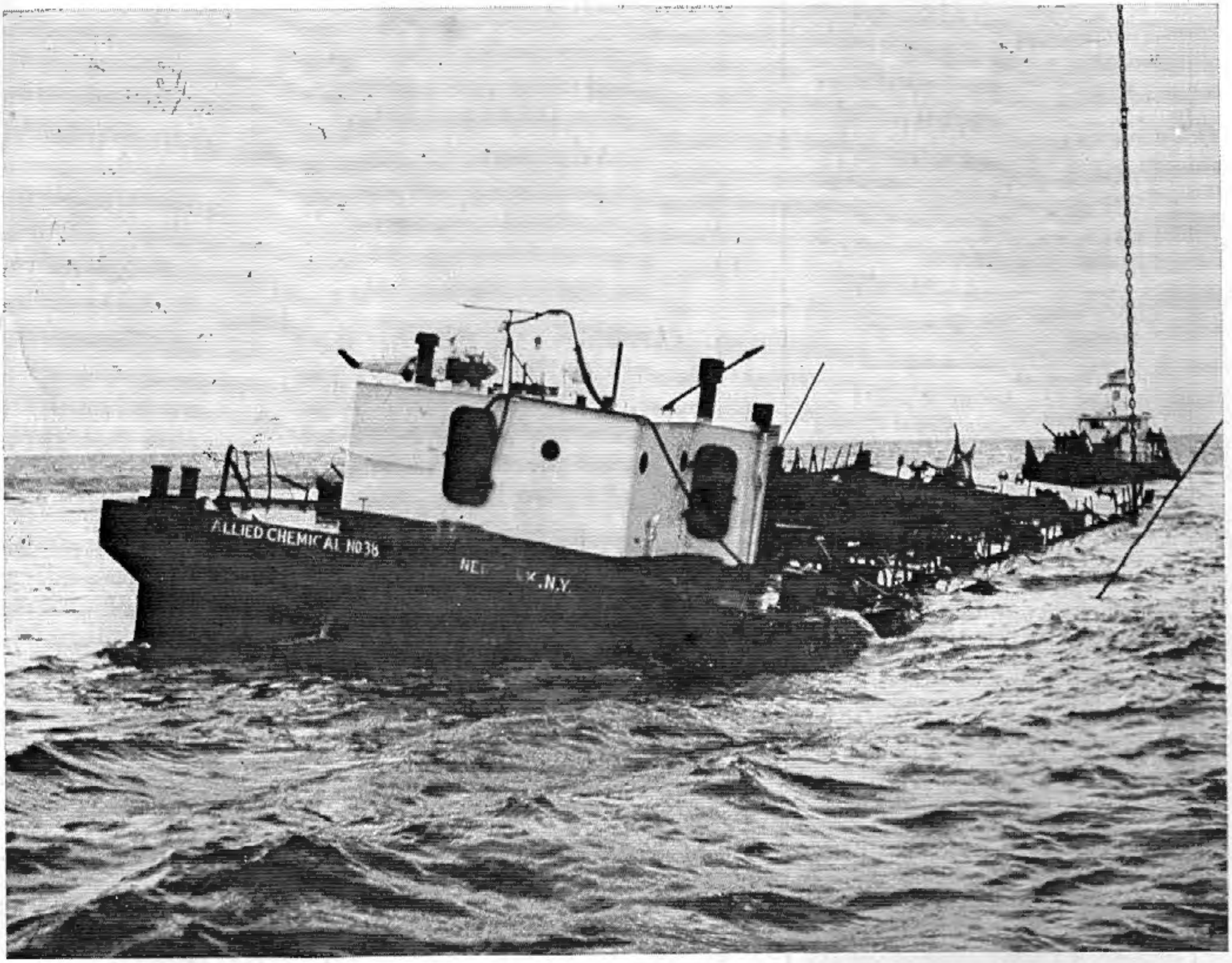
PROCEEDINGS
OF THE MARINE SAFETY COUNCIL



DEPARTMENT OF TRANSPORTATION UNITED STATES COAST GUARD

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PROCEEDINGS

OF THE MARINE SAFETY COUNCIL

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DEPARTMENTS

COVERS

On August 18, 1976, Allied Chemical Corp. tank barge No. 38, carrying a cargo of 1,059 short tons of oleum (concentrated sulfuric acid), capsized in the lower Chesapeake Bay. The hazardous nature of the cargo presented Coast Guard and salvage personnel with an unusual and particularly delicate job.

Many hours and two attempts later, the barge was righted by two 100-ton-capacity Navy cranes. When the barge was boarded, the tanks were found to contain only water. The how's and why's are the subject of this month's features.

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

maritime sidelights

POLLUTION REPORTING

Since 1 January of this year, Coast Guard regulations have specified that all reports of oil or hazardous substance spills into the country's navigable waters are to be made to the Duty Officer, National Response Center.

The National Response Center, located at Coast Guard Headquarters in Washington, is manned 24 hours a day. It is specially equipped and staffed to facilitate pollution reporting and the timely response needed to minimize the environmental damage resulting from these discharges.

Calls to the NRC may be made toll free by dialing 800-424-8802.

LIKE A DUCK TO WATER

If you want to keep a duck out of an oil spill, dye the oily water orange. According to a group of University of Rhode Island students, even hungry ducks do not like to swim through orange water to get food.

Working under a National Science Foundation grant, the students last summer tested ducks' willingness to swim through eight colors of water to reach a food pan in the center of a pool. All the birds had been deprived of food for 24 to 48 hours.

Apparently, the black of an oil spill is the worst possible color, since the ducks showed no hesitation to jump right in. It was almost the same with blue and green water. Yellow, violet, and indigo provided neutral results.

But when it came to orange water, the ducks ran back and forth at the edge of the pool, quacking and showing other signs of distress. After a time some gave up. Others eventually swam over to the food, but obviously would have avoided the water if they could have.

Results with red water had to be discounted after it was learned that the farm where the ducks were raised used red watering pans, and the birds obviously had pleasant associations with that color.

Although they have used only ducks thus far, the student investigators believed that their theory is applicable to other waterfowl. The group has applied for a second grant to be used this coming summer, and is now looking for duck farms using less colorful water and food dishes. Also, they hope to check the birds' reactions to some dyed oil in simulated spills.

A BETTER DIPSTICK

And if you want to measure the thickness of that slick—whatever the color—Drs. Foster H. Middleton and Lester R. LeBlanc, also at the University of Rhode Island, can help.

The two professors of ocean engineering have developed an "oil layer thickness sensor," which is being used in a Coast Guard research program to determine the efficiency of various types of cleanup equipment. The device, a thumbnail-size button made of lead zirconate and lead titanate, can determine within one-tenth of a millimeter (one two-hundred-fiftieth of an inch) the thickness of an oil layer on water and the exact point where the oil and water touch. These two factors are important to the efficient operation of some types of cleanup equipment.

Though it sound like a rather exotic invention, the sensor is essentially a small-scale fathometer. The tiny button is mounted or suspended below the water surface in an aluminum holder and attached to an electrical supply. When an electrical signal is transmitted to the sensor, it causes the button to beam sound toward the water surface.

Since the acoustic properties of water, oil, and air vary, the movement of sound from one of these mediums to another produces an echo at the interface. The echoes are received by the sensor and transmitted to a computer. By measuring the time lapse between the echoes received from the water-oil interface and the oil-air interface, the thickness of the oil layer can be determined as well as the depth of the water.

The sensor reportedly can also be used to measure other chemical contaminants which form layers on the water surface, provided the sound properties of the two are different.

DIVING CHAMBERS

The Coast Guard recently granted final approval to a set of three 1200 FSW commercial diving systems, designed and constructed to Section VIII, Division 2 of the ASME Code. This marks the first time that Division 2, which is based on a factor of safety of three, has been employed in the design and fabrication of a Coast Guard inspected pressure vessel.

An offshoot of the ASME Nuclear Code, Division 2 was first published in 1968. Until Code Case 1570 was approved in March 1973, Division 2, intended for stationary vessels only, could not be used in the design of a pressure vessel for human occupancy (PVHO). In order to preserve the level of control expected in the operation of a Division 2 vessel, this Code Case required PVHO's to meet the following additional requirements:

(1) Loading conditions imposed by movement of the vessel during operation and by relocation of the vessel between work sites shall be considered as part of Par. AD-110.

(2) The User's Design Specification shall include the agreements which resolve the problems of opera-

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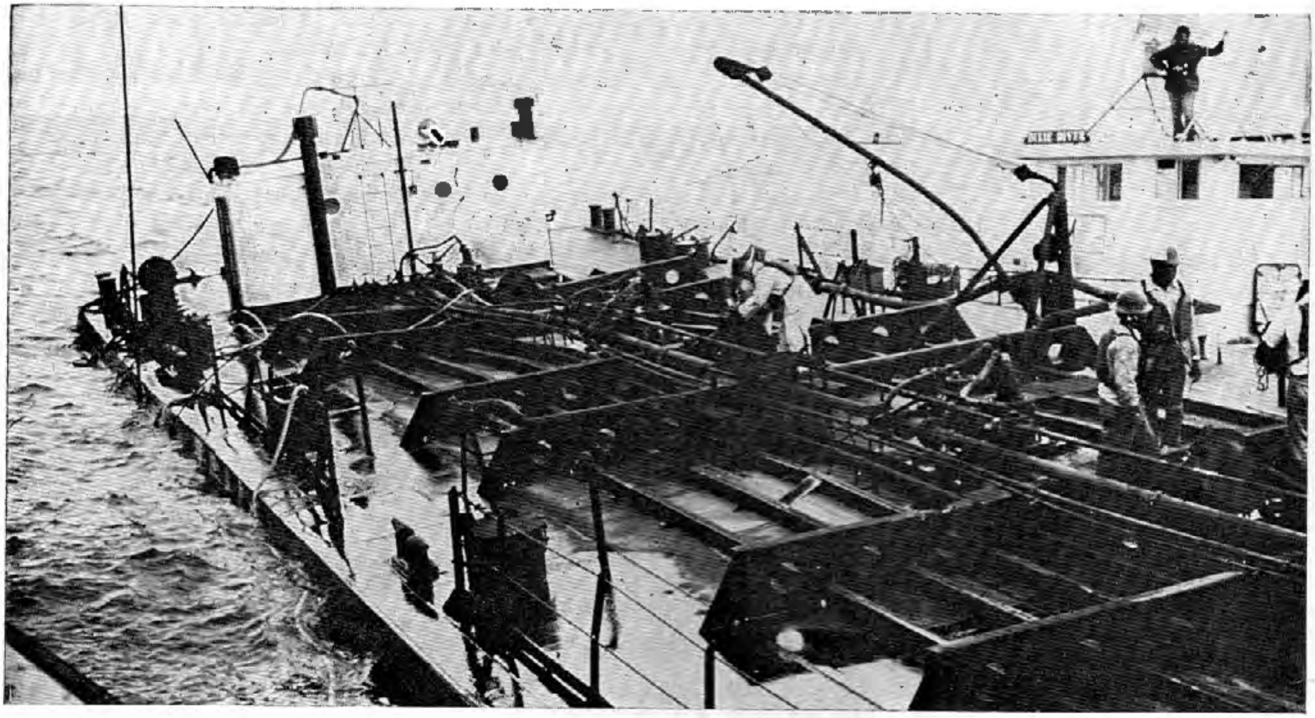


Acid Spill

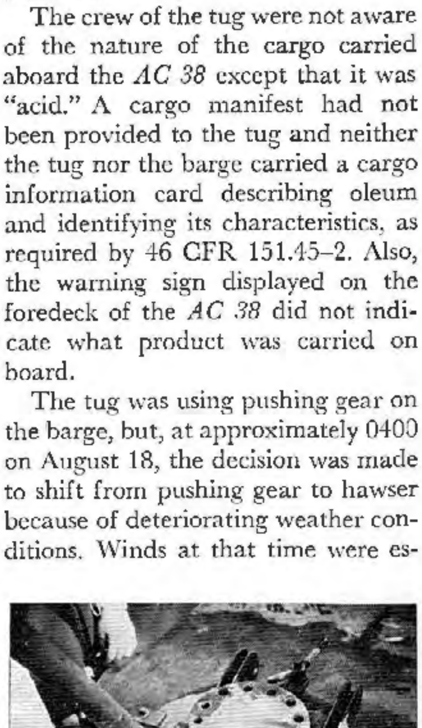
On August 18, 1976, the MT Big Mama *with tank barge* AC 38 *in tow, was underway in the lower Chesapeake Bay en route from Claymont, Del., to Hopewell, Va. At approximately 0540 EDST, about 30 miles north of Norfolk, the barge capsized.*

The *AC 38* had a cargo of 1,059 short tons of 20 percent oleum. The tankerman in charge of the loading of the barge testified that he had checked the barge rakes and all voids for dryness after loading by looking down the hatches from the main deck. All the checked spaces were dry.

The *AC 38* was taken under tow from the loading dock by the tug *Big Boy* on August 17. However, the *Big Boy* soon experienced engine trouble, and the barge was transferred to the *Big Mama* at the lower end of Deepwater range of the Delaware River. The *Big Mama* then set out for Hopewell via the Chesapeake and Delaware Canal.

The crew of the tug were not aware of the nature of the cargo carried aboard the *AC 38* except that it was "acid." A cargo manifest had not been provided to the tug and neither the tug nor the barge carried a cargo information card describing oleum and identifying its characteristics, as required by 46 CFR 151.45–2. Also, the warning sign displayed on the foredeck of the *AC 38* did not indicate what product was carried on board.

The tug was using pushing gear on the barge, but, at approximately 0400 on August 18, the decision was made to shift from pushing gear to hawser because of deteriorating weather conditions. Winds at that time were es-



timated to be NE 10–15 knots, seas 1–1½ feet. The *AC 38* was placed on a 500-foot hawser and the *Big Mama* resumed the voyage at 0435.

When the mate again looked aft he could no longer see the lights of the barge. All hands were called on deck and the towing hawser was reeled in.

The *AC 38* appeared to be riding normally on hawser until approximately 0540 when the barge took a shear to port. The *Big Mama* heeled to port as the towing hawser came under strain, so the mate, who was standing the watch, slowed his engines to reduce the strain. When he again looked aft he could no longer see the running lights of the barge. All hands were called on deck and the towing hawser was reeled in. The hawser, shock line, and towing bridle were recovered intact and undamaged.

The tug then proceeded to the barge and found it floating in an inverted position, slightly down by the bow. Approximately 20 minutes after capsizing, the barge was seen to rise up with about a 4-foot increase in freeboard. It stayed up for about 30 minutes and then settled back into the water and remained in this condition until righted. It is assumed that the cargo escaped during that period.

After righting, the barge was boarded and examined. All the cargo hatches were open and the tanks full of water. The *Big Mama* towed the *AC 38* to Norfolk where a thorough inspection was conducted. A 36-inch fracture was found in the forward starboard corner of the forward rake, and in the center of the fracture was a set-in area 18 inches long, creating an 8-inch hole. The first 18 inches of the fracture was old damage, which had occurred prior to the last hull painting. The set-in area was newer damage, presumably the result of a tug striking, though this could not be documented.

The Coast Guard investigating officer concluded that the proximate cause of the casualty was the hole in the forward rake. Water entered this hole as the *AC 38* was first pushed and then towed, with the following wind and sea adding to the influx. As the forward rake filled with water, the barge trimmed by the bow and the range of stability decreased to a point where, when the *AC 38* sheared to port and the hawser took a heavy

strain, the barge could not right itself and it rolled over. The damage to the cargo hatches and main deck was caused by the extreme reaction between the oleum and seawater as the acid escaped.

It was also concluded that evidence of violations of 46 CFR 151.45 existed in that: (1) The ullage openings and cargo hatches on the *AC 38* were not properly secured; (2) the barge was loaded with approximately 1,059 short tons of cargo, when limited to 1,000 short tons by its Certificate of Inspection; (3) a cargo information card was not carried on either the barge or tug, nor was a cargo mani-

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Where Did All the Acid Go?

by Lieutenant Commander Fred H. Halvorsen

Cargo and Hazardous Materials Division, Office of Merchant Marine Safety

When the Allied Chemical Corp. tank barge 38 capsized in the lower Chesapeake Bay with a full load of oleum, the salvage and safety personnel sent to the scene were presented with an unusual, difficult, and potentially hazardous salvage operation. The oleum was not only highly corrosive but was also highly water reactive. If the cargo were catastrophically released, it was possible that a highly persistent acid-mist cloud could be formed which might drift on the prevailing winds and could cause difficulty to persons on the nearby shore. The entire salvage operation was directed to minimize cargo hazards to salvage and safety personnel and to the nearby populace.

Another problem which soon became of more than just passing interest during the salvage was the fact that the barge was highly stable in the inverted position. The configuration of the barge was such that it was more stable upside down than rightside up when loaded with cargo.

The barge was built with externally framed centerline tanks. Surrounding each tank was a cofferdam about 4 feet wide at the sidewalls and about 3 feet above the barge bottom. Free transverse communication existed between the sidewall cofferdams under the bottom of the barge.

The weight of the barge was about 250 tons plus about 1,000 tons of

cargo. When the barge capsized, the location of the cargo tanks was effectively shifted downward 3 feet—or 1,000 tons in a 1,250 tons system was moved 3 feet closer to the keel of the barge, thus moving the center of gravity correspondingly downward. The barge would be quite happy to maintain an inverted attitude, assuming the cargo tanks were full and the void spaces empty.

Product Description and Hazard Estimate

Oleum is concentrated sulfuric acid; both oleum and sulfuric acid are usually produced by bubbling sulfur trioxide, a fuming liquid, through water. Water and sulfur trioxide vigorously and immediately react on contact to form sulfuric acid. When all the water present has reacted with sulfur trioxide, the solution is saturated—that is, the solution is 100 percent (by weight) sulfuric acid. By bubbling even more sulfur trioxide through 100 percent sulfuric acid the solution becomes supersaturated with sulfur trioxide and is called oleum. The concentration of oleum is classified by the percentage (by weight) of the excess sulfur trioxide present.

The acid carried aboard the *AC 38* was 20 percent oleum (20 percent by weight sulfur trioxide and 80 percent by weight sulfuric acid). Twenty percent oleum is equivalent to 104.5 percent sulfuric acid. To each 100 pounds of 20 percent oleum, 4.5 pounds of water would have to be added to make 100 percent acid. The specific gravity of 20 percent oleum is high—1.918 at 60° F (about 120 lb/ft^3). Twenty percent oleum freezes at 38° F and boils at 280° F.

Diluting concentrated sulfuric acid with water is highly exothermic (heat-producing). For example, about 500 Btu are released for each pound of 104.5 percent sulfuric acid mixed with water to infinite dilution. Theoretically, 1,000 tons of oleum could cause about 900,000 pounds of water to be heated to steam.

Sulfuric acid is highly corrosive to ferrous metals and produces a highly flammable byproduct—hydrogen. The corrosion rate of sulphuric acid on mild steel is quite unusual. It is lowest at about 96 percent acid and highest at about 28 percent acid. The corrosion rate curve, however, does not change smoothly with concentration but passes through a number of local minimums and maximums. In general, however, as the concentration is reduced from 96 percent toward 28 percent the corrosion rate increases markedly. Under confinement, sufficient hydrogen is produced through reaction with mild steel at low acid concentrations to constitute an explosion hazard.

The very corrosive effects of dilute acid on steel was illustrated by the loss of the sulfuric acid barge, *Chembarge No. 4*, in 1964. The barge, which contained 1,400 tons of 93 percent acid, developed a leak from a cargo tank into the bilges where the acid mixed with water and diluted. The highly corrosive mixture reacted with the steel structure, producing irritating fumes and hydrogen gas. Measurements of concentrations showed acid in the bilges to be in the 40- to 50-percent range. After unsuccessful efforts to pump out the diluted acid, several days were spent trying to neutralize it with lime and caustic soda. These efforts also were unsuccessful and, because of the dangerous hydrogen concentrations present in the barge, it was towed to the middle of Lake Huron and sunk in 200 feet of water. Explosions and underwater disturbances were reported shortly after the sinking.

Oleum is listed in 33 CFR 14(b)(1) as one of the "Cargoes of Particular Hazard" (COPH). COPH are bulk liquids whose catastrophic release in a port area would probably cause great difficulty and have the capability to harm people well removed geographically from the site of release. Oleum is included on this list because it is so intensely water-reactive and has the potential to form a persistent acid mist. The only present requirement for COPH is that 24-hour advance notice be given to the Coast Guard prior to transporting or transferring the product in a port area. The advance notice must include the amount and location on board of the COPH.

There are a number of health hazards associated with oleum and sulfuric acid. First, the liquid is intensely corrosive to human tissue and especially eye tissue. Destruction of eye tissue may occur with attendant loss of vision. The vapor or mist from oleum, being primarily sulfur trioxide, is extremely corrosive to the upper respiratory tract. The vapor pressure of 20 percent oleum at 80° F is about 0.1 pounds per square inch absolute which would not constitute an excessive hazard unless directly exposed.

If large quantities of oleum were mixed with water, formation of an acid mist might occur.

If large quantities of oleum were mixed with water, formation of an acid mist might occur. Acid mist formation would be as a result of the heat of dilution vaporizing water, which could produce droplets of acid. This acid mist would be much denser than air and fairly persistent. It would most likely occur as a result of water entering the cargo tanks with the barge in the upright position, or by catastrophic unconfined release of oleum into water.

A Coast Guard research and development project is presently underway to quantify the formation of an acid mist from release into water of violently water-reactive chemicals. Actual spills of oleum with verification and measurement of any acid mist are planned. This project was formulated before the *AC 38* capsizing; however, a great deal of interest has been generated in the project because of the incident.

Pollution Potential

The immediate pollution potential of release of the oleum would be great, but the long-term effects would be negligible. Although very hazardous in concentrated form, oleum is infinitely soluble in water and will dilute to nonharmful concentrations within a relatively short period. In the immediate vicinity of a release, oleum will greatly increase the acidity of the water to levels almost immediately fatal to marine life; moderate fishkills would be expected from a release. However, because of dilution, no serious long-term effects to marine life would be expected.

What Happened

Immediately after the capsizing, the crew of the towboat reported "steam" coming up around the sides of the barge. This continued for about 10 minutes and probably can be attributed to an initial release of oleum. This oleum most probably was forced out of the tanks by a hydrostatic head greater than the surrounding water through the weight-loaded (and hence open when upside down) pressure side of the 2½ inch PV valves. This oleum vigorously reacted with water, producing great quantities of steam. At some point, the internal tank pressure equalized with the outside water pressure and the oleum ceased to flow out.

The oleum remaining in the barge, however, was heated because of the external heat; when it began to cool, water was drawn into the tanks to equilibrate the pressure decrease caused by cooling. In the tanks the acid and this water immediately and vigorously reacted, again pressurizing the tanks and forcing out sufficient liquid so that again the pressure equilibrated. The tanks then were again cooled, again reducing the pressure, and again drawing in water, again reacting, again pressurizing the tanks, and so on.

This cycle was repeated a number of times or perhaps just once. During one of these cycles sufficient water was drawn in to cause massive overpressurization and continuous venting which eventually blew open the 30-inch cargo tank hatches. A tremendous reaction occurred under the capsized barge producing great quantities of steam, and the barge was propelled 4 feet upward in the water for an estimated 30 minutes. After this time the barge sank down in the water and ceased to vent.

At the end of the 30-minute period, the barge tanks were full of steam and acid mist. As these vapors began to cool the steam condensed and the acid mist was absorbed into the seawater. The net effect was a rapid reduction in pressure inside the four cargo tanks. Water was drawn into the tanks until the internal tank pressure and external water pressure equalized.

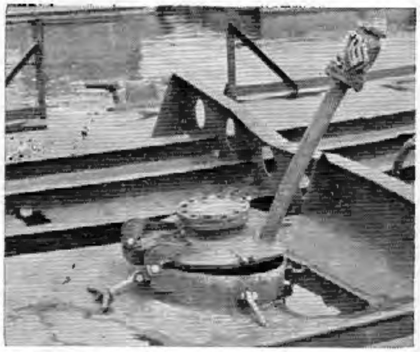
Within an hour after capsizing, the barge had spilled the entire 1,000 tons of oleum. . . .

Thus, within an hour after capsizing the barge had spilled the entire 1,000 tons of oleum into the Chesapeake Bay. The fact that the oleum was injected well underwater fortunately insured that little or no acid mist would form, although there was one report ashore of choking, irritating vapors. However, it appears most likely that the vapors produced were predominantly steam.

What was fortunate for the nearby populace was not so fortunate for the local fish population. The diluting acid caused a transient acidic excursion, and a rather extensive but localized fishkill was sighted on the surface by the first Coast Guard boatcrew on the scene. The fish were not wasted, however, and the seagulls in the area rapidly (and happily) ate the stricken fish. (The seagulls apparently did not mind the traces of acid left on the fish but considered it a tasty garnish, thus destroying the evidence of any adverse pollution effects.)

Somebody Forgot

It is of great interest to note that



when questioned by the first Coast Guard response personnel arriving on scene, the towboat personnel "forgot" that the barge had vented tremendous quantities of vapor, and had been lifted up 4 feet in the water for 30 minutes, obviously releasing the cargo. (This fact only came to light at the official Coast Guard inquiry held 2 weeks later.)

Based on the information available at the time the safety and salvage personnel arrived at the scene, it was believed that the majority of cargo *did* remain aboard the barge and *did* present an imminent hazard.

Righting Attempt No. 1

By the afternoon of the first day, the On-Scene Coordinator, Coast Guard Captain C. E. Thompson, Marine Safety Officer at Hampton Roads, Va., had requested the personnel and equipment necessary to safely right the capsized barge. By the morning of 19 August the following were assembled: two 100-ton-capacity Navy crane barges, two commercial tugs (5,500 and 2,000 horsepower) as well as the towing vessel (2,600 horsepower). In addition, the Coast Guard tug *Mohican* (1,000 horsepower),

From the information available at the time, it was believed that the cargo was still on board.

which served as a command vessel, and other smaller Coast Guard vessels were present. A salvage master and technical personnel were provided by Allied Chemical Corp., who had assumed financial responsibility for the operation.

As soon as possible on the morning of 19 August, a local diver hired by the salvage master surveyed the submerged portion of the barge. Working under conditions of poor visibility (Chesapeake Bay is quite murky) and strong currents, and not being fully acquainted with the barge, the diver made a review of the underwater body. He found no damage beneath the barge nor did he find anything that appeared out of the ordinary.

Immediately following the underwater survey, all parties met to consider the options available for righting the barge. It was decided that the safest way (assuming that there would be some venting of oleum on righting) was for the two most powerful tugs to tow the barge upwind with tow hawsers passed over the bottom of the barge to the four large bits on the high-underwater side. As the barge was pulled broadside through the water, a sufficient righting moment was expected to be generated to turn the barge to the upright position. During this operation, all other vessels were to remain well upwind. The *Mohican* was to stand close by and be ready to wash down the barge with her firefighting monitor nozzles if a vapor cloud was formed after the barge was righted. Before proceeding, it was decided to move the operation 2 miles further east to insure that any cargo vapors, if released, would not reach land.

Rigging operations took several hours and in the late afternoon the four connections to bits on the starboard side of the barge were passed to the 5,000 horsepower tug and 2,000 horsepower tug over the bottom of the barge. When all vessels and cranes were clear, the tugs took a strain on the lines and proceeded to drag the barge over a wide area of Chesapeake Bay. Due to the great difference in horsepower, the tugs were not able to keep an equal pulling strain and the barge tended to slew toward the side of the more powerful tug. After some time, the towing vessel took one of the two lines from the 2,000 horsepower tug and the three tugs took up a strain and again dragged the barge around the Chesapeake Bay.

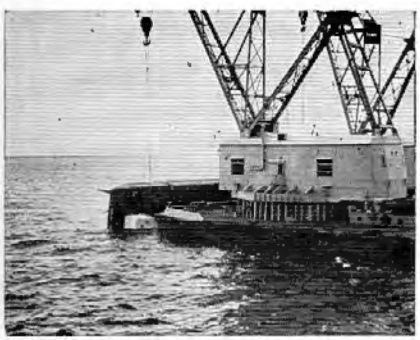
Upon righting, there was no indication of any acid-water interaction or vapor cloud production.

Even this effort was not successful and when one of the lines parted, further righting attempts were suspended due to darkness.

Before anchoring for the night the crane barges and oleum barge were moved westward to within 2 miles of the eastern shore to remove them from the heavily traveled routes in the center of the Bay. It was then decided to use the two 100-ton-capacity Navy crane barges to parbuckle the barge on the following day.

Success!

The barge was first placed at the "business" end of the two crane barges, which were lashed together. Rigging operations consisted of passing two heavy wire cables under the near side of the barge and completely around the barge to the towing bits on the near side. It took nearly all day to rig the barge.



Once all vessels were upwind, the cranes took a strain and began the righting operation. Shortly after the barge began to turn, however, one of the wire cables parted at the point where it passed over the intersection of the bottom and side of the barge. That portion of the wire cable was replaced with chain, and the barge was slowly turned.

Upon righting, there was no indication of any acid-water interaction or vapor cloud production. In fact, the four cargo hatches were wide open. Onboard inspection of the barge showed no acid left in the cargo tanks although they were full of water. Many of the exterior deck longitudinals were deformed inward along with the tank tops, and many of the cargo tank gaskets and dogs were missing. There was evidence of accelerated recent corrosion around the cargo tank hatches.

The most interesting aspect of the damage was that the cargo tank tops were deformed inward—indicating there had been a vacuum inside the tanks. This was somewhat unexpected, since the tanks must have been placed under tremendous pressure when the hatches were blown open and should have been deformed outward. After some thought a possible explanation for this damage emerges.

When the barge capsized, the weight of the oleum bore directly on the inverted tank tops. The structure was not designed for this weight and the tank tops, along with the external framing, were plastically deformed outward—as if under pressure. After the cargo had been released, the tanks were full of steam, acid mist, and hot air. The rapid reduction in pressure caused by cooling

Another thing which is disturbing was the lack of knowledge of the towboat personnel about the cargo.

and condensation could not be adequately compensated by water drawn in through the open hatches. A vacuum developed, and the tank tops were deformed inward.

What We Learned (and Hopefully Won't Forget)

The cause of the capsizing was the loss of stability resulting from the flooded bow rake when the 36-inch fracture in the forward starboard corner of the bow permitted water to enter. The cause of the fracture was indeterminate but the Board concluded that it was most probably caused by a tug striking. Compounding the stability loss caused by the flooded rake was the cargo overloading by about 60 tons.

A factor which might have prevented the capsizing was an alert watch by the towboat personnel. Unfortunately, through the night of 17–18 August, they did not notice the apparent deteriorating condition of their tow and the predictable result. If the towboat personnel had noted the increasing forward draft, they could have boarded the barge to ascertain the cause. The rake could have been dewatered easily, or assistance could have been obtained. As a minimum, the speed of the tow could have been reduced.

Another thing which is disturbing was the lack of knowledge of the towboat personnel about the cargo. They were aware that the product was "acid," but aside from that, had little idea of the hazards. As a minimum, they should have carried a Manufacturing Chemists Association's (MCA) Cargo Information Card, which would have alerted them to the basic hazards of the cargo. By Coast Guard regulation, they were required to carry the MCA Cargo Information Card.

As a final note, the cargo hatches and ullages apparently were not tightly or completely dogged after the barge was loaded. While this fact would not have worsened the effects of the capsizing, under different circumstances, proper securing of ullages and cargo hatches might preclude an accident. ⚓

Acid Spill

(*Continued from page 73*)

fest carried on the tug or any cargo information written in the log of the *Big Mama;* (4) the warning sign on the *AC 38* did not state the name of the commodity carried; and (5) that documentary evidence of the competency of the tankerman to handle oleum was not furnished to an Officer in Charge, Marine Inspection.

There was evidence too of violations of 46 U.S.C. because the Captain was the only member of the tug's crew who held a license and the tug was operated in excess of 12 hours; also the engineer did not hold a Merchant Mariner's Document. However, the lack of proper documents did not contribute to the casualty.

There was also evidence of negligence on the part of the Captain of the *Big Mama* in that he failed to recognize any adverse change in the trim of the *AC 38*.

Recommendations

Based on his findings, the investigating officer made the following recommendations:

(1) That investigations under the Administrative Penalty Proceedings be initiated against the owner and operator of the barge *AC 38* and against the tankerman in charge of loading the barge with oleum.

(2) That further investigation under the Suspension and Revocation Proceedings be initiated against the Captain of the tug *Big Mama*.

(3) That the Commandant of the Coast Guard review the regulations which allow certain Subchapter O cargoes to be carried in Type III barge hulls.

(4) That the Commandant initiate a study of the standard pressure-vacuum relief valve design looking to a method of positive closing in the inverted position. ⚓

maritime sidelights

(*Continued from page 71*)

tion and maintenance control unique to the particular vessel.

The requirements of Code Case 1570 were incorporated into the scope of Division 2 in the summer of 1975. However, the Coast Guard was prohibited by law from accepting Division 2, since it was based on a factor of safety less than four. With the revision of 46 U.S.C. 411 in 1974, permitting the Commandant to establish the design criteria for pressure vessels, the stage was set for accepting Division 2.

Like the Nuclear Code, Division 2 responded to the demand for higher pressures and temperatures for pressure vessels while considering the limitations on existing materials. The justification for increases in allowable stress values for materials in Division 2 is on the basis of: (1) design by analysis, (2) limitations on vessel geometries, (3) limitations on types of welded joints, (4) increased joint and material examinations, (5) design below the creep range, and (6) better fabrication control. Because of this additional degree of sophistication in analysis, approximately 14 man-days were necessary for design review by the Coast Guard.

The diving systems were analyzed by Southwest Research Institute of San Antonio, Tex., and operated by Taylor Diving and Salvage Co. of New Orleans, La. They were originally fabricated in 1972–1973 to Division 2 standards, but, due to the legal obstruction, could not be certified for operation at the Division 2 design depth of 1200 feet. The three systems have operated with a reduced (Division 1) rating, 900 feet, in the North Sea and the Gulf of Mexico, but will now be permitted to operate at the increased depth rating.

COAST GUARD RULEMAKING

(Status as of 1 April 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	X	...	...	...
Standards for flotation (CGD 75–168)	4–29–76	...	7–30–76	X	...	...	...
Safe loading and flotation standards (CGD 75–176)	5– 6–76	...	6–21–76	...	...	1–13–77	7–22–77
Low- and non-powered boat capacity (CGD 74–268)	6–24–76	...	8–24–76	X	...	...	...
Safety standards for boat gasoline fuel systems (CGD 74–209)	9–30–76	...	12– 1–76	...	...	1–31–77	8– 1–77
Visual distress signals on boats (CGD 76–183); Advance notice	9–27–76	...	2– 1–77	X	...	...	...
Standards for electrical systems (CGD 73–217). Corrected 11–11–76	10– 4–76	...	12– 1–76	...	...	1–31–77	8– 1–77
Personal flotation devices, label rewording (CGD 75–008)	12–20–76	...	3– 3–77	X	...	...	...
Personal flotation devices, information pamphlet (CGD 75–008a)	12–20–76	...	3– 3–77	X	...	...	...
Power ventilation on boats (CGD 76–082); Advance notice	3–21–77	...	5– 5–77	...	...	...	...
BRIDGE REGULATIONS							
Fox River, WI (CGD 75–035)	2– 6–75	...	3– 7–75	X	...	...	...
Mystic River, MA (CGD 75–053)	3–27–75	...	4–29–75	X	...	...	...
West Palm Beach Canal, FL (CGD 75–070)	3–27–75	...	4–29–75	X	...	...	...
Norwalk River, CT (CGD 75–216)	11–21–75	...	12–31–75	X	...	...	...
Lake Champlain, VT (CGD 75–222)	12– 8–75	...	1– 9–76	X	...	...	...
Missouri R. IA (CGD 75–244)	2–26–76	...	3–12–76	...	...	3–31–77	4–30–77
Mitchell River, MA (CGD 76–014)	2–19–76	...	4– 5–76	X	...	...	...
Menominee River, WI (CGD 76–069)	4–22–76	...	5–25–76	X	...	...	...
Bayou Lafourche, LA (CGD 76–077)	6–14–76	...	7–20–76	X	...	...	...
Sabine Lake, TX (CGD 76–112)	6–24–76	...	7–26–76	X	...	...	...
Dodge Island, FL (CGD 76–139)	8– 2–76	...	9– 7–76	X	...	...	...
Black River, MI (CGD 76–138)	8–23–76	...	9–28–76	...	...	2–10–77	3–14–77
Atchafalaya River, LA (CGD 76–168)	8–30–76	...	10– 1–76	X	...	...	...
Coffee Pot Bayou, FL (CGD 76–177)	9– 2–76	...	10– 5–76	...	...	12– 6–76	1– 7–77
Curtis Creek, MD (CGD 76–176)	9– 2–76	...	10– 5–76	...	...	12–20–76	1–21–77
Mokelumne River, CA (CGD 74–140)	9– 2–76	...	10– 5–76	...	...	11–29–76	1– 1–77
Weymouth Fore River, MA (CGD 76–175)	9–23–76	...	10–29–76	X	...	...	...
Oakland Inner Harbor Tidal Canal, CA (CGD 76–119)	10–28–76	...	11–30–76	X	...	...	...
Cheboygan River, MI (CGD 76–160)	10–28–76	...	11–30–76	...	...	2–10–77	3–14–77
Niantic River, CT (CGD 76–167)	11– 1–76	...	12– 3–76	...	...	...	...
Niagara River, NY (CGD 76–210)	11–18–76	...	12–20–76	...	...	...	...
St. Johns River, FL (CGD 76–178)	11–18–76	...	12–20–76	...	...	...	...
Dutch Kills, NY (CGD 76–216)	11–29–76	...	12–31–76	...	...	...	...
Lake Washington Ship Canal, WA (CGD 76–117)	11–29–76	...	12–28–76	...	...	...	...
AIWW, North Palm Beach, FL (CGD 76–217)	12– 6–76	...	1– 4–77	X	...	...	...
Pequonnock R., Yellow Mill Channel, and Johnson Ck., CN (CGD 76–219)	12– 6–76	...	1–11–77	X	...	...	...
Harlem River, NY (CGD 76–221)	12– 9–76	...	1–11–77	X	...	...	...

	Notice of proposed rulemaking	Public hearing	Deadline for comments	Awaiting final action	Withdrawn	Published as rule	Effective date
Sandusky Bay, OH (CGD 76–205)	12– 9–76		1–12–77	×			
AIWW, New Smyrna Beach, FL (CGD 76–228)	12–20–76		1–25–77	×			
Sarasota County, FL (CGD 76–230)	12–23–76		1–25–77	×			
Fox River, WI (CGD 75–035)	3–21–77		4–26–77				
Sarasota County, FL (CGD 76–230)	12–23–77		4–19–77				
MARINE ENVIRONMENT AND SYSTEMS (GENERAL)							
Pipelines, lights to be displayed (CGD 73–216). Corrected 10–18–74	9–19–74	10–21–74	11– 4–74	×			
Visual identification of tank barges (CGD 75–093). Corrected 2–23–76	2– 5–76		3–16–76	×			
Anchorages, Boston Harbor, MA (CGD 76–40)	3–29–76		5–14–76	×			
Navigation safety regulations (CGD 74–77)	5– 6–76 Corrected 5–13–76	6–11–76 Wash. 6–17–76 San Fran.	8– 6–76			1–31–77	6– 1–77
Tug assistance (CGD 76–025); Advance notice. Corrected 5–13–76	5– 6–75		8– 6–76	×			
Minimum net bottom clearance (CGD 76–051); Advance notice. Corrected 5–13–76	5– 6–76		8– 6–76	×			
Regulated navigation areas, Apra Outer Harbor, Guam (CGD 74–281)	5–17–76		6–16–76	×			
New Orleans Vessel Traffic Service (CGD 75–112)	6–17–76		9– 3–76	×			
Anchorage ground, Hampton Roads, VA (CGD 76–037)	8– 8–76		8–23–76			12–20–76	1–20–77
Naval anchorage grounds, Waimea, HI (CGD 74–187)	8– 8–76		8–23–76			12–13–76	1–13–77
Anchorage, Lahaina, Island of Maui, HI (CGD 74–191)	8–16–76		10– 1–76			12–13–76	1–13–77
Disestablishment of special anchorage, San Diego Harbor, CA (CGD 76–185)	11–18–76		1– 3–77	×			
Special anchorage area, Camden Harbor, ME (CGD 76–43)	12–13–76		4– 1–77				
Special anchorage area, Put-In-Bay, OH (CGD 76–103)	12–13–76		1–13–77	×			
Special anchorage area, Monterey Harbor, CA (CGD 76–45)	12–20–76		3– 3–77	×			
Special anchorage areas, Trinidad Bay, CA (CGD 76–105)	12–23–76		3– 4–77	×			
Bridge permit actions (CGD 76–144)	1–17–77		3– 3–77	×			
Puget Sound VTS (CGD 75–173)	1–17–77		3– 3–77	×			
Special anchorage areas, Islands of Hawaii, Kauai, and Oahu, HI (CGD 76–186). Corrected 2–22–77	1–21–77		3– 7–77	×			
LORAN–C on vessels of 1600 gross tons or more (CGD 77–002). Corrected 2–17–77	1–31–77	3– 4–77 Wash. 3–16–77 San Fran.	4–20–77				
Prince William Sound VTS (CGD 76–032). Corrected 2–14–77	2– 7–77		4– 6–77				
Special anchorage area, Mackeral Cove, Bailey Island, ME (CGD 76–046)	3– 3–77		4–17–77				
Special anchorage area, St. Simons Island, GA (CGD 76–047)	3– 7–77		4–20–77				
Enlargement of special anchorage area, Beverly Harbor, Salem, MA (CGD 76–192)	3– 7–77		4–20–77				
Special anchorage area, Dana Point Harbor, CA (CGD 76–197)	3– 7–77		4–20–77				
Regulated navigation area, Kittery, ME (CGD 76–235)	3–14–77		4–28–77				
Authorization of safety zones	3–17–77		4–29–77				

	Notice of proposed rulemaking	Public hearing	Deadline for comments	Awaiting final action	Withdrawn	Published as rule	Effective date
MERCHANT MARINE SAFETY (GENERAL)							
Bulk Dangerous Cargoes, Inspection of Barges (CGD 73–271)	3–11–74	4–15–74	4–30–74		12–20–76		
First Aid Certificates (CGD 73–272). Supplemental notice	12– 1–75		1–16–76			3– 3–77	6–30–77
Metal boring, 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	×			
Vessel inspection regulations (CGD 75–074)	9–16–75		10–31–75			1–31–77	6– 1–77
Unmanned barges carrying certain bulk dangerous cargoes (CGD 75–226)	3–15–76		4–29–76			2–10–77	3–14–77
Elevators and dumbwaiters, ANSI Code (CGD 75–001)	4– 5–76		5–21–76	×			
Vapor recovery systems in cargo transfer operations (CGD 75–208); Advance notice	4– 5–76		6–21–76	×			
Towing vessel stability (CGD 76–018); Advance notice	4–12–76		7– 1–76	×			
Tank vessels carrying oil in international trade (CGD 75–240)	4–15–76	5–20–76	6–12–76	×		12–13–76	4– 1–77
Measurement of vessels (CGD 75–078)	4–22–76		6– 7–76	×			
Segregated ballast, certain existing tank vessels (CGD 76–075)	5–13–76		6–30–76	×			
Lifesaving equipment for Great Lakes vessels (CGD 76–033); Advance notice	6– 7–76		9– 7–76	×			
Bulk dangerous or extremely flammable liquid cargoes (CGD 73–096)	6–24–76	8– 3–76	8–20–76	×			
Commercial diving occupational safety and health standards (CGD 76–009); Advance notice	7–15–76		8–16–76	×			
Semi-portable CO_2 systems testing (CGD 75–225)	7–26–76		9–10–76	×			
Integral diesel fuel tanks, small passenger vessels (CGD 75–184)	7–26–76		10–26–76	×			
Damage stability standards for hopper dredges (CGD 76–080); Advance notice	8– 2–76		9–16–76	×			
Small passenger vessels, first aid kit (CGD 75–042)	8–19–76		10– 5–76	×			
Fees for duplicate documents or licenses (CGD 76–124)	9– 2–76		10–18–76	×			
Foreign flag tank vessels, shipping papers (CGD 76–081)	9– 2–76		10–18–76	×			
Self-propelled vessels carrying bulk liquefied gases (GCD 74–289)	10– 4–76	11–15–76	12–15–76	×			
Tank vessels; loading information (CGD 75–041)	10–12–76		11–29–76	×			
Benzene carriage requirements (CGD 75–075); Advance notice	12–23–76		3– 7–77	×			
Marine investigation regulations (CGD 76–149)	12–30–76		3– 1–77	×			
Manning of vessels (CGD 75–178)	3–14–77		4–28–77				
Filling and sounding pipes, gasoline and diesel fuel tanks (CGD 76–154)	3–17–77		4–28–77				
Engine department ratings (CGD 74–045)	1– 6–77		2–20–77	×			
Radar observer endorsement (CGD 76–193)	1–17–77		3– 3–77	×			

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 will be recorded. Proposed changes which have not been placed formally before the public will not be included:

Nautical Queries

The following questions are representative of those included in the first assistant engineer and upper and lower level deck multiple choice examinations.

1. Coast Guard regulations require hydraulic steering gear systems to be equipped with a means of steadying the rudder in an emergency. This may be accomplished with

   A. a suitable arrangement of block and tackle powered by winches.
   B. buffer arrangements to relieve the gear from shocks to the rudder.
   C. a positive arrangement for stopping the rudder before the rudder stops are reached.
   D. a suitable arrangement of stop valves in the hydraulic piping for the rams.

2. Coast Guard regulations require that electric and electrohydraulic steering gear motors shall be

   A. provided with a motor-running overcurrent protection device.
   B. protected by a circuit breaker and a thermal overload device.
   C. served by a single, two-conductor cable.
   D. served by two electric power feeder circuits.

3. Which law concerning oil pollution will affect most people involved with the transfer and transportation of oil?

   A. The River and Harbor Act of 1889.
   B. The Oil Pollution Act of 1924.
   C. The Oil Pollution Act of 1961 (as amended).
   D. The Federal Water Pollution Control Act (as amended).

4. To improve your vessel's stability in a hazardous situation, you should

   A. ballast deep tanks if they are slack
   B. transfer ballast athwartships.
   C. pump out double bottoms.
   D. fill double bottoms from deep tanks.

5. The horizontal joint formed by adjoining plates in hull plating strakes is properly identified as a

   A. bracket.
   B. scarph.
   C. butt.
   D. seam.

6. A hygroscopic cargo is defined as a cargo

   A. capable of absorbing moisture in the form of a gas.
   B. capable of giving off moisture in the form of a liquid.
   C. that will ignite in contact with water.
   D. that is shipped in a liquid state.

7. Which of the following is a proper size block to use with a 3-inch circumference Manila line?

   A. 6-inch cheek, 4-inch sheave
   B. 8-inch cheek, any size sheave
   C. 9-inch cheek, 6-inch sheave
   D. at least 12-inch sheave

8. Which condition can cause a significant decrease in the strength of nylon rope?

   I. Prolonged strain when wet.
   II. Prolonged exposure to strong sunlight.

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

9. The interval of the average elapsed time from the meridian transit of the moon until the next high tide is called the

   A. harmonic constant.
   B. establishment of the port.
   C. half-tide level.
   D. tide cycle.

10. The term "deviation" applies to the angle between the

   A. true meridian and the compass meridian.
   B. magnetic meridian and the compass meridian.
   C. true meridian and the magnetic meridian.
   D. compass meridian and the degaussing meridian.

Answers

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

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) (5–1–75).
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, 9–13–76.
*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, 2–2–76, 4–29–76, 9–30–76, 1–31–77.
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, 2–5–76, 3–1–76, 6–10–76.
*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, 2–5–76, 1–13–77.
174	A Manual for the Safe Handling of Flammable and Combustible Liquids and Other Hazardous Products (9–1–76).
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 (Chief Engineer and First Assistant) (1–1–74).
182–1	Specimen Examinations for Merchant Marine Engineer 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, 2–5–76, 3–1–76, 6–10–76.
*190	Equipment Lists (5–1–75). F.R. 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, 2–5–76, 2–23–76, 3–18–76, 4–5–76, 5–6–76, 6–10–76, 6–21–76, 6–24–76, 9–2–76, 9–13–76, 9–16–76, 10–12–76, 11–1–76, 11–4–76, 11–11–76, 12–2–76, 12–23–76.
191	Rules and Regulations for Licensing and Certification of Merchant Marine Personnel (11–1–76).
*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, 5–6–76.
227	Laws Governing Marine Inspection (7–1–75).
239	Security of Vessels and Waterfront Facilities (5–1–74). F.R. 5–15–74, 5–24–74, 8–15–74, 9–5–74, 9–9–74, 12–3–74, 1–6–75, 1–29–75, 4–22–75, 7–2–75, 7–7–75, 7–24–75, 10–1–75, 10–8–75, 6–3–76, 9–27–76, 2–3–77.
*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, 4–29–76, 6–10–76, 8–5–76, 9–30–76, 1–31–77.
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, 6–24–76.
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 Vessels (Under 100 Gross Tons) (9–1–73). F.R. 1–25–74, 3–18–74, 9–20–74, 2–10–75, 12–17–75, 9–30–76, 1–31–77.
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 FEBRUARY 1977

CG–239, Federal Register of February 3.

*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.