# PROCEEDINGS

## OF THE MERCHANT MARINE COUNCIL

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# PROCEEDINGS

OF THE

MERCHANT MARINE COUNCIL

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# SAFE BY DESIGN

*J. H. Lancaster of the Maritime Administration's Office of Ship Construction lays out in broad strokes many of the safety considerations that make American built vessels "safe by design." This paper was presented at the National Safety Congress last fall.*

THROUGH EXPERIENCE and codification, many safety considerations have been incorporated into the basic design of United States vessels. It is my purpose to review some of these.

The scope of this paper is limited to considerations which affect the safety of the ship as the protecting vehicle for personnel and cargo. Emphasis is directed to safety for dry cargo ships because of their predominance in the current U.S. ship replacement program. Occasional reference will be made to passenger ships which, in general, have more stringent requirements.

As a point of departure, let us consider the basic function of a merchant ship. Simply stated, it is to deliver its cargo (including passengers) from point of loading to point of discharge in good condition. This requires:

*1. A floating, upright vehicle.

*2. Means for controlling or positioning the vehicle.

3. Means for carrying and protecting the cargo.

*4. A continuous intelligence function—receipt, determination, dissemination of information plus decision making.

*5. Provision and maintenance of shipboard personnel and equipment required to carry out the foregoing.

The asterisk designates those items which have a direct relationship to the safety of the ship as a whole which of course is fundamental to the safety of the individual.

Directly opposed to the foregoing requirements for safe passage are the general hazards which may be encountered at sea. These can be grouped in the following manner:

1. *Insufficient buoyancy* due to flooding caused by:
   a. Structural failure.
   b. Collision.
   c. Grounding.
   d. Shipping of water through openings.
   e. Mechanical failure.
2. *Insufficient stability* due to:
   a. Flooding.
   b. Improper initial loading.
   c. Change in loading under way by:
      (1) Shifting of cargo.
      (2) Consumption of fuel.
3. *Fire.*
4. *Explosion.*
5. *Loss of control of ship* by:
   a. Loss of power:
      (1) Propulsive.
      (2) Electrical.
   b. Loss of propeller.
   c. Loss of rudder.
   d. Derangement of steering gear.
   e. Derangement of ground tackle.
6. *Loss of intelligence functions* by:
   a. Loss of power.
   b. Derangement of equipment.
7. *Injury to or loss of personnel.*

Though a ship might be constructed by the most skilled of craftsmen and though it might be manned by the most skilled of mariners, it could easily succumb to one of these hazards through lack of proper basic design.

For this reason, regulations and standards affecting basic design as well as construction and operation have been set up in this country and throughout the world to insure the inclusion of proper criteria of safety in ships. The following is a summary of organizations who participate directly in the establishment of ship (and personnel) safety in the design stage:

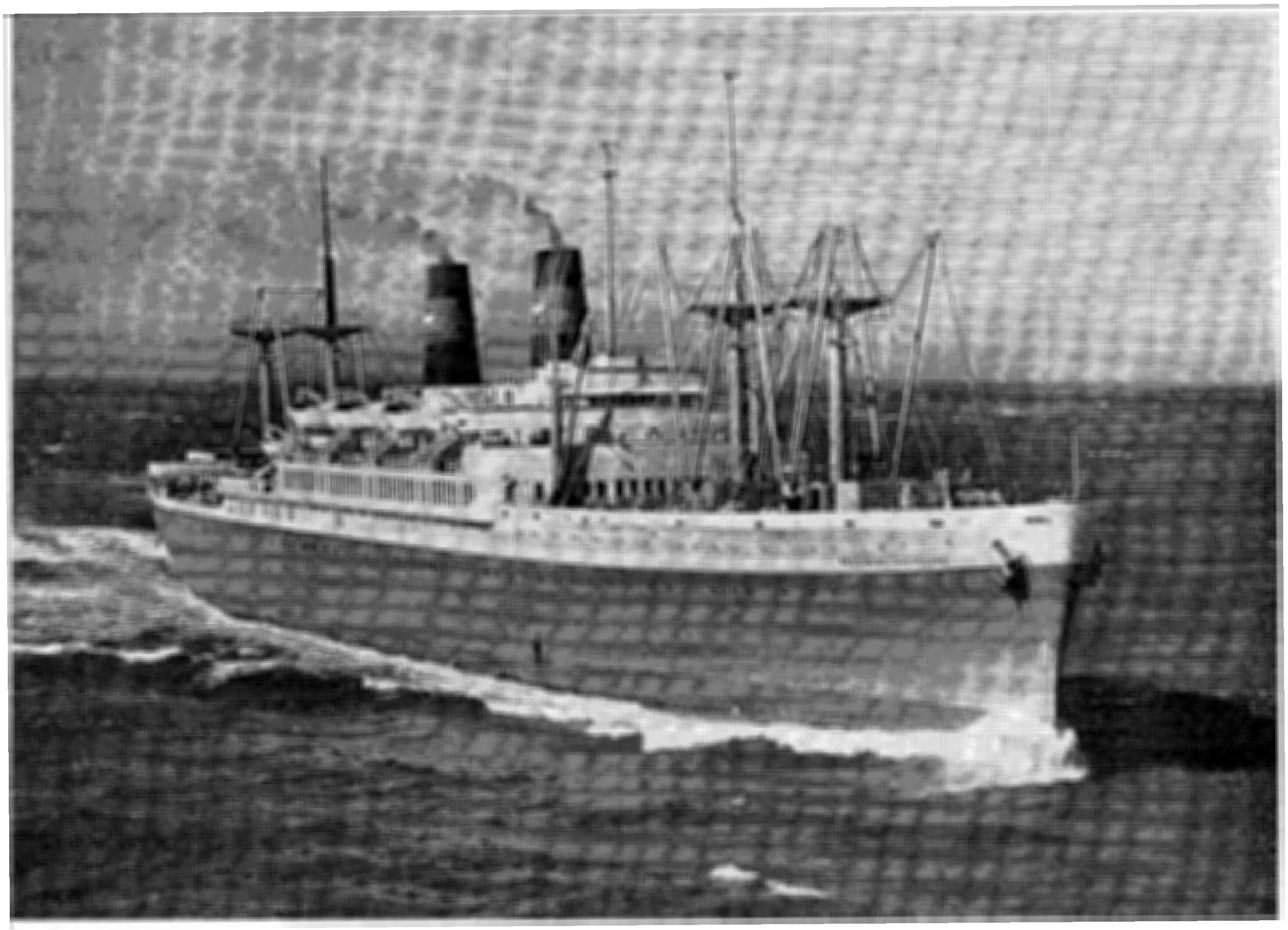
1. *By direct statutory regulation:*
   a. The International Convention for the Safety of Life at Sea—SOLAS (Administered in the U.S. by the U.S. Coast Guard).
   b. U.S. Coast Guard.
   c. U.S. Public Health Service.
   d. Federal Communications Commission.
2. *By other requirements* such as insurance, permission for passage, subsidy, etc.:
   a. The American Bureau of Shipping.
   b. Various agencies for local and specialized purposes such as the Panama Canal Authority, the St. Lawrence Authority, the Suez Canal Authority, etc.
   c. The Maritime Administration of the U.S. Department of Commerce.
   d. The Owner and his Design Agent.

Having introduced the requirements for the safe functioning of a ship, the hazards it must endure, and the organizations concerned with overcoming those hazards via the design stage, let us now examine some of the features which are derived from such basic design considerations.

It is difficult to think of a more basic design requirement than that of the ship's floating—buoyancy in the more technical language of the naval architect. This can be prejudiced by the several hazards previously noted.

*Structural failure* has occasionally caused the loss of a ship. Hull scantlings are basic design information and for merchant ships are generally derived from the ABS Rules. Derivation of these values is ultimately based on past successful design correlated with the calculated hogging and sagging stresses for a wave height equal to 1/20th the length of the vessel. Failures have almost always been associated with a condition of local

**J. H. Lancaster**



*SS* President Cleveland *of American President Lines, a trans-Pacific luxury liner, exemplifies the more stringent rules for passenger vessels.*

stress concentration such as a sharp hatch corner or with material deficiency such as notch brittleness. ABS Rules now specify a type of steel with notch toughness to withstand alternating stresses in cold waters. Avoidance of local stress raisers is also covered by the Rules and by plan approval. Anyone who has been on a ship pounding and straining in a heavy sea appreciates the basic hull structural safety derived from these rules.

*Collision* is another means of losing buoyancy rapidly. From the earliest days of steel ship construction, a collision bulkhead has been required forward. However, it has taken time to cope with the possibility that a ship might be on the receiving end of a collision and to make effective provision for it. This is accomplished through subdivision of the ship by vertical watertight bulkheads so spaced that the flooding of one or more of the holds or spaces will not cause the ship to sink.

The SOLAS convention of 1929, 1948, and 1960 established increasingly definitive requirements for passenger vessel subdivision which have been put into U.S. law by the Coast Guard. The greater the size of the ship and the number of passengers, the greater must be the subdivision.

However, for cargo ships, there is no SOLAS or Coast Guard requirement for subdivision. For subsidized U.S. cargo ships, the U.S. Maritime Administration has required a factor of subdivision of one. This means that each ship is capable of sustaining the flooding of one hold or space without sinking. Stability considerations will be discussed later.

From time to time the wisdom of this requirement is re-examined since in some cases it does limit the length of holds for special cargoes. However, peacetime and wartime experience has justified it. Many an American ship would have been lost without it.

In all considerations affecting flooding and loss of buoyancy, every effort is made to cope with the situation by pumping. Requirements for bilge pumps are standard with the Coast Guard and SOLAS. However, there is a degree of flooding beyond which it is impossible for pumps to cope. Subdivision carries on from that point.

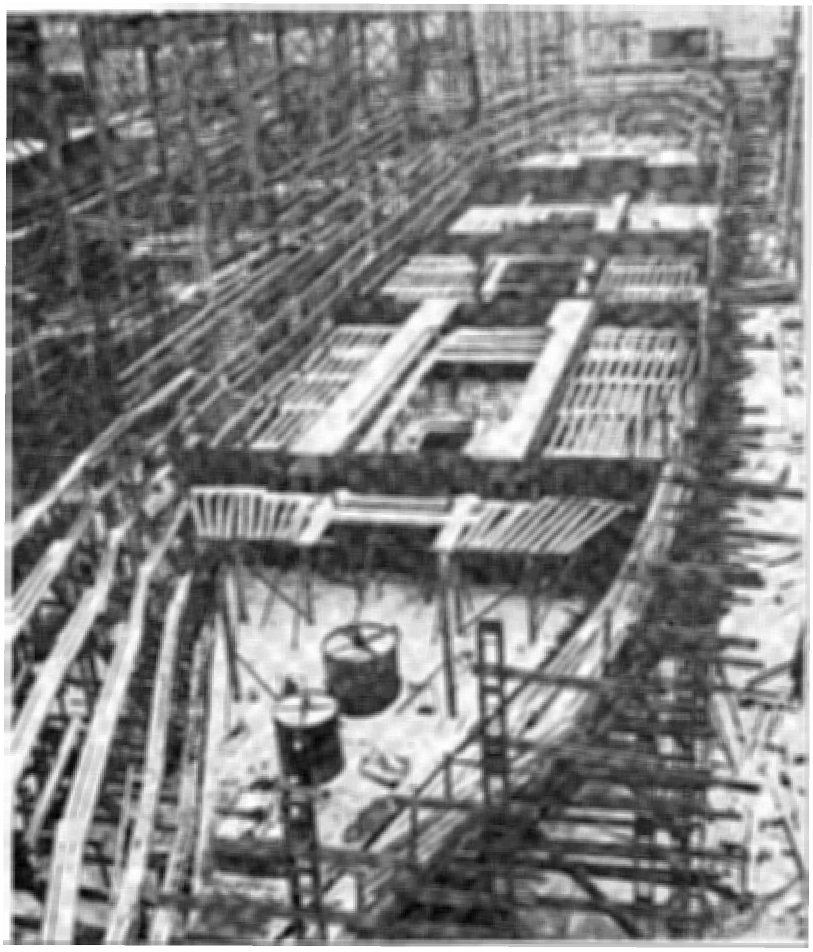
One of the most effective means of preventing flooding due to *grounding* is the provision of double bottoms or the equivalent in a tank. ABS requires them for all ships 300 feet and over in length and SOLAS requires a complete double bottom for passenger ships 249 feet or greater in length. Detailed requirements exist as to their configuration, such as the limiting of the bottom surface of any local well (sometimes necessary for condensate pumps, etc.) to within eighteen inches of the skin. This and the other detailed requirements are implicitly directed towards maintaining integrity of the inner skin in case of deformation and puncture of the outer skin through grounding. Fortunately, double bottoms are also desirable for functional purposes such as the carriage of fuel and water and the provision of a flat surface for the stowage of cargo.

Flooding can also occur through the *shipping of water* through openings in the hull or decks in heavy weather or when the ship is in a listed condition. The ideal situation is to have no openings but this is unattainable for practical reasons. Adequate hatch and often sideport openings are a necessity for loading and discharging the ship efficiently. The design and construction of their covers and closures must be such that they are rugged and reliable in service and the scrutiny of all parties in plan approval is directed to this end. Other requirements such as stop and check valves for overboard discharges have their origin in this flooding consideration.

The possibility of flooding due to *mechanical failure* of the stern tube shaft seal is considered in the SOLAS requirement that all passenger ships have a separate compartment around this area. On single-screw cargo ships, this possibility is usually taken care of by the containment of the shaft alley, the bulkhead gland, and the watertight door at the aft end of the engineroom. Other mechanical protrusions such as bow thruster drive shafts and active stabilizer shafts are also examined from this point of view.

Closely associated with the foregoing discussion of protection against loss of buoyancy is the aspect of stability. It is possible for a ship to remain buoyant and yet cause loss of life to its passengers and crew—the extreme case being that of a ship capsized. The effects of loss of buoyancy and stability are mutually dependent and augmenting and usually result in progressive flooding and sinking of a vessel unless specific provisions have been made in its basic design.

With regard to *loss of stability due to flooding,* after assuring buoyancy through subdivision as previously discussed, each condition of flooding is examined to ascertain how much stability remains in the damaged condition. The worst anticipated service conditions are assumed for the intact ship prior to flooding. Often the calculations show that there would be insufficient stability in a particular service condition. Corrective measures are then devised to assure stability for these conditions in service through requirements for fixed ballast or the filling of certain fuel oil tanks with liquid ballast. Other features such as longitudinal bulkheads and



*Snow covers the under-construction* Mormaccove *at Sun Ship in January 1961.*

tanks which might prejudice stability in the damaged condition are examined and cross-flooding ducts are provided if the effect is serious. Here again as with subdivision, stability in the damaged condition is required for passenger vessels only by SOLAS and the U.S. Coast Guard. The Maritime Administration is the agency invoking these requirements for cargo ships. The net result is the same as for subdivision—a safer ship for peacetime and a more able ship for national defense.

Insufficient stability can also result from *improper loading of cargo, shifting of cargo under way,* and consumption of fuel and water. The loading of cargo and the pattern of consumption of fuel, etc., are items subject to the decision of the master. It is required by SOLAS and the Coast Guard that he be provided with sufficient information to determine the metacentric height or stability of the vessel at all times. The required inclining of the ship at the time of delivery checks its inherent stability and the required stability booklet is directed towards enabling him to determine the stability for other conditions of loading. The carriage of bulk cargoes such as grain present special hazards due to a possible shifting in heavy weather. Accordingly, provisions for grain or shifting hazards are made—the net effect being somewhat similar to that of swash plates in a tank.

The next major hazard is *fire,* probably the most devastating and terrifying of all the peacetime hazards at sea. Here, the ideal solution would be to have a ship built of fireproof material carrying fireproof cargo. Retreating to reality, we try to cope with fire in the design stage through as extensive a use of fireproof materials as possible, containment, detection, means for extinguishing, and provisions for the escape of personnel. SOLAS and Coast Guard requirements for passenger vessels are extensive and exacting whereas cargo ship requirements are less stringent.

Regarding *fireproof materials,* SOLAS defines incombustible material as "that which neither burns nor gives off inflammable vapours of sufficient quantity to ignite a pilot flame when heated to approximately 1382° F (or 750° C). Any other material is a 'Combustible Material.'" For passenger vessels, the Coast Guard requires the extensive use of incombustible materials for ceilings, linings, furring, insulation, etc., in accommodation and service areas. For cargo ships, the rules generally discourage the use of combustibles but do not specifically prohibit them except for corridor, bulkheads and deck coverings within accommodation spaces.

An Alaska passenger-car ferry under construction.

*Containment* is effected by the use of fire-resistant bulkheads, generally designated Class A and Class B, having the capability of preventing the passage of smoke and flame up to the end of the 1-hour and the ½-hour standard fire tests respectively. On passenger ships, main vertical zones not more than 131 feet in length are established through the use of Class A bulkheads. Other spaces which present a fire hazard to accommodations such as galleys, motion-picture projection rooms, machinery spaces, etc., on U.S. passenger ships are similarly isolated by this type of bulkhead in conjunction with the use of a detection system and the use of incombustible material.

Fire and smoke *detection* systems on U.S. passenger ships protect public spaces, cargo spaces and other areas which have high potential for fire such as paint rooms, film lockers, storerooms, etc. Cargo ships have a smoke detection system monitoring cargo spaces and other areas having a fire potential.

Comprehensive means for *extinguishing* fires are required for U.S. passenger and cargo ships, with the more extensive requirements being, of course, for passenger ships. Means include two or more fire pumps, an extensive firemain and hose facility, fixed $CO_2$ systems for cargo and other relatively inaccessible spaces, $CO_2$ or foam systems for boiler spaces, sprinkler systems for special passenger ship areas, hand extinguishers, gas masks, and other portable firefighting equipment.

Means for *escape of personnel* from fire areas is covered in considerable detail by both SOLAS and the Coast Guard for passenger ships, generally, based on the principle that two separate means are required and that access between the two within the space protected must not be restricted.

It should be noted that although the SOLAS convention of 1960 accomplished considerable in upgrading worldwide shipboard protection against fire, the requirements of the Coast Guard for U.S. cargo and passenger vessels still result in a higher degree of safety.

The hazard of explosion seldom materializes on U.S. ships today probably because of the stringent rules of the Coast Guard regarding the construction of pressure vessels and the setting of safety valves. This is a far cry from the early river steamboat days when many a disaster occurred from boiler explosions. Although normally taken for granted, it is an important area which is protected by proper basic machinery design coupled with proper operating practice. Other potentials for explosion or rupture such as ships' tanks, receivers, etc., are also closely regulated by Coast Guard rules for design, construction, and testing.

With the ship reasonably well protected against sinking, capsizing, fire, and explosion thus far, it now becomes necessary to provide assurance that its position afloat can be controlled. The most obvious requirement is that its propulsive and electric power be available. Equally necessary are the requirements that the propeller, rudder, steering gear, and ground tackle be available and in working order.

Concerning *propulsive power*, there is little doubt that the safety of the ship is generally dependent on it, and vitally so, under certain conditions such as a violent storm at sea, proceeding with a lee shore, proceeding and maneuvering in congested waters. Although there are ABS and Coast Guard rules covering various aspects of construction and materials used in machinery and electrical components and their systems, the reliability and consequent availability of equipment on merchant ships depend greatly on the basic design, the integrity and skill of the manufacturer, and upon the operational and maintenance practices of the owner and crew.

Historically, where continuous operation of a plant depends upon a component, component *redundancy* or *systems back-up* has been incorporated into the design. Examples of redundancy in marine power plant design are numerous, such as boilers, auxiliary generators, feed pumps, lube oil pumps, fuel oil pumps, fuel oil heaters, etc. Examples of systems back-up are the auxiliary feed system, lube oil gravity tank system, and auxiliary circulating water system cross connection.

Many of these features are currently being re-examined and the techniques of reliability assessment are beginning to be applied, hopefully to obtain rational, comparative answers to the problems. Carrying on with the pioneering efforts of the Navy, the space, and the electrical industries, the Society of Naval Architects and Marine Engineers has established a panel to assist in the development of meaningful methods and criteria for the marine industry. The emphasis is definitely on "meaningful" since, as every student in first year algebra knows, it is quite possible with a very small amount of algebraic manipulation to prove that "one" is equal to "two".

The problems inherent in the increased use of *centralized control* deserve special note. To date, in this country, definitive rules and regulations have not been adopted because of the controversial issues involved. ABS has issued a guide and the Coast Guard has proposed a set of tentative regulations. At present, however, the official status of these documents is purely "advisory". Nevertheless, from these past several years of development, several fundamental principles for safe design have developed. First, local control which bypasses the central control system must be provided to permit continued operation in case of system failure. Second, control systems must be designed on "fail safe" principles. Third, sufficient manpower must exist to bring the ship safely to its destination in case of complete failure of the centralized control system.

With these broad principles in mind, the designer must advance into the basic design, creating a system which is adequate and safe for the intended manning but which is also economic. It is entirely possible to truly automate every component, every valve, every system using complex monitoring, feed back, and computer technology. However, at the present time the cost of such a system would be very high. Furthermore, the introduction of the additional equipment and the many safeguards creates greater opportunity for control system failure and false alarms. Reliability analysis can be a useful tool in aiding the designer to reach a proper decision.

Returning to the consideration of measures which have been adopted in the basic design to assure continuous propulsive power, today's plants are dependent on *electric power* for continuous operation. Two full-size ship's service generators are therefore required by Coast Guard rules; furthermore an emergency generator outside of the machinery space to supply vital lighting, communication, and other services. It is evident that electric power is so vital that redundancy plus back-up is used to assure its availability for vital services.

The *propeller and rudder* are also obviously necessary for ship control and the adequacy of design is closely controlled by ABS rules and plan approval.

The vital nature of the *steering gear* and its control system are recognized in the ABS and Coast Guard requirements by the requirement for back-up or redundancy. Most units today are designed on the redundant principle (with the exception of the hydraulic ram itself) with two power units, two control systems, and two separate power supplies.

As a last resort in coastal and inland waters, the anchor can be used to control the ship's position. It is, of course, most often used in a routine manner. Here again its importance to ship safety is reflected in the ABS requirement that all ships have two bower anchors. The important function for the safety of the ship is to get the anchor down and the chain out. It is significant that the function of recovery, while very desirable, is not redundant—only one power unit for the anchor windlass is required.

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*Navy duty and the Sun Shipbuilding & Drydock Co. in 1963 as Chief Engineer. In 1965 he became Assistant Chief for Marine Engineering in the Office of Ship Construction for the Maritime Administration. He is a member of the Society of Naval Architects and Marine Engineers and a civil member of the American Society of Naval Engineers. Mr. Lancaster has served in the SNAME Technical and Research Program as chairman of the Ships' Machinery Committee, chairman of the Anchor Windlass Panel, and a member of the Backing Power Panel. He presently is chairman of the Panel on Reliability (M-22) and is a member of the control committee for the revision of Marine Engineering.*

Having endowed the unsinkable, upright, fire and explosion-proof ship with reliable means for controlling its position, it is now necessary to provide an *intelligence* capable of directing the movement of the ship and making the decisions required by routine and emergency shipboard situations. In a general sense, this is presently accomplished through a man-machine relationship informed by an externally oriented information system plus an internal information system. The external information system includes radiotelegraph, radiotelephone, radio direction finder, radar, Loran, and facsimile systems as well as flags, whistles, horn, searchlight, and blinker light. It is interesting to note that the radar, Loran, facsimile, and UHF systems are not required by SOLAS or the FCC. Their presence, however, in foul weather and in congested waters is indeed an aid to the navigation of the ship.

The internal information system includes the engine order telegraph, alarm systems of all types, rudder angle indicator, watch call, data logging, and numerous other systems. Vital systems for ship safety such as the engine order telegraph or bridge to engineroom servo system for centralized control are fed from the emergency bus and also have a back-up system—voice tubes or sound powered phones.

The review up to now has been concerned with the safety considerations in basic design directed towards keeping the ship intact, controllable, and inhabitable as a vehicle. If, however, disaster should strike, provision is made to abandon ship. The stringent rules of the Coast Guard and SOLAS regarding the provision, construction, equipping, and launching of lifeboats and other lifesaving equipment define closely what the basic design must include. Amongst other regulations, the latest rules require that sufficient lifeboat capacity be provided on each side to accommodate all persons aboard a cargo ship plus liferaft capacity for at least one-half the total complement. For passenger ships, the impracticability of such a provision is recognized and lifeboat capac-

(Continued on page 169)

**How are dangerous values of static electricity generated aboard vessels; how do we control this always present danger? A former chief of the electrical branch of the Coast Guard's Merchant Marine Technical Division answers these and other questions in an illuminating article on . . .**

# Static Electricity

**Cmdr. John H. Dorsey, USCG (Ret.)**

STATIC ELECTRICITY is one of the most common phenomena of nature. The generation of static charges cannot be prevented, nor is it practicable to attempt to do so. It is commonly felt that static electricity is generated by friction but experiments have shown that a static charge results when two dissimilar substances are brought in contact and then separated. While in contact, a readjustment of their surface and molecular forces occurs at their interface. This readjustment is accomplished by an interchange of electrons; the substance to which the electrons pass and accumulate acquires negative electrification; the other an equal positive electrification. If one of the substances is an insulator and the two materials are separated, electrons cannot readily move along the insulator's surface to permit the charge on each surface to return to normal. Consequently, the electric charge becomes trapped on the two separated substances, the effect being more pronounced if the separation is done quickly. This contact-separation process may be caused by such actions as a rubber belt on a steel pulley, a hydrocarbon liquid flowing turbulently in a pipe or by a paint spray gun.

As common as static electricity may be, it is only a fire hazard when a field is created with sufficient potential gradient to break down the separating medium (usually air mixtures) creating an electrical spark. Many spark discharges do not cause explosions because the energy is too low or too diffused to be incendive. In fact it has been reported that crackling discharges have been recorded and observed in various types of fuel tanks without incident. But such facts are not too comforting since the amount of energy required to cause an explosion depends on a variety of factors, such as type of mixture, ratio of mixture, temperature, geometry of tank or humidity.

In the marine industry there are many ways in which static charges can be developed. However, it is proposed to cite only a few common causes.

*Flowing or spraying liquids.* Perhaps the most common operation on tank vessels which generates static electricity is the pumping of flammable liquids, particularly hydrocarbons. Places where friction is severe (pipelines, filters, etc.) and locations in which agitation is extreme (a filling line discharges above the liquid surface) can be sources of high static charge. Liquids of high electrical resistivity are particularly susceptible. Examples of such liquids are kerosene, gasoline, acetone, ethylacetate, ethers and some alcohols. In normal tank vessels, the tank itself is somewhat grounded by contact with the water. However the static charge may be developed in such quantity that the plating and the liquid soon reach great extremes of opposite polarity and produce fields as high as 80,000 volts per meter. The charge is eventually dissipated through the ground connection of the tank. However, this dissipation time, also called relaxation time, can run from 30 seconds for very high resistivity fuel to as much as several hours in low resistivity products. However the dissipation period may be longer than expected if the product contains any appreciable amount of water. This increase is caused by the static charge induced by the water droplets settling through the product to the bottom of the tank.

If high field strengths are common in cargo tanks why aren't static caused sparks very common in cargo tanks? As a matter of fact static sparking is probably fairly common. However during most of the sparking period the ullage space contains a too-rich or too-lean mixture, thus effectively preventing explosions. In addition it appears that the spark discharges are of low energy or are too diffused to cause ignition. But the probability of creating an incendive spark is greatly increased if an ungrounded probe approaches or is approached by the liquid surface. The probe acts to concentrate the field at the point of the probe, the field strength increasing to high values as the probe approaches the liquid surface. In practice probes are present in the guise of sounding rods on tapes handled by men in rubber soled shoes.

Some of the precautions that should be observed to reduce the hazard of static discharges in cargo tanks are:

(a) Use the lowest loading rate commensurate with the operational requirements. A high velocity of product flow increases the rate of static generation.

(b) Filling lines should terminate at the bottom of tanks to reduce the effect of agitation. Low filling rates should be used until the discharge opening is well covered.

(c) When the product is known to be dirty, especially when extensive water contamination is present, product filling rates should be lowered. Conversely there are effective anti-static additives which can reduce the tank potentials to insignificant levels under all circumstances.

(d) All metal parts of the tank and filling system should be well grounded. It is especially important that metal hose clamps used in non-conducting hose be well grounded. Ungrounded conducting parts, such as these, are a serious hazard in regions where static is a problem, because they permit a high rate of discharge.

(e) Men taking soundings should wear conductive footwear and try to see that sounding tapes are grounded.

Alternately, nonconductive tapes may be used.

Figure 1 shows a common method of connecting a tank vessel to shore. When such a system is used the following sequence for connecting and disconnecting the binding cable and base should be followed:

When connecting: 1. Check to see switch is open. 2. Connect bonding cable to ship. 3. Close switch. 4. Connect cargo base.

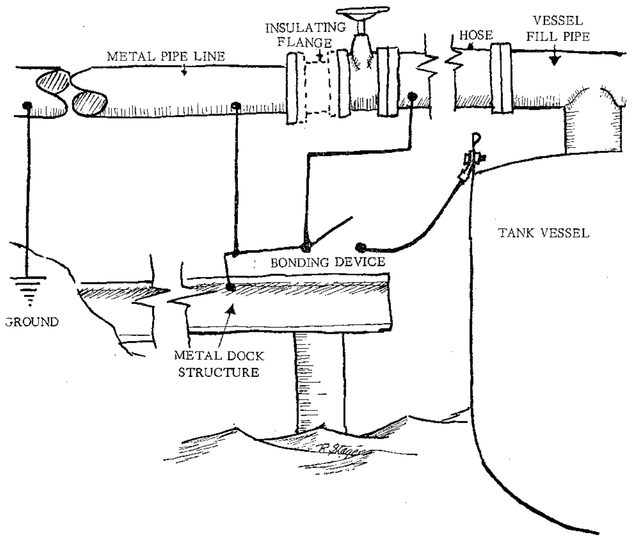



*Figure 1—A suggested method of grounding hose, vessel and dock to a common ground to eliminate static charge and stray current. Switch is closed before hose is coupled and opened after hose is decoupled.*

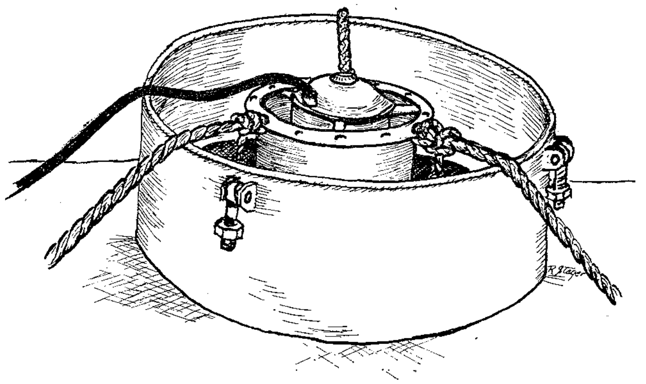


*Figure 2—Blower is supported by line in tank opening without grounding. Static charge of dangerous value can develop on motor frame.*

When disconnecting: 1. Disconnect and remove cargo base. 2. Open switch. 3. Remove bonding cable.

### *GAS STREAMS*

Gases, when not contaminated with impurities of solid or liquid particles, generate little electrification in their flow. However, in normal industrial situations contamination is usually present in the form of dirt, metallic oxides from piping scale, water vapor and the like. When such gases discharge from a pipe or duct it is possible to create dangerous static fields. Conversely gas in a closed system of piping and equipment is not usually a problem.

Examples of gas type discharges found on shipboard are steam smothering or clear-out lines, carbon dioxide nozzles, ventilation systems and sand blasting. For all of these systems the static accumulation can be reduced or eliminated by proper grounding of the discharge pipe. Figure 2 shows an example of a blower used to ventilate a tank during gas freeing operations. The blower housing is completely isolated from the barge and could accumulate quite a large charge. Just such an arrangement was used on a barge involved in a tank explosion in which the cause was not specifically established. A simple bonding strap between the fan housing and the barge structure would have eliminated static sparking as a possible cause.

Although not strictly speaking a gas phenomenon, spray painting has similar characteristics. In this case, relatively non-conductive liquid is ejected from a nozzle at high velocity in the form of fine droplets, an operation capable of generating high-voltage static electric charges on the object being sprayed. Voltages of 8,000 volts and higher have been measured where a metal object being sprayed was insulated from ground. The use of volatile flammable solvents in the painting of equipment is hazardous if the object being painted is not adequately grounded.

### *MOVING BELTS*

Although belt drives have been rarely used in ships in the past years, there is a trend toward their use, particularly in some foreign countries. In this country such uses as self-unloaders and conveyors, are fairly well known. However, the use of belt drives in an area where hazardous vapors or dusts are present should be discouraged. Rubber or leather flat belts running at moderate or high speeds may generate sufficient static electricity to produce sparks several inches long. Vee belts are not as susceptible to hazardous static generation as flat belts. In all cases where belts must be used in hazardous areas, conducting belt material should be used. It is preferable to use belt material that is conducting all the way through. Some conducting belts have only a surface coating of conducting material which may wear off. Maintenance of belts is particularly important to safety. Belts can become coated with grease and dirt so as to form a nonconducting skin. In hazardous areas only metal pulleys should be used and they should be carefully grounded. Ball or roller bearings are preferable to sleeve bearings. In cases where belt drives must be used the maintenance personnel should be especially careful not to replace the conducting belts with nonconducting ones.

In summary, static sparking is a physical phenomenon that is prevalent and cannot be prevented. However, a knowledge of the precautions to observe when hazardous mixtures of gas or dust are present can reduce the probability of explosions to a very low value. By intelligent use of safe practices recommended, your vessel will not be a case history for a marine board to speculate on whether or not static sparking was the cause of an explosion. ⚓



223-954—66——2

# BOW THRUSTERS

Lt. Cdr. C. J. Walz, USCG

**A relatively new shipping development, the bow thruster, is helping to save time and money in docking and undocking. The sketch below tells of the Grace Line system. This is not unique with Grace, as the photographs on these pages will indicate.**

GRACE LINE MASTERS in the west of South America trade over the years have found it necessary to dock and undock unassisted in certain South American ports. Tugs are not available in some of the ports of call, and where they are obtainable they are small, low-horsepower craft and, thus, of limited value to the shiphandler.

The hazards of this type of close quarters maneuvering increase, of course, with the size of the vessel, sail area, limited accessibility of various docks and inadequate draft-to-depth ratio.

Six considerably larger units under construction at Sun Shipbuilding and Dry Dock Co. could add measurably to the Grace Master's unease during the docking and undocking in these South American ports were it not for the saving feature of incorporating a unique maneuvering propeller. To achieve desired vessel control, particularly in areas where tug service is less than adequate, the owners have arranged for the installation of bow thrusters on these new 560 foot C4 type vessels. The bow thrusting arrangement consists basically of five sections here described but briefly.

*Tunnel Assembly*

A tubular type weldment is permanently secured into the hull with a shaped casting fitted at each end and faired into the line of the hull. Six stays extend radially inward to support a removable gear drive and a single 79″ four bladed propeller with its hydraulic pitch changing and control mechanism (see figs. 1 & 2).

*Prime Mover*

An 800 hp. constant speed nonreversing water-cooled electric motor drives the propeller. Electrical power is derived from one of the vessel's three 1000 kw. ship's service generators.

*Hydraulic Power Unit*

This unit lubricates all moving parts and bearings within the bow thruster and effects pitch change of the propeller blades.

*Indicating Panel*

An instrument panel contains steering direction lights, an ammeter to indicate prime mover load, alarm

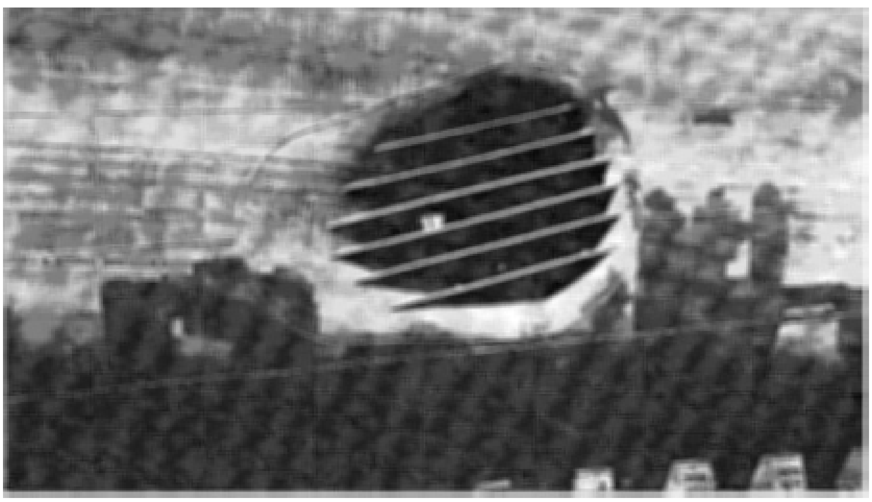


*Figure 1.—Bow thruster of* Santa Lucia *as viewed from starboard side. The two lower protection bars are removable to provide access to the tunnel.*

*Figure 2.—Captain G. Didriksen, master* Santa Lucia *at bow thruster main control stand.*

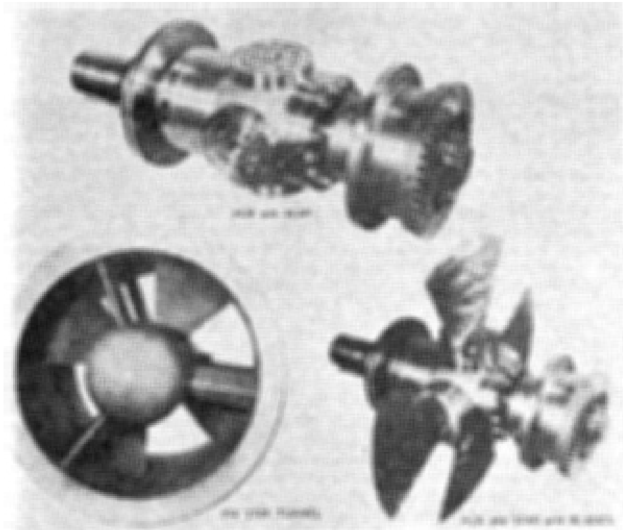


*Figure 3.—Bow thruster tunnel, hub, gear and blades.*

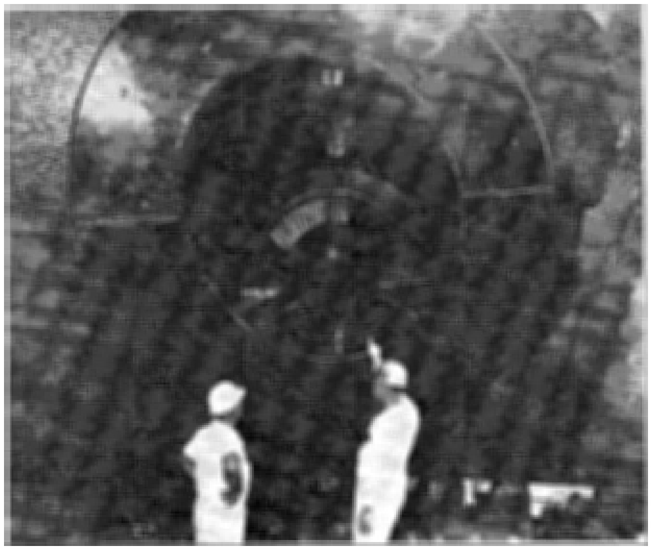
lights with audible signals to indicate abnormal pressures and temperatures, pushbutton controls for remote stopping and starting of the prime mover and associated machinery.

*Control System*

A main control stand (fig. 3) is located within the bridge. Slave stands, one on each bridge wing, are mechanically connected to the main control stand.

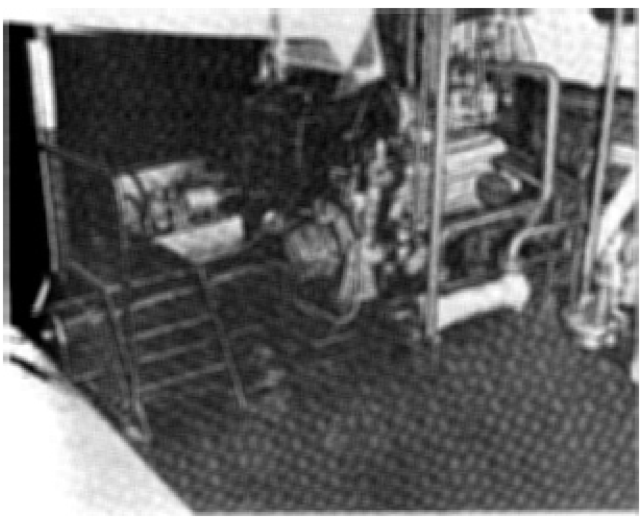
Movement of the control handle to the right will result in the vessel's

(Continued on page 170)

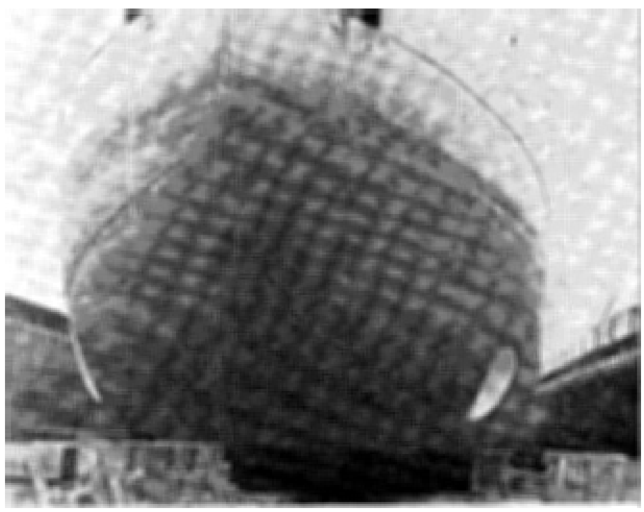


*Crewmen of the tanker* Esso Bangor *of Humble Oil & Refining Company can and do refer without dismay to the hole in their ship's hull—the vessel's "bow thruster," a 6-foot, 7-inch diameter tunnel through the forward section of the tanker, above, with a large variable-pitch propeller positioned midway through the yawning cavity. Humble plans to install the device on two other tankers, and observes that economies are greatest for tankers that carry varied cargoes requiring several dock moves for each loading or unloading. The bow thruster pushes a jet of water through the tunnel—in either direction since the pitch of the propeller can be reversed—moving the bow either closer to or away from the dock. As a bonus, the device shortens a vessel's turning radius in close quarters. The bow-thruster tunnel is located low on the side of the ship, 73 feet back from the bow. Gears and shafting link the propeller to an 800-horsepower diesel engine on the deck above the tunnel. Speed of the engine and the pitch of the propller are controlled from the bridge.*

*View in Thruster Room on M/S* Henry Ford II, *showing 500 H.P. Cummins Diesel engine that drives the bow thruster. A portion of the tunnel appears lower left in picture. Hydraulic system that delivers oil to propeller pitch changing mechanism is housed in control box just to left of engine.*



*Bow of M/S* Henry Ford II *in dry dock at Fraser-Nelson S/B & DD Co. shipyard, Superior, Wis., showing bow thruster tunnel openings.*



*Some observations of the U.S.P. & I. Agency of the Marine Office of America*

# NOT A LIFE GUARD IN SIGHT

Ring toss is a rather pleasant game played by kids. Aboard a tug it means only one thing, someone's in the water! Then it is no game and the rings had better be available and ready for instant use.

Life preservers, liferings and life buoys are emergency equipment, and only U.S. approved types may be on board documented vessels of the United States.

Many times during our safety inspections aboard tugs, ferries, dredges, fishing vessels, yachts, etc., this equipment is found to be neglected, not kept in "instant emergency" use status, and the delay in getting it clear could very likely mean the difference between just a soaking or a drowning.

Men sometimes misunderstand the true importance and proper utilization of their lifesaving equipment. It is tragic when a tug goes down carrying the float-off raft with it because someone had lashed it securely in place.

We noticed recently on a small ferry where the raft painter had been so lashed around the holding cradle that it would have had to be cut in five or six places in order for the raft to be free!

Or what happens when a swift current carries a man away because no lifering or throw line is right at hand and kept so it can be used instantly while there is still a chance to get it to the person struggling in the water perhaps fully clothed and certainly somewhat in shock from his unexpected immersion.

There were over a *thousand* drowning fatalities in 1964 because persons got overboard while not wearing a life preserver or buoyant vest. According to the official records:

1. Of 1,192 fatalities in boating accidents *reported to the Coast Guard,* 1,161 perished in the water, and 1,057 of these were by drowning.
2. Of the 1,161 persons who perished in the water, 1,034 had no lifesaving device.

Self-preservation is the first law of nature—so doesn't it make just plain common sense to wear that preserver when you are working on deck; regardless of how routine the task may seem or how calm the weather. Remember even the strongest swimmer is helpless if he is knocked unconscious or dazed during a fall into the water.

How about the rest of the emergency equipment? Are the liferings and buoys strategically spotted? Are the water lights working?

Are the lifelines coiled and secured in such a way that it won't take more than a few seconds to release them and they will pay out smoothly, not in one big snarl?

How about a ring and line at the gangway when tied up or a few rings out on the tow where the men are working or standing lookout?

Are rings close to the man at the wheel or would he have to run out and down a ladder to get to one?

And how would you get a man back aboard once you hauled him alongside? On many small boats this is not a simple task.

Talk this over aboard your boat, check your emergency equipment, and practice your emergency procedures.

*(L. L. Beal and Robert H. Smith)*

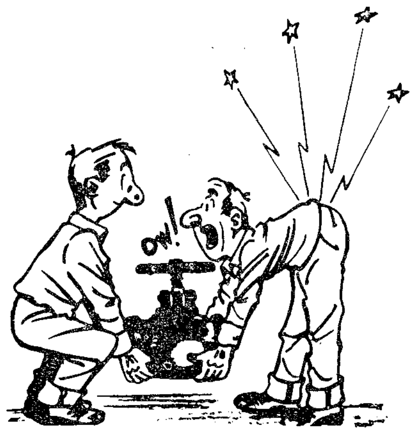
⚓

# IS A PICTURE WORTH A THOUSAND WORDS?

A noted student of human behavior said, "We are what we repeatedly do." In no other industry is there more repetition of the same tasks day after day, voyage after voyage, than in ours. If the tasks are repeatedly performed in a careless and unauthorized manner, the seaman becomes a menace and eventually someone gets hurt. We are not talking about the accidents involving the failure of a piece of equipment. What we want to stress and picture are the three most-often-reported injuries which indicate a complete disregard for your vessel's safety program.

## FALLS, SLIPS, AND TRIPS

Oldtime sailors used to have "Hold Fast" tattooed on the back of one of their hands as a reminder that "one hand is for the ship and one hand for yourself." If you don't care to decorate yourself, remember that the primary reason for these accidents is *inattention to the job on hand!* Don't let your mind wander because you are doing the routine automatic job of walking. And we mean walk—don't run. When you run, your body is not under proper control. "Haste makes waste" is not idle talk. You have to watch where you put your feet—so don't carry a load in front of you that will block your view.




### LIFTING

The spine is not for lifting! Squat down in front of the object you are going to lift, back straight and arms down, and let those long muscles of the legs and arms do the work. Do not be afraid to yell for assistance if the load looks bulky or heavy. A good rule of thumb is: a man in good health should not lift over one-half of his own weight. You are no good to your job, your family, or yourself with a slipped disk or strained sacroiliac!

### ELECTRICITY

Electricity packs a mighty wallop, one-tenth ampere of current causes death if it lasts for 1 second or more and finds its way through a body, and could be a short circuit to Eternity. If you are lucky enough to escape a funeral you are sure to end up with a severe skin burn or destroy a vital organ. Especially be careful when you are using portable power tools—just because the tool will run is no guarantee that the electrical leads can be picked up carelessly. ⚓

# DROPPING YOUR HOOK

The best advice given a graduating class at one of our nautical academies was that "if you wish to succeed as an officer, you must first be agreeable to be taught many things you know already." The speaker meant that seamanship can only be acquired at sea but unfortunately familiarity breeds contempt. The routine procedure of anchoring in familiar waters, utilizing only an experienced "seaman's eye" as has been done thousands of times, every now and then brings anguish and misery to a skipper.

When you call out "let'er go, Mate" and the hook goes down do you know exactly where you are? Have you broken out a large-scale chart of the area and studied it so you know where it is *not* safe to anchor? Have you read and understood all the Notices to Mariners pertaining to the channel or river you are piloting and are they inscribed on the chart? Have you taken cross bearings and positioned yourself on the chart, and have you firmly in mind the wind force and direction and the state of the currents and tides for the season? Elementary you say! Let us recite you two of several cases from our files, because a page of history is frequently more persuasive than 10 pages of logic.

A company had authority to lay a submarine gas pipeline across a busy river, in the vicinity of piers and the approach areas to the berths. They arranged for issuance of a Notice to Mariners which cautioned against anchoring within 500 yards north and south of a line marked by range lights on each shore. An experienced skipper sailing north up the river one clouded-over night perceived that the berths were all occupied and decided to anchor and wait his turn. He testified that he was aware of the pipeline and that he dropped the hook when his seaman's line of sight convinced him that the range had opened and he had traversed more than one ship's length past the gasline. When they tried to hoist the anchor they had a little difficulty, but *persisted* and were astonished to see a geyser erupt off their bow. This incident cost the company over $300,000 for repairs to the gasline and legal fees.

Another expensive case was the vessel which entered a harbor about 0400, under the conn of a pilot, expecting to be met by tugs to assist snaking her up through a narrow channel. When the tugs did not appear the pilot selected an open spot in the quarantine anchorage and let go the anchor for a temporary hold. Then the captain noticed range lights new to him and questioned the pilot, who told him that they marked a natural gas pipeline being laid in a trench which had not as yet been covered over. The pilot also disclosed that a Notice to Mariners had been published to this effect, which was unknown to the master, and that the pilot thought the vessel was clear of the range when he advised anchoring. Shortly after, a launch came out from shore and told the skipper to heave up as he was in pipeline area. In retrieving the anchor the crew noticed an unusual strain *but continued heaving* and when the hook broke water a short piece of pipe came up with it. At the investigation it was brought out that the vessel was anchored by "seaman's eye" without benefit of pelorus bearings, no harbor chart had been broken out, and that while coastal charts had been corrected not much work was done on the inside charts. It was inferred that the master relied on the saying, "a pilot is a living chart who advises the conning of the vessel as she enters and negotiates the pilotage waters." It took almost $400,000 for reimbursement of out-of-pocket repair expenses and legal fees, before the file was closed.

In many circumstances, such as sudden fog in restricted waters or a steering casualty, the prudent seaman will prefer to anchor. But if there is the least bit of difficulty when heaving in, back your anchor out and check your charts for indicated telephone or power cables or pipelines. If you have the slightest doubt as to the correctness of your charts or up-to-date Notice to Mariners, swallow your pride and get on the air requesting information. If it could be that you fouled a high-voltage cable, gasoline or oil line under pressure, an early warning can allow shore installations to close valves or switches that will minimize contamination damage or avoid serious explosions. While it is a hard decision to make, it would be better to slip and buoy the anchor and reclaim it later. In the two cases related above this action certainly would have reduced the monetary cost.

Supervisory Safety Letter of the U.S. P.&I. Agency, by Alvin Robinson and Robert Smith. ⚓

# Liferafts Aid Fish Boat Rescues

During the past year, three notable fishing vessel casualties occurred in the North Atlantic. Fortunately, there was no loss of life, though, in each case, the vessel had to be abandoned in a comparatively short period of time. While other vessels stood by to render assistance, the actual rescues were expedited by the use of inflatable liferafts, and the possibilities of personal injury or death to the crews were greatly reduced. As a result of his experience one of the rescued captains strongly recommended that: "All fishing vessels be equipped with Coast Guard approved inflatable liferafts."

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 10 to 12 feet. The engineer had joined the captain on the bridge in the early evening and had reported everything in order and running normally. A short time later, he noticed black smoke coming from the engineroom. Upon investigation, flames were noted emerging from underneath the deck planks on the starboard side of the engineroom. 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. An attempt was made to use the wooden dory, but, when the dory was put over the side, it immediately capsized in the rough water. Two six-man liferafts were then inflated and used by the crew to escape the vessel. The crew was immediately picked up, uninjured, by a nearby fishing boat. Before any further action could be taken, the burning vessel swamped and sank.

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 upon investigation 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 engineroom, was awakened by an object striking the hull somewhere forward of the engineroom. He went directly to the engineroom 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 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 engineroom 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.

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 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 seas slammed the dory against the vessel, damaging it, causing it to sink. 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 are, nevertheless, indicative of some of 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 occurred in midwinter, and the possibilities of drowning, injury, or exposure would have been greatly increased if the men had been forced into the water.

# Long But Successful Fire Battle

A fire was discovered in the lower 'tween deck of No. 2 hold of a general-cargo-laden freight vessel 6 days out of an east coast port. The first indication was smoke detection by the vessel's smoke detector. The general alarm was sounded, mechanical ventilation to the holds was secured, and ventilation dampers to No. 2 hatch were secured. Within minutes a bank of eleven 100-lb. $CO_2$ cylinders was discharged in No. 2 LTD while the foredeck hatch tarpaulins and ventilator covers were wetted down. Simultaneously, two fire hydrants located at the aft end of the forecastle head were left open to flood the foredeck with a continuous flow of water.

Within an hour of the original alarm when it appeared that the fire was being contained, the smoke detector indicated adjacent compartments were being affected.

While additional cylinders, two at a time, were discharged into No. 2 LTD at intermittent intervals, it was decided to attempt further evaluation of the conditions in the 'tween deck area.

A thermometer lowered into the filling line of No. 2 port cargo deep tank indicated a temperature of nearly 107° F. After 1½ hours from the original alarm, the lower 'tween deck level registered a temperature fall to 70° F. No. 1 and No. 3 hatches were entered and inspection there disclosed no evidence of fire. From all apparent indications, the fire was believed to be confined to the after end of No. 2 LTD, portside, in the area of baled rag stowage.

No. 2 hatch was kept airtight, and at intermittent intervals of 5 to 6 hours, two 100-lb. $CO_2$ cylinders were discharged into the area. Firehoses were rigged to maintain a continuous flow of water over hatch tarpaulins, ventilator covers, and the main deck. A continuous watch was maintained on the smoke-detecting system and at No. 2 hatch. Every 2 hours, a thermometer was inserted into the deep tank filling line to check the temperature at the LTD level. It remained in the vicinity of 90° F. The vessel continued her voyage for another 4 days, effectively controlling the fire and upon arrival at her first port of call she was granted permission to berth.

After docking, the local fire department boarded the vessel to fight the fire. Their inspection indicated that the fire was isolated and confined. Preparations were made to discharge the cargo that would hinder firefighting operations. While the hatch was opened for unloading, the smoke and fumes progressively increased, necessitating evacuation and resecuring of the hatch. $CO_2$ was discharged into the area, and after a while the hatch was reopened while firemen again tried in vain to reach the fire. It was decided to resecure the hatch and lacking additional $CO_2$, steam was substituted and admitted into the $CO_2$ line. The steam was left on continuously in an attempt to smother the fire.

Early the next morning the hatch was reopened and cargo was discharged, and while firemen fought the fire, a portable pump was installed to remove water accumulating from the firehoses. Examination of the compressed bales of rags indicated that the fire was burning outward from the centers. Almost to the hour, 5 days after the fire was originally observed, it was considered extinguished and the crew was released from fire duty while firemen remained to guard the hatch.

The firefighting had been prolonged, but successful. The casualty had resulted in neither deaths nor personal injuries and damage to the vessel's structure was slight. ⚓

## "HOTWORK" REPAIRS START CARGO FIRE

Shore repairmen were contracted to make various minor repairs on a vessel while the loading of general cargo was taking place. One of these repairs was the installation of a doubler over a before-welded crack in a distilled water tank which extended into the cargo hold.

The repair party with a welding permit from the local captain of the port in hand boarded the vessel and immediately commenced work by burning and flushing down the old welded crack. Wood sheathing and cargo abutted the adjacent bulkhead. No fire watch was set. The work continued for over an hour when the smoke-detecting alarm sounded in the wheelhouse indicating a fire in No. 3 lower 'tween deck and lower hold. The lower 'tween deck space of No. 3 hatch was covered with a tarpaulin, and forty-five 50-pound bottles of $CO_2$ were released. After a replenishment supply was delivered to the vessel, 17 more bottles of $CO_2$ were released into the covered areas and the local fire department called.

Local fire officials and ship's officers then analyzed the problem of combating the fire, after which the fire department assumed jurisdiction with the master's permission. Removing the tarpaulin, the firemen and longshoremen worked through the night unloading cargo from the lower 'tween deck. Due to intense smoke it was necessary at times to vacate the stevedores and to permit the discharge of cargo by firemen using oxygen packs.

The next morning, the firemen were able to remove the hatch boards covering No. 3 lower hold and continue fighting the smoldering fire by lightly wetting down the cargo using a fog nozzle. On the following day, 2 days after the outbreak of the fire, the last of the cargo was removed from the lower hold.

Upon inspection, it was found that the "hotwork" repairs to the water tank ignited the protective wood sheathing. This heat caused the adjacent cargo of cardboard cartons to catch fire.

The fire, loss of time, and lengthy process of unloading could have been avoided if the repair had been carried out when the hold was empty or if proper preventive measures had been taken. It is the responsibility of ship's officers under these conditions to be aware of such repairs and to insure that adequate safety precautions are implemented. ⚓

# GANGWAY SAFETY

The gangway, one of the most important pieces of equipment used by all persons boarding and leaving vessels, is frequently subject to misuse by seamen who should be familiar with this equipment. Since the degree of caution, agility, and sobriety of all who come aboard cannot be controlled, it is of the utmost importance that gangways be constructed, rigged and maintained in such a manner as to afford protection to the users.

When ascending and descending gangways, many seamen fail to use their "know-how". They forget the adage, "one hand for the ship, one hand for yourself". Being too hasty is undoubtedly the cause of the majority of gangway accidents. Attempting to skip down on the edge of the steps instead of placing each foot firmly on each step has been the cause of some accidents.

Descending an inclined gangway requires proper body position. Turn the body somewhat to one side and keep one hand above, grasping the right handline, and one below grasping the left handline, thereby reducing the chance of falling forward.

The protective value of a properly rigged gangway safety net has been proved on numerous occasions. For some unknown reason a small minority of persons, when attempting to board an accommodation ladder or brow gangway, simply misjudge their footing and walk off the dock.

The purpose of the gangway safety net is to prevent persons from falling between the ship and dock in the vicinity of the gangway. As a general rule the net is rigged between the ship and dock equidistant fore and aft of the lower end of the accommodation ladder, or rigged to best advantage underneath the brow gangway.

Here are some general safety precautions that will insure GANGWAY SAFETY FOR ALL HANDS:

1. Gangway net *must* be in place while moored to a dock.
2. Taut double handrails *must* be provided on both outboard and inboard side of the gangway. Stanchions *must* be rigidly secured in sockets.
3. Measures *must* be taken to prevent overcrowding of gangways.
4. A life ring with throw-line attached *must* be kept readily available.
5. Gangways *must* be adequately lighted at night.
6. Gangway *must* be rigged at a safe incline with duckboards in place when necessary.
7. Gangway *must* be free of grease, oil, trash, etc.
8. Gangway watchman *must* be instructed to check regularly on conditions of gangway, due to changes in elevation from tide or draft.

# ACCIDENTS ARE CAUSED

Most people think that accidents just happen—that they are just due to "bad luck." These same people would laugh if you said they were superstitious. But the attitude that accidents just happen, that they can't be avoided, is just as ridiculous as that old wives' tale about black cats and broken mirrors.

Nothing could be further from the truth than this belief about accidents being unavoidable. Experts say that practically all accidents—say 99 out of a hundred—are avoidable. And if you want more proof just look at the reduction in the longshore accident record that has taken place in the past few years. There would be no accounting for the drop if accidents "just happened." That we've cut down the accident toll shows we can do something about them, that they can be prevented.

Now the one or so out of a hundred accidents that cannot be prevented might be called "Acts of God"—lightning, hurricanes, tornadoes, tidal waves, happenings that we are practically powerless to prevent, although we can take some precautions against them. The other 99 percent of accidents clearly have a man-made cause. If you check back far enough, you'll find that somewhere, somehow, someone could have done something to prevent most accidents. ⚓

# SAFETY IS PLANNING

An accident is a mistake, caused primarily by poor, or no previous planning. It is the end result of a wrong move, a wrong decision, a wrong thought—all of which can be traced to poor or no planning. If a job is to be a success, right and proper planning must go into it. And if a man is to be safe, the same amount of planning must accompany the work he is doing, no matter how small or insignificant it may seem at the time. If a man isn't awake and alert, if he isn't observing or thinking, if he hasn't planned beforehand and carefully considered every possibility which could occur while working onboard ship—he is likely to sustain a serious injury before too many voyages are completed. Good work and safe work is the result of careful and meticulous thought and planning. An accident is a mistake. Safety isn't. Safety is a well-thought-out scheme which precedes any job. So start planning safety into your jobs. Learn the right and safe way to do it. Take interest in your work. Be alert and watchful, not inattentive and indifferent. Obey safety rules and work procedures associated with your particular job. Plan well, and you should live a long time to enjoy your accomplishments.

Accidents occur as a result of hazards, mechanical or human, which in turn exist only because of the fault of some person or persons. "On the spot" inspection and immediate correction of any defect or unsafe condition which come to light can eliminate any mechanical or physical hazards.

Human hazards, however, present a different problem, which must be met by constant thinking and planning ahead for Safety. Suppose a man shows a careless attitude in his work. That man must be given closer supervision and stronger and more frequent talks in safe practice and work methods. This is where his fellow crewmen, by sharing "know-how" and experience with him, will find themselves benefited by having a safer and more useful co-worker.

*From Lykes Lines Safety Bulletin* ⚓

## SAFE BY DESIGN

(Continued from page 159)

ity is provided on each side for one-half the number of people aboard with an additional provision for 25 percent of the total number of persons in the form of liferafts. In this sense, it is somewhat safer to travel on cargo ships.

What can be concluded from this discussion of safety considerations in the design of U.S. merchant ships?

The first conclusion is that, in addition to detailed consideration for individual safety, broad and fundamental considerations of safety are incorporated into the basic design of U.S. merchant ships.

The second conclusion is that a "completely safe" ship is not feasible. A recognition of the other factors involved is always necessary. For illustration, a "completely safe" ship from the point of view of subdivision would have very close spacing of its bulkheads but would not be able to carry cargo of any magnitude. On the engineering side, the "completely safe" ship would have at least two propellers, two rudders, and two machinery plants. In competitive situations, this would be disastrous. The decisions to be made for ships in this respect are little different from those which are made for other modes of transportation.

The third conclusion is that there is always a considerable amount of evaluation required of an owner and a designer to match different degrees of protection against the effectiveness to be realized and the economics of the situation. In my opinion, it is not an unhealthy attitude to examine all features including those of safety with an economics probe. I do submit, however, that it would be very unhealthy to render a decision in such matters on economics alone. The necessity for regulatory participation in safety matters originated to a large degree from this type of approach.

The fourth conclusion is that U.S. merchant ships today incorporate the highest standards of safety in the world. There is little doubt that this contributes to the higher cost of U.S. ships. However, I believe that this approach is derived from and supported by the average American's concern for safety of personnel. It is also possible that in the long run the extra investment pays off with a lower casualty rate and with ships better equipped for national defense. ⚓

# nautical queries

### DECK

Q. What is a circle of equal altitude?

A. A circle of equal altitude is a circle on the surface of the earth, on every point of which the altitude of a given celestial body is the same at a given instant. The pole of this circle is the geographical position of the body and the great circle distance from this pole to the circle is the zenith distance of the body.

Q. Describe what is meant by a "bore."

A. A "bore'" is a very rapid rise of the tide in which the advancing water presents an abrupt front of considerable height. In shallow estuaries where the range of tide is large, the high water is propagated inward faster than the low water because of the greater depth at high water. If the high water overtakes the low water an abrupt front is presented with the high-water crest finally falling forward as the tide continues to advance. Also called *eager, mascaret,* and *pororoca.*

Q. (a) When do neap tides occur?

(b) How does the range of tide at such times compare with the average range?

A. (a) Neap tides occur when the moon is in its first and third quarters in quadrature.

(b) The range of tide at the time of neap tides is less than the average range.

Q. (a) What is the diurnal range of the tides?

(b) What occasions the difference in height between two successive high waters of the tide?

A. (a) The difference in height between higher high water and lower low water is known as the diurnal range.

(b) The principal cause for a difference in height between two successive high tides is the declination of the moon.

Q. What regions of the earth may not be shown by the ordinary Mercator chart projection?

A. The polar regions and extreme north and south latitudes adjacent thereto cannot be charted on the ordinary Mercator projection.

### ENGINE

Q. Explain the use and advantages of reheaters in connection with turbines.

A. In expanding through a turbine, steam becomes wet. This moisture causes both corrosion and erosion, especially in the later stages. Therefore, some turbines are fitted with reheaters between the high-pressure and low-pressure units. Wet steam is removed and reheated by an outside source. It is then returned to the unit as dry or superheated steam. This feature not only lessens damage to blading, but combines the thermodynamic advantages of superheat, giving increased economy.

Q. What are the principal sources of loss of energy which occurs in all turbines?

A. 1. External losses.

(a) Loss in working substance. The leakage of steam along the shaft through the shaft glands.

(b) Heat loss. From the turbine to the surrounding atmosphere through radiation, convection, and conduction.

(c) Work loss. Due to mechanical friction in the bearings, reduction gears, etc.

2. Internal losses.

(a) Throttling loss. Whenever steam passes through a steam admission valve and there is a drop in pressure without the performance of work.

(b) Leaving loss. The residual velocity of the steam leaving the turbine.

(c) Windage loss. Caused by fluid friction as the turbine wheel and blades rotate in the surrounding steam.

(d) Nozzle and blade loss. Caused by friction as the steam passes through these spaces.

(e) Diaphragm packing loss. Caused by leakage of steam from one stage to another (Impulse type).

(f) Tip leakage loss. Caused by leakage of steam over the ends of both the fixed and moving blades without doing any work (Reaction type).

## BOW THRUSTERS

(Continued from page 163)

bow swinging to the right and movement of the control handle to the left will result in the vessel's bow moving to the left. This is accomplished by varying the pitch of the continually rotating propeller. The vessel's bow is thrust to port or starboard, at any desired rate or brought to a quick stop and reversed in direction, all without a change in direction of the prime mover or propeller.

The sequence of operation is essentially as follows. Desired thrust (zero thru full) as indicated by the position of the control handle is pneumatically transmitted from the main control stand to a pitch positioner located in a control panel assembly at the prime mover. A servo valve then admits oil to one face or the other of a servo piston in the propeller hub body. The piston's axial movement is translated to rotary motion through a sliding block and crank ring; each blade being connected to the crank ring, the pitch change is simultaneous.

The indicating panel is located within the bridge. It provides visual and audible presentation to disclose faults in the various sections and visual indication by red, green and yellow lights to indicate port, starboard, or no thrust being effected, so that the operator can ascertain the status of the unit at all times.

During underway trials the installation was well received. Grace officials expect that service usage will permit the elimination of tugs in some instances and a reduction in the number of tugs normally required. Considering that as many as fifty dockings and undockings will be made during a six week round trip, the equipment should see plenty of operation. Mooring to buoys is not unusual in this trade and the bow thrusters will no doubt also prove to be advantageous in this maneuver.

*Lieutenant Commander Cletus J. Walz, a graduate of the U.S. Merchant Marine Academy, entered the Coast Guard in 1953. He holds an unlimited master's license and has served in various Coast Guard sea and shore billets including two major marine inspection offices, Baltimore and Philadelphia. He is presently assigned as Senior Resident Inspector at Sun Shipbuilding and Dry Dock Co., Chester, Pa.* ⚓

## AMENDMENTS TO REGULATIONS

The *Proceedings* does not normally reprint Federal Register material in toto because of space limitations. Rather, as a public service, mention is made on this page of those Federal Register items published during the month that have a direct effect on merchant marine safety. Then, should one wish to read the regulation in its official presentation, he must purchase the applicable Federal Register from the Superintendent of Documents. Always give the date of the Federal Register when ordering. This date can be found in the *Proceedings* coverage of the items. See instructions in publications panel inside back cover.

### EXPLOSIVE RULES AMENDED

The Interstate Commerce Commission in Change Order No. 72 has made changes in ICC regulations with respect to definitions, descriptive names, classifications, specifications of containers, packing, marking, labeling, and certification for certain dangerous cargoes, which are now in effect for land transportation. Various amendments to the Dangerous Cargo Regulations in 46 CFR Part 146 have been included in the Federal Register of June 14, 1966 in order that these regulations governing water transportation of certain dangerous cargoes will be as nearly parallel as practicable with the regulations of the Interstate Commerce Commission which govern the land transportation of the same commodities.

### *CIRCULAR*

### TIME EXTENSION FOR OBTAINING LIFESAVING EQUIP.

Owners, masters and agents of ocean and coastwise vessels are requested to obtain the additional new equipment required for lifeboats at the earliest possible date. However, upon request for deferment of compliance with such equipment regulations for any reason, the Officer in Charge, Marine Inspection, may issue a deficiency notice on Form CG-835 specifying a date by which the equipment shall be on board, which in no event shall exceed 6 months from date Form CG-835 is issued. This is the crux of Navigation and Vessel Inspection Circular 2-66A which may be obtained at the local marine inspection office or by writing Commandant (CHS), U.S. Coast Guard, Washington, D.C., 20226.

### *STORES AND SUPPLIES*

Articles of ships' stores and supplies certificated from June 1 to June 30, 1966, inclusive, for use on board vessels in accordance with the provisions of Part 147 of the regulations governing "Explosives or Other Dangerous Articles on Board Vessels" are as follows:

#### CERTIFIED

*Apollo Chemical Corp.*, 250 Delawanna Ave., Clifton, N.J. 07014. Certificate No. 669, dated June 8, 1966, KEMKLEEN, APOLLO BURNER CLEANER or BC-69; Certificate No. 670, dated June 8, 1966, PENTRON M; Certificate No. 671, dated June 8, 1966, PENTRON D.

*Whale Chemical Co.*, 36 Belmont Pl., Staten Island, N.Y. 103101. Certificate No. 672, dated June 17, 1966, NS-44, FUEL OIL ADDITIVE. Certificate No. 673, dated June 17, 1966, NS-301; Certificate No. 674, dated June 17, 1966, NS-201, G.P.C.; Certificate No. 675, dated June 17, 1966, NS-303.

### *AFFIDAVITS*

The following affidavit was accepted during the period from May 15, 1966, to June 15, 1966:

*DeZurik Corp.*, Sartell, Minn. 56377, FITTINGS.[1]

[1] Acceptance covers 4″ and 6″ diameter cylinders.

#### NOTICE

**It is now possible to keep your Coast Guard publications up to date by using the column entitled "Marine Safety Publications and Pamphlets" as a ready reference. Following the title of each publication are the dates of the Federal Registers which amend it. With the use of the proper Federal Register, each pamphlet can be kept up to date until a new issue is available.**

## 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 Sunday, Monday, and days following 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 may be purchased from the Superintendent of Documents, Government Printing Office, Washington, D.C., 20402. Subscription rate is $1.50 per month or $15 per year, payable in advance. Individual copies may be purchased so long as they are available. The charge for individual copies of the Federal Register varies in proportion to the size of the issue but will be 15 cents unless otherwise noted in the table of changes below. Regulations for Dangerous Cargoes, 46 CFR 146 and 147 (Subchapter N), dated January 1, 1966 are now available from the Superintendent of Documents, price $2.50.

| CG No. | TITLE OF PUBLICATION |
|---|---|
| 101 | Specimen Examination for Merchant Marine Deck Officers (7–1–63). |
| 108 | Rules and Regulations for Military Explosives and Hazardous Munitions (8–1–62). |
| 115 | Marine Engineering Regulations and Material Specifications (9–1–64). F.R. 2–13–65, 8–18–65, 9–8–65. |
| 123 | Rules and Regulations for Tank Vessels (4–1–64). F.R. 5–16–64, 6–5–64, 3–9–65, 9–8–65. |
| 129 | Proceedings of the Merchant Marine Council (Monthly). |
| 169 | Rules of the Road—International—Inland (9–1–65). F.R. 12–8–65, 12–22–65, 2–5–66, 3–15–66. |
| 172 | Rules of the Road—Great Lakes (6–1–62). F.R. 8–31–62, 5–11–63, 5–23–63, 5–29–63, 10–2–63, 10–15–63, 4–30–64, 11–5–64, 5–8–65, 7–3–65, 12–22–65. |
| 174 | A Manual for the Safe Handling of Inflammable and Combustible Liquids (3–2–64). |
| 175 | Manual for Lifeboatmen, Able Seamen, and Qualified Members of Engine Department (3–1–65). |
| 176 | Load Line Regulations (1–3–66). |
| 182 | Specimen Examinations for Merchant Marine Engineer Licenses (7–1–63). |
| 184 | Rules of the Road—Western Rivers (6–1–62). F.R. 1–18–63, 5–23–63, 5–29–63, 9–25–63, 10–2–63, 10–15–63, 11–5–64, 5–8–65, 7–3–65, 12–8–65, 12–22–65, 2–5–66, 3–15–66. |
| 190 | Equipment lists (8–3–64). F.R. 10–21–64, 10–27–64, 3–2–65, 3–26-65, 4–21–65, 5–26–65, 7–10–65, 8–4–65, 10–22–65, 10–27–65, 1–27–66, 2–2–66, 2–5–66, 2–10–66, 3–15–66, 3–24–66, 4–15–66. |
| 191 | Rules and Regulations for Licensing and Certificating of Merchant Marine Personnel (2–1–65). F.R. 2–13–65, 8–21–65, 3–17–66. |
| 200 | Marine Investigation Regulations and Suspension and Revocation Proceedings (10–1–63). F.R. 11–5–64, 5–18–65. |
| 220 | Specimen Examination Questions for Licenses as Master, Mate, and Pilot of Central Western Rivers Vessels (4–1–57). |
| 227 | Laws Governing Marine Inspection (3–1–65). |
| 239 | Security of Vessels and Waterfront Facilities (7–1–64). F.R. 6–3–65, 7–10–65, 10–9–65, 10–13–65, 3–22–66. |
| 249 | Merchant Marine Council Public Hearing Agenda (Annually). |
| 256 | Rules and Regulations for Passenger Vessels (4–1–64). F.R. 6–5–64, 8–21–65, 9–8–65. |
| 257 | Rules and Regulations for Cargo and Miscellaneous Vessels (1–3–66). F.R. 4–16–66. |
| 258 | Rules and Regulations for Uninspected Vessels (1–2–64). F.R. 6–5–64, 6–6–64, 9–1–64, 5–12–65, 8–18–65, 9–8–65. |
| 259 | Electrical Engineering Regulations (7–1–64). F.R. 2–13–65, 9–8–65. |
| 266 | Rules and Regulations for Bulk Grain Cargoes (7–1–64). F.R. 3–10–66. |
| 268 | Rules and Regulations for Manning of Vessels (2–1–63). F.R. 2–13–65, 8–21–65. |
| 270 | Rules and Regulations for Marine Engineering Installations Contracted for Prior to July 1, 1935 (11–19–52). F.R. 12–5–53, 12–28–55, 6–20–59, 3–17–60, 9–8–65. |
| 293 | Miscellaneous Electrical Equipment List (4–1–66). |
| 320 | Rules and Regulations for Artificial Islands and Fixed Structures on the Outer Continental Shelf (10–1–59). F.R. 10–25–60, 11–3–61, 4–10–62, 4–24–63, 10–27–64. |
| 323 | Rules and Regulations for Small Passenger Vessels (Under 100 Gross Tons) (1–3–66). |
| 329 | Fire Fighting Manual for Tank Vessels (4–1–58). |

### CHANGES PUBLISHED DURING JUNE 1966

The following have been modified by Federal Registers:
Dangerous Cargoes Regulations, Federal Register, June 14, 1966.



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