided for the support, maintenance, and repair of all lighthouses and other aids to navigation, was the first to provide for any public work. Prior to that time navigation aids had been established by individual colonies, usually at the prodding of local merchants or mariners.

The first true lighthouse in this country, and probably in all of North America, was built in 1716 on Little Brewster Island at the entrance of Boston Harbor. For its support, according to the "Boston News Letter" of September 17, 1716,

> . . . all Masters shall pay to the Receiver of Impost, one Penney per Ton Inwards, and another Penney Outwards, except Coasters, who are pay Two Shillings each, at their clearance Out, and all Fishing Vessels, Wood Sloops, etc., Five Shillings each by the Year.

The first keeper, who also acted as pilot for vessels entering the harbor, was paid an annual salary of £50. In 1718 he and his wife and daughter were drowned when their boat capsized as they were returning to the island from Boston. A 13-year-old Bostonian, soon to become a prominent Philadelphian, memorialized the accident in a poem which he sold in the streets. Just how Benjamin Franklin's literary efforts were received by the people of Boston is not certain, but it may be worth noting that no copies of "Lighthouse Tragedy" have survived, and that young Ben let no grass grow under his feet before setting out for Philadelphia.

During the War for Independence, Boston Light was a property of considerable importance to both sides. Since in the end it proved easier to destroy than to defend, the tower did not survive, being burned by the Americans in 1775 and blown up by the British the next year. The present tower was built on the same site in 1783. Sandy Hook Lighthouse, built in 1764 at the south end of the entrance to New York Harbor, seemed destined for the same fate in 1776, but had been so well built that it defied all attempts to destroy it, and it remains today as the oldest standing lighthouse in the United States.

Anyone who has ever seen a remote lighthouse must have considered what the life of a keeper must have been like, especially in the days before radio communications. Monotony and isolation are words often associated with the life, and these aspects alone make it clear that this was an occupation for a select few. The psychological demands of the job must have been severe at times. Family life was interferred with, the keeper's family either sharing the loneliness or else enduring long periods of separation, as were often necessitated by the children's education.

Many times, though, keepers must have longed for a little *more* isolation. Many a letter was sent off to the district inspector reporting disagreements between keepers on two- or three-man stations (or their families), which sometimes led to blows and even an occasional invitation to duel. Robert Louis Stevenson, in his writings on the life of his grandfather, a noted lighthouse engineer, spoke of the same problem at the Scottish lighthouses with which he was familiar, all manned by two or three keepers:

> These usually pass their time by the pleasant human expedient of quarreling; and sometimes, I am assured, not one of the three is on speaking terms with any other.

and on the two-man shore stations, it might be that

> . . . the principal is dissatisfied with the assistant, or perhaps the assistant keeps pigeons, and the principal wants the water from the roof. Their wives and families are with them, living cheek by jowl. The children quarrel . . . and the mothers make haste to join in the dissention.

If the life was one of monotony, it was a monotony broken by periods of intense activity and often considerable danger. It would be hard to find a place more exposed to the violence of nature than a lighthouse. Flooding of quarters at the more vulnerable lights was not at all uncommon in heavy weather. As late as 1938, five people, including the keeper's wife, were drowned when the dwelling at the Prudence Island (R.I.) Light was carried away by the waves. The keeper also was washed away and would have drowned had not another wave deposited him back on the shore. And even the keepers of more elevated stations, such as Tillamook Rock, Oregon, more than once have been horrified to see a column of green water break over the lantern. Most of the damage to that station occurred when rocks thrown by the waves broke the lantern panes 150 feet above the sea or crashed through the roofs of the buildings. After one storm in 1886, a half-ton mass of concrete was discovered to have been thrown 83 feet up onto the top of the rock.

The most famous storm casualty among American lighthouses was the old Minot's Ledge Light 1¼ miles off Cohasset, Mass. This was an iron framework tower completed in 1850 after 2½ years of work. Several times during the construction, both the workmen and their machinery were washed off the rock, which is only partially exposed at low water. The first keeper resigned within 10 months, convinced that the structure was unsafe. In April of 1851, a particularly violent storm battered the lighthouse for more than a week. The two assistant keepers kept the lamps burning and the bell ringing, but by the night of April 16 they apparently were not optimistic about their chances, as they cast a bottle adrift with a message for the outside world. At 1 a.m. on April 17, just after high water, local residents ashore heard a furious pounding on the lighthouse bell, and then silence. At dawn nothing was visible where the tower had been. The bodies of both men later were recovered. In 1860 a new stone tower was completed on the same rock after 5 years of determined effort. Solid stone for the first 40 feet, it has withstood every gale since, with no significant damage.

Heavy seas, of course, are not the only weather hazard. In the prominent positions that they occupy, lighthouses are excellent targets for lightning. This was especially a problem in the early days of U.S. lightkeeping. In the Eighteenth Century, after the Boston Lighthouse had been struck several times, efforts were made to have lightning rods installed, but the idea was resisted by "several godly men of those days who thought it vanity and irreligion for the arm of flesh to presume to avert the stroke of Heaven." Apparently after further damage, however, it came to be felt—much to the keeper's relief—that the stroke of Heaven was becoming a bit excessive, and the conductors were installed.

Ice also has been a minor, and at times major, problem. After the winter of 1873–74, when the keepers arrived at the newly completed Spectacle Reef Lighthouse at the western end of Lake Huron, they found ice encasing it to a height of 30 feet. They were obliged to hack away the iceberg in order to get inside. In 1918, both floating and accumulating ice damaged lighthouses and lightships on the east coast as far south as Cape Hatteras.

Even wildlife could provide an unexpected danger. Flocks of birds were often attracted to the light and would come crashing through the lantern panes, the larger ones easily capable of doing damage to the lens, to say nothing of any unfortunate keeper who happened to be in the way. And the keeper of a series of post lights on the southern rivers might suddenly find himself sharing a post with a rattler or water moccasin.

During the Civil War, as in the Revolution, lighthouses were points of interest to both sides. Along the southern coasts nearly all lighthouses, lightships, and other aids to navigation, except for the few which were either defended or inaccessible, were captured and put out of commission. Many were destroyed.

Something does not seem quite appropriate in the notion of a lighthouse being attacked by Indians. Yet that seemingly unlikely possibility became a reality on the Florida Coast during the Seminole War in 1836.

The assistant keeper of the Cape Florida Lighthouse, John Thompson, and a black man were alone at the light on the afternoon of July 23 when they came under attack. They escaped to the tower and for several hours exchanged musket fire with the Indians from the windows. At dark the Indians set fire to the door and other wooden parts that they could reach. The two men carried a musket, balls, and powder keg to the top of the tower. Thompson returned and tried to cut away the lower half of the wooden stairs, but it was too late and he was forced back by the quickly spreading flames. The Indians' musket balls had punctured tanks containing about 225 gallons of oil and nearly everything in the lighthouse, including Thompson's clothing, had been wet by the streams of oil. The flames eventually made their way into the lantern, forcing the men out onto the two-foot-wide platform. There they lay on the hot metal, their clothes catching fire, unable to move without showing themselves.

At last, in hopes of putting a quick end to their suffering, Thompson heaved the powder keg into the tower. The explosion did not have the desired effect, but damped the fire temporarily. After his companion had been fatally wounded, Thompson, himself wounded and badly burned, decided to jump from the tower. At the last moment he thought better of it, however, and within minutes the fire died down and a cooling breeze began to blow. The Indians, thinking him dead, made off with their plunder in the keeper's sloop at about 2 a.m.

His circumstances had improved considerably, but Thompson still found little reason to be cheerful. "I was now almost as bad off as before," he wrote, "a burning fever on me, my feet shot to pieces, no clothes to cover me, nothing to eat or drink, a hot sun overhead, a dead man by my side, no friend near or any to expect, and placed between 70 and 80 feet from the earth with no chance of getting down."

At last, sometime in the afternoon, two Navy ship's boats appeared with a detachment of seamen and marines, the powder keg explosion having been heard 12 miles off. With considerable difficulty, Thompson was lowered from the lighthouse and taken to a military hospital.

Certainly all of this should not suggest that the average keeper began his day with the expectation of some catastrophe before nightfall, or that his principal burdens were not after all those brought on by monotony and boredom. Yet whatever the particular problems of his station may have been, one can readily appreciate the apparent sense of relief expressed by the keeper of a Hawaiian light who had been dismissed for inefficiency. To the inspector he wrote:

> With blessing and thankful thoughts I dropping this few remarks to you, and given you my farewell thanks and aloha nui. Off cause it is my fault and I cannot blame this to no body.

There are many stories of outstanding service by lighthouse keepers in the face of great adversity, such as that of Marcus Hanna of Cape Elizabeth, Maine. In January 1885, the schooner *Australia* grounded on a ledge near the light. The captain had been swept away by the waves, and the two crewmen had taken to the rigging. The temperature was 10 degrees below zero, and the men were coated with ice and completely unable to help themselves. Hanna made repeated casts with a weighted line in an effort to reach the men, but without success until a huge wave smashed the vessel against the rocks, putting her on her beam ends. At last getting hold of the line, one of the men jumped into the water and the keeper, with great effort, pulled him up over the ledge. Hanna repeated the procedure and was nearly exhausted when help arrived in time to pull the second man ashore.

Lifesaving aside, it was at times an act of genuine heroism just to keep a signal functioning, as is illustrated by the case of the woman keeper of Angel Island Light in San Francisco Bay. Reporting a malfunction in the machinery of the fog signal on July 2, 1906, she said that she "had struck the bell by hand for 20 hours and 35 minutes, until the fog lifted," and on July 4, "stood all night on the platform outside and struck the bell with a nail hammer with all my might. The fog was dense."

Historically, lighthouse keeping was very much a family business, and stories of such dedication and tenacity are not restricted to the keepers themselves. In 1856, Samuel Burgess, keeper of Matinicus Rock Light 25 miles off the coast of Maine, was prevented from returning to the island due to rough weather. His 14-year-old daughter Abbie normally assisted her father in his duties, in addition to caring for her three younger sisters and invalid mother. On January 19 the sea completely swept the island, washing away everything not held down and completely destroying the original dwelling, then used as a storehouse. The new house was flooded, and as the tide rose, the family was forced to retreat into the light towers at either end of the structure. For 4 weeks Abbie performed her own accustomed duties as well as her father's, and not once did the lights fail. On another occasion a year later, Abbie kept the lights burning for 3 weeks, their provisions dwindling until the mother and four girls were subsisting on one egg and one cup of corn meal a day. In 1861 Abbie married the son of her father's successor at Matinicus, and later was appointed his assistant at Whitehead Light.

On Christmas Eve, 1865, the keeper of the light at Cape Ann, Mass., was delayed overnight by a snowstorm, and his wife, alone with two babies, fought her way across 300 yards of rugged terrain and snowdrifts to keep the island's twin lights burning.

Not the sort of life for just anyone. But fortunately it was the *only* calling for a few. And to the dedication and even heroism of the best of them, many a mariner has owed his life.

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Nautical Queries

The questions on this page are selected from examinations presently in use for deck officers (2d and 3d Mate) and engineers (2d and 3d Assistant).

Deck

1. In the southern hemisphere the wind flow associated with a low-pressure system will have which of the following characteristics?

I. The wind velocity is least near the center of the system.
II. The direction of the flow is counter-clockwise.

A. I only.
B. II only.
C. Both I and II.
D. Neither I nor II.

2. You are steering 275° by gyrocompass, with a gyro error of 3° East. The wind is north and causing 3° leeway. What would be the true course made good?

A. 275°.
B. 281°.
C. 278°.
D. 269°.

3. A freshwater correction is usually listed on the ship's capacity plan. This correction gives the

A. mean draft at light displacement when in fresh water.
B. difference between the salt water and fresh water capacities of the deep and double bottom tanks.
C. additional draft that a ship may add to her seasonal Plimsoll marks when loading in fresh water.
D. change in TPI and MT1 figures when entering fresh water.

4. Your vessel is not under command due to engine breakdown and is now dead in the water on the high seas. Which of the following signals should be sounded in reduced visibility?

A. Two prolonged blasts of the whistle.
B. One short, one prolonged, and one short blast of the whistle.
C. One prolonged and three short blasts of the whistle.
D. One prolonged and two short blasts of the whistle.

5. Which of the following best indicates how many tons of cargo a vessel can carry?

A. Bale cubic.
B. Deadweight.
C. Loaded displacement.
D. Gross tonnage.

Engineering

6. Which end point should be reached first in a boiler?

A. Combustion.
B. Circulation.
C. Evaporation.
D. Carry-over.

7. Fireside burning of boiler tubes is usually the direct result of

A. oxygen corrosion.
B. gas laning.
C. overheating due to poor heat transfer.
D. High furnace temperature.

8. The correct method of expanding a generating tube at the boiler drum is to

A. roll heavily at the tube end prior to welding the tube to the drum tube sheet.
B. roll slightly at the tube end prior to welding the tube to the drum tube sheet.
C. roll to a depth less than the thickness of the drum tube sheet.
D. roll to a depth greater than the thickness of the drum tube sheet.

9. The minimum feedwater inlet temperature to a boiler economizer is determined by the

A. superheater outlet temperature.
B. surface area of the third stage heater.
C. dew point temperature of the stack gases.
D. radiant heat transfer in the furnace.

10. To prevent vibration damage to the fuel supply line of a diesel engine you may use

A. a loop of hard drawn copper tubing.
B. welded flange connections for all joints.
C. rigid pipe hangers and supports.
D. a length of flexible nonmetallic hose.

Answers

1. D 2. A 3. C 4. D 5. B 6. A 7. C 8. D 9. C 10. D

MERCHANT MARINE SAFETY PUBLICATIONS

The following publications of marine safety rules and regulations may be obtained from the nearest marine inspection office of the U.S. Coast Guard.* Because changes to the rules and regulations are made from time to time, these publications, between revisions, must be kept current by the individual consulting the latest applicable Federal Register. (Official changes to all Federal rules and regulations are published in the Federal Register, printed daily except Saturday, Sunday, and holidays.) The date of each Coast Guard publication in the table below is indicated in parentheses following its title. The dates of the Federal Registers affecting each publication are noted after the date of each edition.

The Federal Register will be furnished by mail to subscribers, free of postage, for $5.00 per month or $50 per year, payable in advance. The charge for individual copies is 75 cents for each issue, or 75 cents for each group of pages as actually bound. Remit check or money order, made payable to the Superintendent of Documents, U.S. Government Printing Office, Washington, D.C. 20402.

CG No.	TITLE OF PUBLICATION
101	Specimen Examinations for Merchant Marine Deck Officers (Chief Mate and Master) (1–1–74).
101–1	Specimen Examinations for Merchant Marine Deck Officers (2d and 3d mate) (10–1–73).
108	Rules and Regulations for Military Explosives and Hazardous Munitions (4–1–72). F.R. 7–21–72, 12–1–72, 11–14–74, 6–18–75.
115	Marine Engineering Regulations (6–1–73). F.R. 6–29–73, 3–8–74, 5–30–74, 6–25–74, 8–26–74, 6–30–75.
123	Rules and Regulations for Tank Vessels (1–1–73). F.R. 8–24–73, 10–3–73, 10–24–73, 2–28–74, 3–18–74, 5–30–74, 6–25–74, 1–15–75, 2–10–75, 4–16–75, 4–22–75, 5–20–75, 6–11–75, 8–20–75, 9–2–75, 10–14–75, 12–17–75, 1–21–76, 1–26–76.
169	Rules of the Road—International—Inland (8–1–72). F.R. 9–12–72, 3–29–74, 6–3–74, 11–27–74, 4–28–75, 10–22–75.
172	Rules of the Road—Great Lakes (7–1–72). F.R. 10–6–72, 11–4–72, 1–16–73, 1–29–73, 5–8–73, 3–29–74, 6–3–74, 11–27–74, 4–16–75, 4–28–75, 10–22–75.
174	A Manual for the Safe Handling of Inflammable and Combustible Liquids and Other Hazardous Products (6–1–75).
175	Manual for Lifeboatmen, Able Seamen, and Qualified Members of Engine Department (3–1–73).
176	Load Line Regulations (2–1–71). F.R. 10–1–71, 5–10–73, 7–10–74, 10–14–75, 12–8–75, 1–8–76.
182	Specimen Examinations for Merchant Marine Engineer Licenses (1–1–74).
182–1	Specimen Examinations for Merchant Marine Licenses (2d and 3d Assistant) (4–1–75).
184	Rules of the Road—Western Rivers (8–1–72). F.R. 9–12–72, 12–28–72, 3–8–74, 3–29–74, 6–3–74, 11–27–74, 4–16–75, 4–28–75, 10–22–75.
190	Equipment List (8–1–72). F.R. 8–9–72, 8–11–72, 8–31–72, 9–14–72, 10–19–72, 11–8–72, 12–5–72, 1–15–73, 2–6–73, 2–26–73, 3–27–73, 4–3–73, 4–12–73, 4–26–73, 6–1–73, 8–1–73, 9–18–73, 10–5–73, 11–26–73, 1–17–74, 2–28–74, 3–25–74, 4–17–74, 7–2–74, 7–17–74, 9–5–74, 10–22–74, 11–27–74, 12–3–74, 12–30–74, 1–15–75, 1–21–75, 2–13–75, 2–19–75, 3–18–75, 3–19–75, 4–9–75, 4–16–75, 5–1–75, 5–7–75, 6–2–75, 6–25–75, 7–22–75, 7–24–75, 8–1–75, 8–20–75, 9–23–75, 10–8–75, 11–21–75, 12–11–75, 12–15–75.
191	Rules and Regulations for Licensing and Certification of Merchant Marine Personnel (6–1–72). F.R. 12–21–72, 3–2–73, 3–5–73, 5–8–73, 5–11–73, 5–24–73, 8–24–73, 10–24–73, 5–22–74, 9–26–74, 3–27–75, 6–2–75, 7–24–75, 8–13–75, 12–11–75.
*200	Marine Investigation Regulations and Suspension and Revocation Proceedings (5–1–67). F.R. 3–30–68, 4–30–70, 10–20–70, 7–18–72, 4–24–73, 11–26–73, 12–17–73, 9–17–74, 3–27–75, 7–28–75, 8–20–75, 12–11–75.
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257	Rules and Regulations for Cargo and Miscellaneous Vessels (4–1–73). F.R. 12–22–72, 6–28–73, 6–29–73, 8–1–73, 10–24–73, 12–5–73, 3–18–74, 5–30–74, 6–24–74, 1–15–75, 2–10–75, 8–20–75, 12–17–75.
258	Rules and Regulations for Uninspected Vessels (5–1–70). F.R. 1–8–73, 3–2–73, 3–28–73, 1–25–74, 3–7–74.
*259	Electrical Engineering Regulations (6–1–71). F.R. 3–8–72, 3–9–72, 8–16–72, 8–24–73, 11–29–73, 4–22–75.
*266	Rules and Regulations for Bulk Grain Cargoes (5–1–68). F.R. 12–4–69, 8–20–75.
268	Rules and Regulations for Manning of Vessels (12–1–73).
293	Miscellaneous Electrical Equipment List (7–2–73).
*320	Rules and Regulations for Artificial Islands and Fixed Structures on the Outer Continental Shelf (7–1–72). F.R. 7–8–72.
323	Rules and Regulations for Small Passenger Vessel (Under 100 Gross Tons) (9–1–73). F.R. 1–25–74, 3–18–74, 9–20–74, 2–10–75, 12–17–75.
329	Fire Fighting Manual for Tank Vessels (1–1–74).
439	Bridge-to-Bridge Radiotelephone Communications (12–1–72). F.R. 12–28–72, 3–8–74, 5–5–75.
467	Specimen Examinations for Uninspected Towing Vessel Operators (10–1–74).

CHANGES PUBLISHED DURING JANUARY 1976

CG–123, Federal Registers of January 21 & 26.

CG–176, Federal Register of January 8.

*Due to budget constraints or major revision projects, publications marked with an asterisk are out of print. Most of these pamphlets reprint portions of Titles 33 and 46, Code of Federal Regulations, which are available from the Superintendent of Documents. Consult your local Marine Inspection Office for information on availability and prices.