PROCEEDINGS
OF THE MARINE SAFETY COUNCIL

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PROCEEDINGS

OF THE MARINE SAFETY COUNCIL

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CONTENTS

FEATURES

DEPARTMENTS

COVERS

Front: View from the rear of an International Ice Patrol C–130 aircraft in the vicinity of the Grand Banks of Newfoundland during last year's iceberg season. Surveying the berg at close range is the Coast Guard Cutter *Evergreen*. Every year at this time the Ice Patrol begins the task of tracking icebergs over a 40,000-square-mile area of the North Atlantic. The Coast Guard has participated in the service from its first full season in 1913, the year following the *Titanic* disaster.

Back: This pinnacled iceberg is not only photogenic; it also happens to be 550 feet high, as tall as the Washington Monument. It was sighted in 1958 in Melville Bight, Greenland, by the Coast Guard icebreaker *Eastwind*. At the time—and still, as far as we know—it was the highest iceberg ever recorded by the Coast Guard.

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B: n(50); c(16); e(5); f(4); ghj(3); r(2); bkipq(1)
C: eglmp(1)
D: i(5); adgklm(1)
E: mn(1)
F: kp(1)
Lists TCG–06, CG–13, CG–20, CG–52

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

maritime sidelights

WELL DONE!

A casualty which occurred 2 years ago on the Lower Mississippi River has led to the first award ever of a merchant marine medal for an action on the inland waterways. Captain Roy Bishop of the MV *National Glory* was recently presented the Merchant Marine Meritorious Service Medal in recognition of his "outstanding leadership, heroism, and skill" in containing a potentially disastrous tank barge fire. The presentation was made by Howard F. Casey, Deputy Assistant Secretary of Commerce for Maritime Affairs.

Shortly after midnight on 3 March 1975 two tows collided at Old Town Bend, mile 644.5. The *National Glory,* 5 miles downriver, responded to the distress calls and found one of the tows drifting with its fuel cargoes in flames. After breaking up the damaged tow, the *National Glory,* assisted by the MV *Ann Gladders,* isolated and grounded the two burning barges and extinguished the fire. Without regard for their own safety, Captain Bishop and his crew boarded one of the barges, which was carrying 21,000 barrels of gasoline, and expertly put out the flames with chemicals. They remained at the scene throughout the night and the next morning, spraying the barge with water to avert a possible reflash.

Letters of commendation were presented to each of the crewmen of the *National Glory:* pilot Joe Schubert, deckhand Larry Riggens, tankermen Bill Muirhead and Roger Raines, and utility tankerman Orville Drake (posthumously), and to the captain and crew of the *Ann Gladders.*

In addition, a special letter of commendation was presented to William A. Creelman, president of the Transport Division of National Marine Service, which owns the *National Glory.* That commendation was in recognition of the firefighting training and equipment—exceeding Coast Guard requirements—that the company provides to its crews.

DEADLY INDEED

In the February issue, we published an article entitled "Pumprooms Are Deadly." The following is an abbreviated account of a recent pumproom casualty which sadly confirms that title.

On January 10, in Las Mareas, Puerto Rico, the U.S. flag tanker SS *Thomas Q* was undergoing ballasting operations after completing discharge of a cargo of naptha. The evidence presently available suggests that the pumpman entered the aft pumproom against the chief engineer's orders, and was overcome by naptha vapors on the first platform. The chief engineer entered the pumproom in a rescue attempt and was also overcome. An able seaman then discovered the situation and also attempted a rescue. Realizing that he was being overcome, however, the seaman managed to get himself out of the pumproom and sounded the alarm. A rescue finally was made with the use of a self-contained breathing apparatus—too late, unfortunately, for the chief engineer. The pumpman and the seaman survived.

The cause of the fatality can be traced to five factors, any one of which alone would have been sufficient to cause the casualty. In combination, they assured it.

First, there was *equipment failure.* The cargo pump seals were faulty and had leaked naptha.

Second, there was *human error.* Two valves which should have been opened prior to engaging the cargo pumps were not opened. This resulted in a pressure buildup in the pumps and subsequently a greater release of cargo.

Third, there was *disobedience.* The pumpman entered the pumproom against the orders of the chief engineer.

Fourth, there was *poor judgment.* Both the chief engineer and the seaman attempted a rescue without proper equipment and without following a prearranged rescue plan.

Fifth, there was *inadequate ventilation.* Only natural ventilation supplied fresh air to the pumproom. Although the ship was equipped with a forced air ventilation system, it was inoperative at the time.

This unfortunate incident should teach us all a lesson and serve as a poignant reminder that pumprooms are indeed deadly.

ALUMINUM COUPLINGS

For the past 2 years, the Coast Guard has accepted coated aluminum fire hose couplings for use on inspected vessels or facilities. This acceptance was based upon test reports from independent laboratories which indicated that the coated aluminum couplings were equivalent in strength and corrosion resistance to brass or bronze couplings. Subsequent field experience, however, has not verified the laboratory results.

Reports have been received of instances of corrosion in the threads of the aluminum couplings when connected to brass couplings. Rough use apparently damages the coating, exposing bare metal and rendering it

(*Continued on page 65*)

International Ice Patrol 1977

In February or March of each year, depending upon iceberg conditions, the International Ice Patrol commences its annual service of guarding the southeastern, southern and southwestern limits of the regions of icebergs in the vicinity of the Grand Banks of Newfoundland for the purpose of informing passing ships of the extent of this dangerous region. Reports of ice in this area will be collected from passing ships and from flights by Ice Patrol aircraft. Information on ice condition is provided by the Ice Patrol at 0000 GMT and 1200 GMT each day in an Ice Patrol Bulletin which is sent out by radio and landline circuits.

This season marks the 65th year since the inception of the International Ice Patrol. The 1975 and 1976 iceberg seasons proved to be relatively light with approximately 100 and 151 bergs respectivey drifting south of 48° N latitude. During the previous 3 years a combined total of 3,820 icebergs were sighted or predicted to have drifted south of 48°N into the North Atlantic shipping routes. This was well over three times the 1946–1976 yearly average of 309 icebergs. Never before had there been three successive heavy seasons in a row. Although this winter has proved to be colder than normal, experience has shown that iceberg season severity is not dependent on one environmental parameter but rather a complex interaction of many factors. Unfortunately present technology does not

allow for reliable predictions of season severity using readily available or obtainable data. Are we in for another light season or will the winds and currents combine in such a way as to induce rapid drifts of large numbers of bergs toward the Grand Banks? Only time will tell.

Reporting

All shipping is requested to assist in the operation of the International Ice Patrol by reporting all sightings of ice at once to COMINTICEPAT NEW YORK NY via the radio stations listed in the following section. When reporting ice please include the following information:

1. **Position of ice.**
2. **Size and shape of icebergs.**
3. **Concenration of ice (for sea ice, in eighths).**
4. **Thickness of ice (for sea ice, in feet).**

Table 2 may be used to describe icebergs reported to the Ice Patrol.

In addition to ice reports, sea surface temperature and weather reports are of importance to the Ice Patrol in predicting the drift and deterioration of ice and in planning aerial patrols. Shipping is urged to make sea surface temperature and weather reports to the Ice Patrol every 6 hours when within latitudes 40° to 50° N and longitudes 42° to 60° W. Ships with but one radio operator should prepare the reports every 6 hours as requested and hold them for transmission when the radio operator is on watch. When reporting, please include the following:

1. **Ship position.**
2. **Course.**
3. **Speed.**
4. **Visibility.**
5. **Air and sea surface temperature.**
6. **Wind direction and speed.**

It is not necessary to make the above report if the ship is making routine weather reports to METEO WASHINGTON.

Ice sightings, weather, and sea surface temperature should be reported to COMINTICEPAT NEW YORK NY through U.S. Coast Guard Ocean Weather Station C7H, U.S. Coast Guard Communications Stations, and, if these cannot be worked, Canadian Coast Guard Radio Station St. John's/VON. Frequencies to be used are indicated in Table 3. Merchant ships calling to transmit Ice Patrol traffic are requested to use the regularly assigned international call sign of the station being called; however, Coast Guard stations will be alert to answer NIK or NIDK calls if used.

Gulf of St. Lawrence Information

Sea ice information services for the Gulf of St. Lawrence and approaches from 58°00′ W to 66°30′ W longitudes, including the Strait of Belle Isle to west of Belle Isle itself, are provided by the Canadian Ministry of Transport during the approximate period December to late June. Ships may obtain ice information by contacting Ice Operations Officer Dartmouth, Nova Scotia via any east coast Canadian Coast Guard Radio Station. Details of the services are available from Ice Operations Office, Marine Services Information Center, Ministry of Transport, P.O. Box 1013, Dartmouth, Nova Scotia. Telephone 902–426–5664 or 5665. Telex 019–22625.

Supplementary ice information and navigational warnings for the Strait of Belle Isle, the coast of Newfoundland, and the Grand Banks may be obtained by contacting Canadian Coast Guard Radio Stations, St. Anthony/VCM, Comfort Cove/VOO, St. Lawrence/VCP, or St. John's/VON.

Table 1.—*Broadcasts of the Ice Patrol Bulletin*

Radio station	Time of broadcast (GMT)	Frequencies (kHz)
CW Broadcasts		
Coast Guard Communications Station Boston/NIK.	0018	5320, 8502.
	1218	8502, 12750.
Canadian CG RADSTA St. John's/VON	0000 and 1330	478.
Maritime Command Radio Mill Cove/CFH	0130 and 1330	438 (off 1330 second Thursday each month), 4255, 6430, 8679, 12726, and 16926.5. 22397.5 on request.
Navy LCMP BCST		
Norfolk, Virginia	0500–0600 and 1700–1800	8090, 12135, and 16180. 20225 (1700–1800 only).
Londonderry, N. Ireland	0500–0600 and 1700–1800	7504.3(LSB) and 12691(LSB)(1700–1800 only).
Thurso, Scotland	0500–0600 and 1700–1800	3724 (LSB) (0500–0600 only.)
Keflavik, Iceland	0500–0600 and 1700–1800	5167 (LSB) (0500–0600 only.)
Radiofacsimile Broadcasts (drum speed 120)		
Coast Guard Communications Station Boston/NIK.	1600	8502, 12750.
Fleet Weather Central Norfolk/NFAX (Limits of all known ice on nephanalysis).	0605 and 1805	3357 (0605 only), 4975, 8080, 10865, 16410 1805 only), and 20015 (0605 only).
Maritime Command Radio Halifax/CFH (Primarily sea ice in Gulf of St. Lawrence and north. Limits of icebergs sometimes given.).	0000 and 1200	4271 (off 1200 third Thursday each month), 9890 and 17560 (off 1200 second Monday each month).
Radio Bracknell/GFE	1400	4782, 9203, 14436, and 18261.(N. Atl. Ice Obs.)
Radio Hamburg-Quickborn/Pinneburg/DGC, DGN.	0905 (except Sundays and holidays) and 2145.	3695.8 (0905–1014 GMT) and 13627.1 (2108–2157 GMT). (Ice conditions in West Atlantic).
Special Broadcasts		
Canadian CG RADSTA St. John's/VON	As required when icebergs are sighted outside the limits of ice between regularly scheduled broadcasts.	Preceded by International Safety Signal (TTT) on 500 kHz.

Table 2.—*Iceberg identification*

Size	Height		Length	
	Feet	Meters	Feet	Meters
Growler	Less than 4	Less than 1	Less than 20	Less than 6
Small Iceberg	4–50	1–15	20–200	6–60
Medium Iceberg	51–150	16–45	201–400	61–122
Large Iceberg	151–250	46–75	401–700	123–213
Very Large Iceberg	More than 250	More than 75	More than 700	More than 213

Shape	Description
Blocky	Steep sides with flat top. Very solid. Length-Height ratio less than 5:1.
Drydock	Eroded such that a large U-shaped slot is formed with twin columns. Slot extends into or near waterline.
Dome	Large round smooth top. Solid type iceberg.
Pinnacled	Large central spire(s) or pyramid(s) dominating shape.
Tilted-Blocky	Blocky iceberg which has tilted to present a triangular shape from the side.
Tabular	Flat topped iceberg with length-height ratio greater than 5:1.

Table 3.—*Calling and transmission of traffic*

Purpose	Frequencies which should be used
Calling	500 kHz (if 500 kHz is being used for distress traffic then 512 kHz may be used as supplementary calling frequency). 2182 kHz (voice). Assigned HF (CW) calling frequencies.
Working Frequencies	
Station	
Ocean Weather Station C7H (occupied 1 August through 15 April only).	466 kHz (CW), 2670 kHz (Voice).
Coast Guard Communications Station Boston/NMF.	472, 8728, 12934.5, 22487.5 (available on request) kHz (CW).
Coast Guard Communications Station Portsmouth/NMN.	466, 8465, 12718.5, 16976 kHz (CW) 2670 kHz (Voice).
Canadian Coast Guard Radio Station St. Johns/VON.	478 kHz (CW).

Caution

Shipping is reminded that in spite of the best efforts of the Ice Patrol to prevent such occurrences, icebergs have and will drift unnoticed into the usual shipping routes in the area of the Grand Banks. The positions of icebergs in the Ice Bulletin are updated for drift at 12 hour intervals. However, it is stressed that after about 5 days without resighting, the positions estimated by drifting are unreliable. Date of an iceberg sighting is indicated in the Ice Bulletin.

In general, only icebergs south of about 48°N are included in the Ice Bulletin. In the event there are large numbers of icebergs south of 48°N, the Ice Bulletin will carry the positions of only those icebergs near the limits of ice and isolated icebergs or iceberg groups.

Carefully conducted tests by the Ice Patrol have proven that radar cannot provide positive assurance of iceberg detection. Since sea water is a better reflector of radar signals than ice, an iceberg or growler inside the area of sea return on the radar scope may not be detected. The *average* range of radar detection of a dangerous growler or very small iceberg, if detected at all, is only 4 miles. While radar remains a valuable aid for ice detection, its use cannot replace the traditional caution exercised in the vicinity of the Grand Banks while transiting south of the estimated limits of all known ice.

Note

Comments concerning operation of Ice Patrol, particularly concerning the effectiveness of the times and frequencies of radio transmissions, are of much interest to the Ice Patrol and are earnestly solicited. Ships are also requested to mail facsimile charts received at sea to Commander, International Ice Patrol, Building 110, Governors Island, New York, N.Y., 10004. Please indicate the frequency used and date, time, and position when the facsimile broadcast was received on the chart. ⚓

Underkeel Clearance

by Captain A. F. Dickson
Chief Marine Superintendent
Shell International Marine

In Part III of the Federal Register of 6 May 1976, the Coast Guard issued an Advance Notice of Proposed Rulemaking on "Minimum Net Bottom Clearance" (CGD 76–051). This request for comments on the conceptual proposal elicited 77 comments, most against the proposal. One commenter enclosed a copy of the following paper, originally published in October 1967 in The Journal *of the Institute of Navigation of the Royal Geographical Society. Although the opinions and assertions here are not necessarily those of the Coast Guard, it is felt that the paper provides a useful discussion of a number of elements of the problem. It is therefore republished with the kind permission of the Institute of Navigation.*

—Executive Secretary
Marine Safety Council

Introduction

The problem of underkeel clearance is not new; since time immemorial navigators have been concerned to know the minimum depth of water in which they can sail with a ship of given draft. Until quite recently, underkeel clearance requirements were determined almost entirely empirically, and in many cases the rule of thumb values used can be shown to be greater than the requirement of navigational safety would dictate.

In the years since the war the pattern of the oil industry has changed and very large ships are now commonly used to carry crude oil cargoes to a large number of ports around the world. It is obvious that use of these ships, with their deep drafts, has meant that a number of expensive dredging projects have been put in hand to provide adequate access to the ports served. Continuing escalation in size means this will probably continue.

In determining the depth suitable for a ship of given draft, the required underkeel clearance must obviously be known and the costs involved in providing for each foot of draft have made it necessary to study much more scientifically the minimum underkeel clearance which must be provided. However, at the outset it must be emphasized that, despite the considerable amount of work which has been done on the subject over the last few years, we still do not know how to reduce all the elements which affect underkeel clearance to an exact formula.

It has often been said that navigation itself is an art and that the navigator, having determined as accurately as he can the answer to a particular problem, must rely in the final analysis on his judgement; and so it is with underkeel clearance. However, it is the author's contention that by logical analysis of all the factors which affect underkeel clearance, a navigator can now make a much more sensible assessment of the underkeel clearance which should apply to a given set of circumstances for his ship than would have been possible years ago, and this is of very considerable commercial value.

It is not intended in this paper to deal with financial considerations in any detail, but as an indication of the magnitude of the figure involved for a 200,000-ton tanker, the additional earning capacity per foot of draft would be about £25,000 per annum, and there are already some 80 ships of, or around, this size on order from the world's shipyards. This figure is quoted simply to show the degree of commercial importance which attaches a correct assessment of the maximum draft for a given port or a given ship.

Underkeel Clearance

Most charter parties require the charterer to exercise due diligence to ensure that a ship chartered to proceed to a given berth has sufficient water to allow her to reach the berth and there lie safely afloat. It is, therefore, necessary for the charterer to ensure that the depth of water both in the approaches to the berth and at the berth provides "safely" for the ship which he proposes to charter. It is common these days to talk of underkeel clearance of 3 to 4 feet in the right circumstances for even the largest tankers, and it is perhaps interesting at this stage to look at a simple drawing showing a tanker of 200,000 tons deadweight at her full draft of, say, 62 feet 6 inches with an underkeel clearance of 3 feet.

Figure 1 illustrates that such an underkeel clearance, which may well be practicable in the right circumstances, does not allow any margin for appreciable change in the ship's draft due to motion or unknown siltation of the channel.

It is well known that ships underway change their underkeel clearance, compared to the value when the ship is stopped. The change results from the combined change of the ship's trim and the water level due to motion, these facts usually being combined under the term *squat*. To examine the problems it seems logical first to consider underkeel clearance requirements in still-water conditions, and then to deal separately with the effect which wave conditions may have on the ship.

Still-water Conditions

When examining any sea area or channel, account has to be taken of the accuracy with which navigational depths are known. This is, of course, dependent on the accuracy of the original survey to determine the depth, and the change of depth which must be anticipated since that survey. In the majority of cases where depths of water for large tankers are to be considered, account is taken of the stand of the tide, and here again assessment must be made of the predicted stand of the tide at a given time, if necessary checking to determine whether the actual stand is in accordance with prediction. The depths in the approaches to the Port of London illustrate the problems which face port authorities, pilots and shipmasters required to make accurate assessments of the depth of water available, particularly as the increase in draft of tankers has made it necessary to consider shoal areas far to seaward of what would have been regarded as the practical limits of the port 10 years ago.

It is well known that the depths in many, if not all, the channels leading into the Port of London are unstable, and the Port of London Authority very wisely set up a committee some time ago to study the problem of depths in the approaches to the port. One result of this work is that efforts are now being directed to afford navigators information on the depth of water in critical areas to within plus or minus 1 foot. In order to achieve this accuracy, resurvey of the most critical areas is necessary at intervals of only 6 weeks. The Port of London Authority, in close consultation with the Admiralty, has also set up distant recording tide gauges which will provide information on the stand of the tide at any given time against prediction.

It is interesting to note that a close examination of survey methods used by surveyors indicates that depths shown on navigation charts may be in error by as much as 12 inches; the Admiralty and the Port of London Authority have at present under examination ways in which these inaccuracies can be reduced. It seems reasonable to suppose that with high precision sounding equipment and more accurate tidal data, the 6-weekly survey checks mentioned should provide the navigator of an incoming ship with accurate knowledge as to depth within plus or minus 1 foot, provided always that the distant recording tide gauges can indicate any difference between the rise of tide on a particular day and the predicted value for a given time.

The foregoing serves to indicate that the first essential requirement in determining a suitable underkeel clearance is to assess the accuracy with which the depth of water is known. There is no doubt that there is a need for improvement in survey accuracy and tidal information over large areas of the world's seas where, until the advent of present-day drafts, water would have been considered more than adequate for navigation. One has only to look at a chart of the North Sea and consider the navigation of ships already being built to sail with a fully laden summer draft of 62 feet 6 inches to realize that accurate knowledge of depth and underkeel clearance requirement will have to be taken into account far outside the confines of ports to which a ship may be bound.

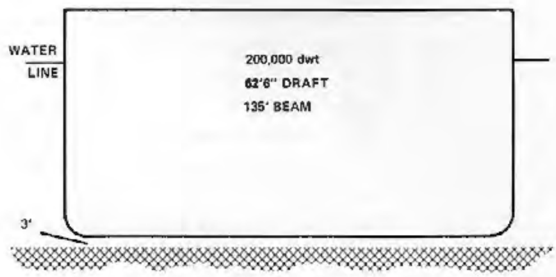

FIGURE 1.—*Outline of 200,000 d.w.t. tanker 3 ft. clearance from seabed*

It is fortunate that the greater part of the passages on which the very large tankers now being built are expected to trade will lie in really deep water, but in addition to the North Sea, already mentioned, depths are critical in the Malacca Straits and some areas of Japanese coastal waters. The optimum operation of large tankers in the future is bound to give rise to a need for extensive resurvey of quite large areas of relatively shallow sea, and close reexamination of the accuracy of tidal predictions.

Squat

The expression "squat" in this paper refers to the total decrease in the clearance under a ship's keel which occurs due to change in the ship's trim and depression of the water level in her immediate vicinity due to her forward motion. The following propositions are now generally widely understood and accepted:

(1) When a large tanker is underway and laden ap-

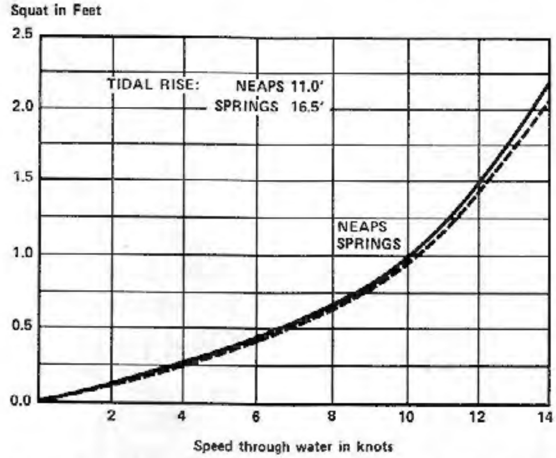

FIGURE 2.—*The squat which calculation shows would be experienced in the Sea Reach Channel in the Thames (47,000 d.w.t. tanker on 37 ft. draft Yantlet Channel ½ mile east of sea reach No. 3 buoy at 1½ hours before local H.W.)*

proximately to an even keel condition, she will change her trim by the head by an amount dependent on her speed.

(2) Any ship underway suffers apparent sinkage due to a depression of the water level in her immediate vicinity. The amount of the depression increases with confinement of the ship in a narrow channel and the speed of the ship.

The author's company has been associated with model experimentation and practical tests over a number of years to determine the total amount of squat to which a tanker will be subject in any given circumstances. The subject has been very adequately covered in a paper presented to The Honourable Company of Master Mariners on 11 January 1967 by the author's colleague, Captain J. D. Rendle, but it is worth here, for illustration purposes, looking at the effects of squat in three typical channels (figures 2, 3, and 4).

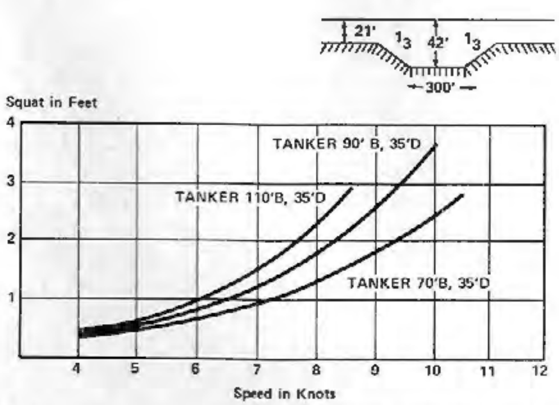

FIGURE 3.—*Squat calculated by Sogreah method for channel squat in an estuary channel*

These figures illustrate that for a given ship in a given circumstance, speed is a significant factor affecting squat. However, in confined channels a large proportion of the ship's power is used up in pushing the water past the ship between her sides and the bank of the channel, so that her canal speed is always substantially less than her sea speed for a given power, and there are many practical cases where ships do not have sufficient power to proceed at speeds which would give rise to values of squat great enough for the ship to ground. In fact, it is generally true in practice that ships in confined channels are much less likely to ground due to squat than are ships with small underkeel clearance in relatively unconfined waterways.

Squat values can be calculated accurately for a given channel by a number of methods. The close comparison of various methods is apparent in figure 5, where values calculated by the methods adopted by the Rotterdam Port Authority and the author's company are illustrated. At low speed values, there is very close agreement, with no great disparity at high speeds.

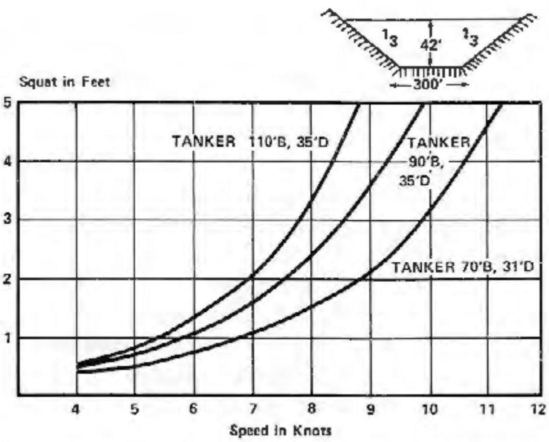

FIGURE 4.—*Squat calculated by Sogreah method for channel squat values for given speeds of varying tankers in a completely enclosed channel*

Mention has been made previously of the tendency which large tankers have to trim by the head when underway trimmed to even keel at rest, and it could be argued that a small stern trim in the stopped condition would counteract the ship's tendency to trim by the head when underway. However, in the author's company, the view is taken that even-keel trim is the best practical condition for a ship to navigate shoal areas, because if for any reason she uses up her underkeel clearance it is better to ground the forward part of the ship than the after part, and also in very soft bottom conditions ships can be navigated satisfactorily with the ship's forefoot in the mud.

It is obviously necessary when considering underkeel clearance requirements to take account of the effect of small clearance on the maneuverability of a given ship.

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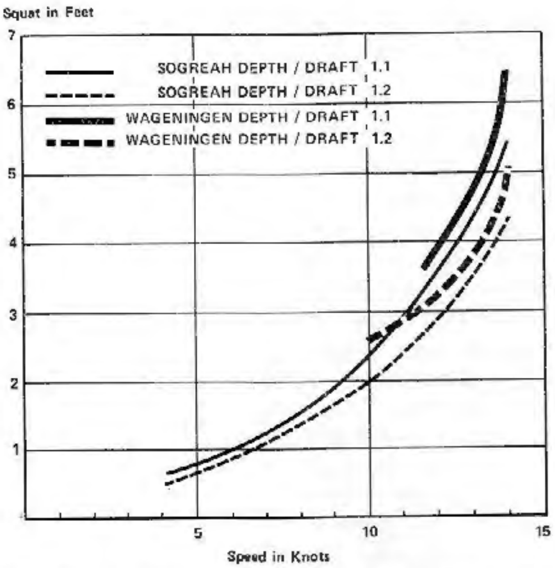

FIGURE 5.—*"Open water" squat, 200,000 d.w.t. ship*

The two relevant characteristics for ships in confined waters are steerability and stopping. It is the author's contention that large tankers steer perfectly adequately even with very small effective underkeel clearances, and it is axiomatic that the smaller underkeel clearance a ship has, the easier it is to reduce her speed for maneuvering purposes. A consideration of interest is that where ships have to be moved bodily through the water by tug power, e.g. swinging in a turning basin or breasting into a berth, reduction of underkeel clearances makes a considerable difference to the amount of effort necessary to push the ship through the water. It is the custom in the Shell Company to allow a final underkeel clearance for maneuvering reasons of 2 feet after account has been taken of all other considerations.

There is some evidence to show that reduction in underkeel clearance reduces the velocity at impact which a tanker has when berthing. It used to be argued that larger tankers berthed with less velocity than smaller vessels because more care was taken by masters and pilots of big ships, but in the author's opinion it is more logical to assume that bigger ships berth at a given berth with less velocity than smaller ships because they have less water under the keel and consequently move towards the berth more slowly than smaller ships.

Until quite recently it was customary in the oil tanker industry to increase the underkeel clearance for any given navigational circumstance with increase in size of ship. However, it seems more logical to look at each particular case giving due weight to the effect of squat and the final underkeel clearance required for maneuverability by a given ship in particular circumstances.

The nature of the bottom has to be taken into account when determining a satisfactory underkeel clearance, because where ships have to cross sea areas or navigate channels with a rock bottom, the underkeel clearance allowance must ensure against the possibility of the ship taking the bottom. On the other hand, if the bottom of the channel or shoal area to be crossed is very soft silt, then it may be sensible to navigate in a way that allows the ship to sail through the soft silt on the bottom.

To conclude, it is suggested that the factors to be taken into account to determine underkeel clearance in conditions where no movement of the ship due to wave action can be expected can be set down as follows:

(1) the degree of accuracy with which the depth of a given sea area can be established;

(2) the accuracy with which tidal height can be determined for a given time over a given shallow area;

(3) the change in the ship's underkeel clearance due to squat, which is dependent on her speed and the confinement of the area or channel in which she is sailing;

(4) the maneuvers which the ship has to carry out;

(5) nature of the bottom, and therefore the final degree of underkeel clearance which must be allowed after due weight has been given to (1), (2), and (3) above.

Wave Motion

When a ship is affected by wave action she may roll, pitch and heave, and all these motions must affect the underkeel clearance which the ship requires for navigational speed. In the section of the paper dealing with underkeel clearance considerations in still water, mention was made of account which has to be taken of the nature of the bottom; it is immediately obvious that when ships have a vertical movement in relation to the bottom due to wave action, grounding will result in much more severe damage. In fixing underkeel clearances it is absolutely necessary where the bottom is hard to take adequate insurance against the possibility of a ship striking the bottom whilst moving in a seaway.

Again, in the section dealing with still-water conditions, it was suggested that required underkeel clearance could be determined with a reasonable degree of accuracy. Unfortunately, this is not yet the case when movement of the ship due to wave action has to be taken into account.

It is, perhaps, worth referring again to figure 1, which showed clearly that with large ships a small angle of roll or heel will cause the ship's bilge to take bottom. This, of course, is also true of small angles of pitch. Until recently underkeel clearance allowances to take care of ship motion in shoal areas were made entirely by rule of thumb, but because of the serious risks of damage which have already been mentioned, the rule of thumb values tended to be very much on the safe side. Fortunately, to date there have been very few cases of ships grounding due to wave motion when crossing shoal areas, but on the other hand there is no doubt that the profitability of a very large number of voyages must have been decreased because of overgenerous allowance made for underkeel

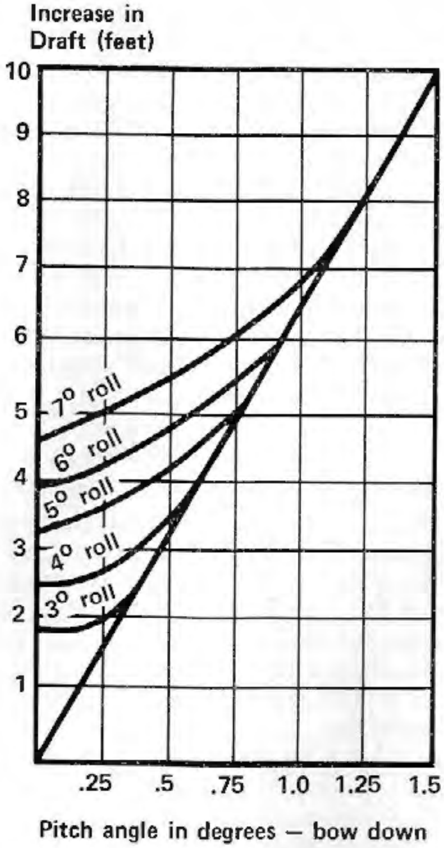

FIGURE 6.—*50,000 d.w.t. tanker: combined effect of roll and pitch on draft*

clearance to take account of anticipated wave conditions when navigating shallow water.

As a first approach to the problem it might appear sensible separately to evaluate roll, pitch and heave, which a given ship might experience in a particular sea area with a given wave condition, and simply add these effects to determine the incremental underkeel clearance required to take account of wave motion. This, however, does not give the correct value. Although large modern tankers have very high block coefficients, there is nonetheless a considerable rounding of the hull at the ends of the ship which make it unnecessary to add the effect of roll to pitch until a certain value of roll has been reached. Figures 6 and 7 illustrate the combined effects of roll and pitch on tankers of 50,000 and 115,000 tons deadweight respectively.

The modifying effect of shallow water on waves and swell reduces ship motion from that experienced in deep sea conditions. Furthermore, there is substantial evidence to suggest that in shallow water ship motion is damped by the cushioning effect of water trapped below the ship's bottom and that this effect increases with decrease in clearance.

It is immediately apparent that the ideal solution to the problem for any given ship in a given sea area would involve relating the underkeel clearance required to a given wave condition specified; however, a solution along these lines makes it necessary to be able to determine with a sufficient degree of accuracy:

(a) The motion of a ship in terms of her roll, pitch and heave related to sea level, which must in turn be related to a known datum.

(b) The analysis of wave conditions, bearing in mind that wave length, height and direction are all important and have differing effects depending on the course and speed of the ship.

The number of variables involved make it immediately apparent that an enormous number of observations would be necessary in each particular sea area to provide adequate data for analysis from which to predict accurately the ship's motion in relation to a particular set of wave conditions. The idea that the sea conditions prevailing might be related to some index between 0 and 10, against which underkeel clearance could be determined, remains attractive, but in all practical circumstances when efforts have been made to treat the problem in this way, it has become apparent that it would be necessary to devote a very considerable amount of tanker time to practical ex-

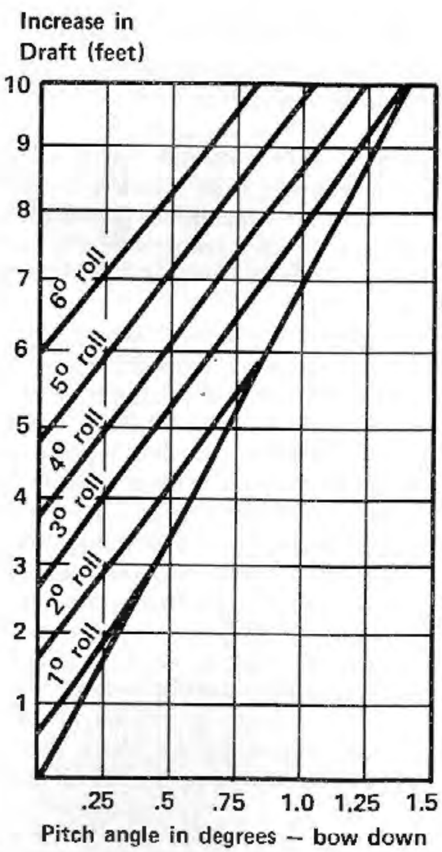

FIGURE 7.—*120,000 d.w.t. tanker: combined effect of roll and pitch on draft*

perimentation before any analysis along the lines envisaged could be made.

Fortunately, it is quite possible to demonstrate with known instrumentation and techniques, wave conditions under which ships will have no significant movement, so that in practice still-water underkeel clearances can be used, and practical tests have further indicated that a given underkeel clearance can be regarded as satisfactory up to a known sea condition specified in terms of wave height. It must, however, be borne in mind that ship motion is not dependent simply on wave height, but will vary with changes of period and direction. It further must be emphasized that the foregoing treatment depends on ability to monitor wave conditions adequately, and in some areas this has proved to be much more difficult than at first envisaged.

Notwithstanding what has been said, it is not unreasonable to suppose that if a large number of ships were instrumented in a way which would indicate their effective underkeel clearance when navigating particular sea areas, and observations from these ships could be coordinated with adequate wave monitoring equipment over a period of years, it would be possible to determine practically the relationship between sea conditions and underkeel clearances required.

Consideration has been given to suitable instrumentation for tankers in the author's company to allow these problems to be studied, and a number of ships have now been equipped. Basically, two types of instrumentation are involved:

Echo sounders.—These operate on exactly the same principle as navigational echo sounders but four transducers are used at the extremities of the length and beam of the ship, so that if ship is sailing over a flat seabed, the four sounders will indicate the underkeel clearance under her flat bottom.

At the beginning of the paper, it was argued that adequate underkeel clearance was a matter for navigational judgment and if masters and pilots are to exercise this judgment sensibly they must have adequate instrumentation to build up experience on what happens to the ship in given circumstances. For this reason all new large ships in the fleets with which the author is connected will be fitted with specialized echo sounding equipment of this type. The echo sounder as a navigational instrument is now of far more value in shallow water than in deep water, and it has been obvious for some years the manufacturers are now directing their research to improving the shallow-water performance of the equipment.

Motion recorder.—The ship motion instrumentation used to date was designed by the Sierra Research Corporation to determine the movement of aircraft carriers' decks. It uses a stabilized vertical gyroscope for measurement of pitch and roll angles and an accelerometer mounted with its sensitive axis perpendicular to the deck for measuring acceleration normal to the deck. Attempts have been made to feed the output of this instrument into a small computer so that the lowest point of the flat bottom of the ship's hull relative to the seabed can be determined continuously and thus avoid laborious calculation. This instrumentation as a whole has been of very considerable value in practical experimentation, but there are difficulties when measuring very small angles of roll, pitch and values of heave. The author's technical colleagues are satisfied, however, that a suitable, relatively inexpensive (£15,000) instrument can be developed which will determine with an accuracy of plus or minus 1 foot changes in underkeel clearance relative to a flat bottom under the ship due to the ship's motion under the effect of waves.

Unsheltered Moorings

It has been the practice of the oil industry for a number of years to berth tankers at buoy moorings offshore so that the tanker when berthed may be subject to quite severe wave conditions. The underkeel clearance required in berths of this type is obviously a matter for serious consideration, and the introduction of ships at even larger drafts makes it necessary to devote attention as a matter of urgency to this particular aspect of the underkeel clearance problem.

To date it has been common to assume that ships in unsheltered areas such as the Eastern Mediterranean need an underkeel clearance to cater for worst expectable weather conditions of about 10 feet. But provision of 10 feet of water under the keel of a ship at maximum draft off the berth can be very expensive indeed, and it would certainly not appear sensible to spend a very large amount of money to cater for a sea condition which might occur very seldom. For example, if a 5-foot underkeel clearance could be shown to be sufficient for all reasonably expectable bad weather conditions in a loading berth, it might be cheaper for ships to short-load in extreme weather conditions rather than provide underkeel clearance sufficient for such conditions.

The instrumentation described above would appear to be suitable for evaluation of the underkeel clearance problem in offshore moorings, and efforts are being made in Shell to study the problem with suitably equipped ships in berths where appropriate.

Practical Experimentation

To date, four particular areas have been examined using tankers equipped with the instrumentation described with the following results:

Bonny River

Oil from the Nigerian fields is loaded into tankers at Bonny and ships then navigate a dredged channel over the Bonny Bar, which is affected by typical West African coast swell conditions. Historically, the Nigerian Port Authority have recommended varying underkeel clearance to take care of changes in swell conditions expected at different times of the year. In June 1965, a 50,000-ton ship, laden to suitable draft in ballast, made repeated transits of the channel for 5 days; underkeel clearance and ship motion were measured continuously with echo sounders and the Sierra motion recorder. The latter showed that the ship did not move to any appreciable extent in swell conditions where the wave height was under 6 feet, the highest experienced during the trials. As a result of these tests a 2-foot-6-inch underkeel clearance will be used for tankers leaving Bonny as soon as instrumentation can be introduced to monitor the wave conditions offshore and ensure that swell conditions are 6 feet or less. It may be that further experience will show that the 2-foot-6-inch underkeel clearance can be maintained with swell conditions even higher than 6 feet.

The Rip survey

The entrance to Port Phillip Bay, known as The Rip, is notorious for erratic wave and tidal conditions. The bottom is hard rock and consists in the shallowest area of needlelike pinnacles. The damage which a ship would suffer if she grounded on these rock pinnacles is self-evident, and consequently it has been customary to allow very large underkeel clearances.

Practical tests were made in September 1965, when a 50,000-ton ship was navigated over 200 times across the critical area ballasted to drafts up to 42 feet. The wave conditions were measured during all these runs and the results of the ship's echo sounder and her motion recorder were analyzed. It was found that in all but the most severe weather conditions the draft of the ship for this particular area could be increased from the present value of 38 feet to at least 42 feet.

Another finding of interest was that the motion of the ship in The Rip in a given wave condition is substantially greater when the ship is heading to seaward, that is into the sea, than when she is navigating the passage inward running with the sea, due to the speed of the ship varying the frequency of the encounter.

Durban

The draft for Durban has for many years been restricted to 38 feet and all concerned with the operation of large ships have been conscious of the possible effects of roll which a ship may experience immediately to seaward of the entrance to Durban Harbor.

In September 1966, tests were made with a 50,000-ton tanker over five days, when the experience used in Bonny and in The Rip survey was deployed in examining over 42 transits the behavior of a ship at 38 feet draft on all states of tide. The underkeel clearance determined indicated that ships can navigate the entrance to Durban Harbor at 42 feet draft in perfect safety providing the entry is made at high water and the swell conditions are not too severe. Delays in awaiting suitable conditions to navigate the entrance would be virtually insignificant. . . .

Europoort

Europoort is already suitable for ships of well over 100,000 tons deadweight and the authorities are energetically examining what must be done to make Europoort suitable for the large number of ships in the 200,000-ton range which users of the port plan to trade to Europoort from the end of this year onwards.

The dredged channel will have to extend far out into the North Sea to natural deep water, and it is obviously essential that the authorities and the users of the port must be satisfied as to the underkeel clearances which will allow maximum draft to be used for any given depth.

A team of very highly skilled people was set up by the Netherlands authorities to study these matters, and they examined the possibility of doing full-scale tests in an area of the North Sea where the bottom is flat, the intention being that ship movement could be determined in relation to wave conditions. These measurements could then be used to find the correct correlation to model studies to allow the Europoort entrance to be studied on model scale. However, to date this has not proved to be feasible but the team is studying the motion of a dredger operating continuously in the entrance, and in addition tankers with suitable instrumentation will be boarded on each entry into Europoort so that their underkeel clearances related to wave conditions prevailing can be determined with a view to assessing more accurately the underkeel clearance which the very large tankers will require.

Conclusions

1. The underkeel clearance required for any given tanker to navigate a sea area unaffected by wave conditions which cause ship motion can now be calculated with a degree of accuracy suitable for all practical purposes.

2. Where ship motion must be expected, known techniques do not yet enable required underkeel clearance to be derived by calculation.

3. The effects of small underkeel clearance in damping ship motion are of very considerable importance, and it is incorrect to add the trigonometrical effects of pitch, roll and heave expectable in deep water to determine the underkeel clearance required in a shallow area.

4. Highly sophisticated echo sounding equipment is now available which will determine small underkeel clearances over the whole of the ship's flat bottom area to an accuracy of plus or minus 6 inches, and in addition, instruments are available which will indicate ship motion relative to a fixed plane. Practical tests using the foregoing equipment in tankers can be undertaken to determine:

(a) Wave conditions which will not result in any significant wave motion of the ship.

(h) Underkeel clearances which will provide adequate safety up to a wave condition which can be monitored. ⚓

Statistics of Casualties 1976

Annually the U.S. Coast Guard presents a statistical summary of commercial vessel casualties that were investigated by Coast Guard marine inspectors during the previous fiscal year. The public, industry, and the Coast Guard have used the findings of these investigations to establish standards and determine the need for legislation to improve the protection of safety of life and property at sea.

The master of a vessel is required by law to report a marine casualty as soon as possible after its occurrence to the Officer in Charge, Marine Inspection, U.S. Coast Guard. Casualties involving commercial vessels are required to be reported to the Coast Guard whenever the casualty results in any of the following:

(a) Actual physical damage to property in excess of $1,500;

(b) Material damage affecting the seaworthiness or efficiency of a vessel;

(c) Stranding or grounding (with or without damage);

(d) Loss of life;

(e) Injury causing any person to remain incapacitated for a period in excess of 72 hours, except injury to harbor workers not resulting in death and not resulting from vessel casualty or vessel equipment casualty.

Every event involving a vessel or her personnel which meets any of the conditions of a reportable casualty is of great concern to the Coast Guard. A number of reportable casualties are not investigated by the Coast Guard each year simply because they are not reported. Thus it is of primary importance that the masters of all vessels ensure that all casualties are reported and investigated. Through the cooperation of the masters, owners, and agents of commercial vessels many of the unreported casualties can be investigated.

The statistical summary represents casualties to commercial vessels which meet the above criteria. It is important to note that in contrast to previous years this summary represent casualties reported to Coast Guard Headquarters during an extended fiscal year of 15 months, which ended September 30, 1976. This factor should be taken into consideration in any comparison with statistics of previous fiscal years.

Statistics concerning noncommercial recreational boating accidents can be found in CG–357, Boating Statistics, published by the Office of Boating Safety.

This summary also includes those casualties serious enough by reason of dollar damage or number of deaths and/or injuries to warrant the convening of a Marine Board of Investigation. Included in this year's statistics are the following Marine Boards of Investigation: the explosion of tank barge B924 at Greenville, Mississippi; the capsizing and sinking of the drilling rig *Ocean Express* in the Gulf of Mexico; and the sinking of the SS *Edmund Fitzgerald* in Lake Superior. These major marine casualties resulted in 46 deaths, 7 injuries, and property damage amounting to $25,790,000.

This statistical tabulation is intended to summarize the casualty experience for the entire commercial fleet. Because this summary is so all-encompassing, the use of the statistics may lead to erroneous conclusions unless the limitations of the data are well understood.

The Information and Analysis Staff of the Office of Merchant Marine Safety will gladly assist in quantifying those limitations for each specific need. Comments and recommendations for changes or improvements to these statistics should be addressed to Commandant (G–MIS/83), U.S. Coast Guard, Washington, D.C. 20590.

Statistical Summary of Casualties to Commercial Vessels[1]

1 July 1975 to 30 Sept. 1976 Fiscal year 1976[2]	Nature of casualty																		
	Collisions; crossing, meeting and overtaking	Collisions, while anchored, docking or undocking	Collision, fog	Collisions with piers and bridges	Collisions, all others	Explosion and/or fires—cargo	Explosion and/or fires—vessel's fuel	Explosion and/or fire—boilers, pressure vessel	Explosion and/or fire—structure, equipment, all others	Grounding with damage	Grounding without damage	Founderings, capsizings and floodings	Heavy weather damage	Cargo damage	Material failure—structure and equipment	Material failure—machinery and engineering equipment	Casualty not otherwise classified	Total
Number of casualties	228	196	22	619	474	9	56	5	215	484	646	564	78	17	160	268	170	4211
Number of vessels involved	720	566	54	1204	894	12	57	5	219	823	1016	685	104	21	171	272	327	7150
Number of inspected vessels involved	177	136	15	388	297	7	10	1	61	202	300	66	63	12	125	165	107	2132
Number of uninspected vessels involved	543	430	39	816	597	5	47	4	158	621	716	619	41	9	46	107	220	5018
PRIMARY CAUSE																		
Personnel fault:																		
Pilots—State	8	8	0	43	6	0	0	0	0	7	31	0	0	0	0	2	5	113
Pilots—Federal	0	7	0	15	0	0	0	0	0	3	7	0	0	0	0	0	0	32
Licensed officer—documented seaman	131	75	14	355	170	1	2	0	5	174	185	31	2	0	4	4	17	1170
Unlicensed—undocumented persons	59	25	5	16	61	0	3	0	7	96	95	49	0	0	0	1	11	428
All others	16	13	1	46	21	4	4	0	13	16	27	12	0	6	9	1	29	218
Calculated risk	0	0	0	3	10	0	1	0	1	4	1	5	2	0	0	0	0	27
Restricted maneuvering room	12	21	4	44	27	0	0	0	6	25	35	19	1	2	1	3	10	210
Storms—adverse weather	2	22	3	31	49	0	1	0	0	52	33	66	89	10	18	1	28	405
Unusual currents	0	1	0	2	4	0	0	0	0	0	1	1	0	0	0	0	1	10
Sheer, suction, bank cushion	16	2	0	8	3	0	0	0	0	3	6	0	0	0	0	0	3	41
Depth of water less than expected	0	2	0	4	10	0	0	0	0	88	268	1	0	0	0	0	0	373
Failure of equipment	24	43	1	65	54	0	36	5	66	61	70	67	1	1	68	220	97	879
Unseaworthy—lack of maintenance	0	0	0	0	1	0	0	0	0	0	0	30	0	0	3	0	0	34
Floating debris—submerged object	0	0	0	2	109	0	0	0	1	11	2	41	0	0	1	1	0	168
Inadequate tug assistance	1	1	0	16	4	0	0	0	0	3	3	0	0	0	0	0	0	28
Fault on part of other vessel or person	439	332	24	540	328	2	1	0	8	264	235	173	5	1	43	7	81	2483
Unknown—insufficient information	12	14	2	14	37	5	9	0	112	16	14	190	4	1	24	32	45	531
TYPE OF VESSEL																		
Inspected vessels:																		
Passenger and ferry—large	4	3	0	14	7	0	0	0	1	5	3	0	0	0	4	7	4	52
Passenger and ferry—small	17	7	3	8	32	0	1	0	15	22	31	28	2	0	17	33	7	223
Freight	17	34	3	95	60	0	5	1	24	31	73	4	32	12	59	65	37	552
Cargo barge	13	9	0	16	22	1	0	0	2	21	16	10	13	0	6	0	7	136
Tankships	12	21	2	29	32	0	1	0	9	13	37	5	9	0	22	52	13	257
Tank barge	107	51	6	214	116	5	2	0	6	99	134	12	4	0	6	2	32	796
Public	1	3	0	0	2	0	0	0	1	2	2	1	1	0	1	4	1	19
Miscellaneous	6	8	1	12	26	1	1	0	3	9	4	6	2	0	10	2	6	97
Uninspected vessels:																		
Fishing	68	53	13	24	104	0	21	0	69	143	138	259	7	0	20	76	17	1012
Tugs	236	146	11	470	265	3	12	1	37	234	233	157	18	2	9	20	41	1895
Foreign	41	66	7	81	51	1	6	3	18	32	107	9	1	4	2	2	22	443
Miscellaneous	198	175	8	241	177	1	8	0	34	212	236	194	15	3	15	9	140	1668
GROSS TONNAGE																		
300 tons or less	376	318	34	478	504	4	44	2	142	394	423	562	37	5	65	134	125	3647
Over 300 to 1,000 tons	177	102	9	305	130	2	2	0	14	245	211	85	10	3	12	14	89	1410
Over 1,000 to 10,000 tons	127	80	7	272	177	6	4	0	31	132	197	24	23	2	40	34	59	1215
Over 10,000 tons	40	66	4	149	83	0	7	3	32	52	185	14	34	1	54	90	54	878
LENGTH																		
Less than 100 feet	316	258	32	373	415	4	35	1	124	334	318	501	28	3	55	123	91	3044
100 to less than 300 feet	338	209	13	616	338	7	13	2	43	405	446	166	30	6	33	25	154	2844
300 to less than 500 feet	19	28	4	42	51	1	2	0	16	28	40	5	4	1	10	15	20	286
500 feet and over	47	71	5	173	90	0	7	2	36	56	182	10	42	11	73	109	62	976
AGE																		
Less than 10 years	381	220	27	577	393	9	27	3	83	394	489	182	61	10	82	116	149	3203
10 to less than 20 years	158	138	8	306	194	2	13	0	39	201	265	159	19	1	35	44	92	1674
20 to less than 30 years	70	59	5	139	101	1	6	1	34	95	103	123	11	1	14	27	30	823
30 years and over	111	149	14	182	208	0	11	1	63	133	156	221	13	9	40	85	56	1450

See footnotes at end of table.

Statistical Summary of Casualties to Commercial Vessels [1]—Continued

1 July 1975 to 30 Sept. 1976 Fiscal year 1976 [2]	Nature of casualty																	
	Collisions; crossing, meeting and overtaking	Collisions, while anchored, docking or undocking	Collision, fog	Collisions with piers and bridges	Collisions, all others	Explosion and/or fires—cargo	Explosion and/or fires—vessel's fuel	Explosion and/or fire—boilers, pressure vessel	Explosion and/or fire—structure, equipment, all others	Grounding with damage	Grounding without damage	Founderings, capsizings and floodings	Heavy weather damage	Cargo damage	Material failure—structure and equipment	Material failure—machinery and engineering equipment	Casualty not otherwise classified	Total
LOCATION OF CASUALTY																		
Inland—Atlantic	28	37	6	124	97	2	11	2	46	109	164	109	5	0	23	43	33	839
Inland—Gulf	100	66	7	180	102	3	16	2	48	72	176	93	4	3	8	13	44	936
Inland—Pacific	12	21	0	55	63	0	8	0	36	108	110	63	4	2	26	45	16	569
Ocean—Atlantic	9	6	6	1	23	0	4	0	17	13	16	54	20	2	20	58	12	261
Ocean—Gulf	15	9	0	4	51	0	8	0	12	23	9	65	5	1	13	20	7	242
Ocean—Pacific	12	2	0	0	40	0	5	0	23	28	11	80	30	8	30	52	6	327
Great Lakes	4	3	0	67	26	1	0	0	2	22	27	7	2	0	12	22	11	206
Western rivers	41	36	3	148	43	3	4	0	19	91	93	86	0	0	4	2	22	595
Ocean—other	0	2	0	2	3	0	0	0	6	5	3	3	3	0	4	6	4	41
Foreign waters	7	14	0	38	26	0	0	1	6	13	37	5	5	1	20	7	15	195
TIME OF DAY																		
Daylight	111	113	15	330	251	5	32	3	124	213	308	267	37	7	96	170	86	2168
Nighttime	103	64	7	258	176	3	17	0	81	235	257	225	23	9	39	78	56	1661
Twilight	14	19	0	31	47	1	7	2	10	36	51	72	18	1	25	20	28	382
ESTIMATED LOSSES																		
Vessel	9876	5092	582	8605	19092	1135	6129	300	22151	25660	557	34015	10793	78	11012	7410	7425	169812
Cargo	1214	116	10	6274	9160	212	33	0	2081	7027	5	3743	1956	379	689	7	232	33138
Property	65	1259	0	17958	6909	717	30	0	4491	1381	131	1686	749	23	1136	4	1202	37741
VESSELS TOTALLY LOST																		
Inspected	3	0	0	4	2	2	1	0	7	2	0	11	1	0	3	1	1	38
Uninspected	18	3	4	8	20	0	18	0	52	42	0	226	3	0	2	1	11	408

[1] Statistics concerning recreation and pleasure boating accidents are published in CG-357.
[2] Includes FY 76 Transition Quarter.

Statistical Summary of Deaths/Injuries Due to a Vessel Casualty [1]

1 July 1975 to 30 Sept. 1976 Fiscal year 1976 [2]	Nature of casualty																	
	Collision; crossing, meeting, and overtaking	Collision; while anchored, docking, or undocking	Collision, fog	Collisions with piers and bridges	Collisions, all others	Explosion and/or fires—Cargo	Explosion and/or fires—Vessel's fuel	Explosion and/or fire—Boilers, pressure vessel	Explosion and/or fire—Structure, equipment, all others	Grounding with damage	Grounding without damage	Founderings, capsizings and floodings	Heavy weather damage	Cargo damage	Material failure—Structure and equipment	Material failure—Machinery and engineering equipment	Casualty not otherwise classified	Total
Number of casualties	15	6	3	6	7	4	8	4	24	2	7	72	1	1	9	4	13	186
Number of inspected vessels involved	1	2	0	2	0	3	3	0	4	1	1	1	0	1	4	2	7	32
Number of uninspected vessels involved	15	4	3	4	7	2	5	4	20	1	6	72	1	0	6	2	8	160
Number of persons deceased/injured	13/13	6/13	2/3	1/11	13/5	7/8	2/8	5/2	15/28	1/5	3/5	137/25	/1	1/	34/8	2/3	27/15	269/153
PRIMARY CAUSE																		
Personnel fault:																		
Pilots—State																		0
Pilots—Federal																		0
Licensed officer—documented seaman	1			2		1	2		1	1		3					1	12
Unlicensed—undocumented persons	4	3	2		1				3		2	12						27
All others			1		1	1	1		3									7

See footnotes at end of table.

Statistical Summary of Deaths/Injuries Due to a Vessel Casualty[1]—Continued

1 July 1975 to 30 Sept. 1976 Fiscal year 1976[2]	Nature of casualty: Collision; crossing, meeting, and overtaking	Collision; while anchored, docking, or undocking	Collision, fog	Collisions with piers and bridges	Collisions, all others	Explosion and/or fires—Cargo	Explosion and/or fires—Vessel's fuel	Explosion and/or fire—Boilers, pressure vessel	Explosion and/or fire—Structure, equipment, all others	Grounding with damage	Grounding without damage	Founderings, capsizings and floodings	Heavy weather damage	Cargo damage	Material failure—Structure and equipment	Material failure—Machinery and engineering equipment	Casualty not otherwise classified	Total
PRIMARY CAUSE—Continued																		
Error in judgement—calculated risk																		0
Restricted manuevering room	2				1							3					1	7
Storms—adverse weather				2			1				1	12	1		1		1	19
Unusual currents												1						1
Sheer, suction, bank cushion																		0
Depth of water less than expected											2							2
Failure of equipment	2						3	4	6	1		5			5	4	2	32
Unseaworthy—lack of maintenance												1						1
Floating debris—submerged object												1						1
Inadequate tug assistance																		0
Fault on part of other vessel or person	7	3		1	3	1			1			2			2		4	24
Unknown—insufficient information				1	1	2	1		10		2	33		1	2		6	59
TYPE OF VESSEL INVOLVED																		
Inspected vessels:																		
Passenger and ferry—large				/4													/6	0/10
Passenger and ferry—small	/1	/9								/4	/2						/1	0/17
Freight							2/		4/2			1/		1/	29/4	/2	1/2	38/10
Cargo barge																		0/0
Tankships																	/1	0/1
Tank barges		/1				4/7	/1		/2								1/1	5/12
Public																		0/0
Miscellaneous				1/2			/3					5/			1/1	/1	3/	10/7
Uninspected vessels:																		
Fishing	1/4		/1		4/3		/2		7/7	1/1	3/2	66/9	/1		1/	2/	1/1	86/31
Tugs	1/3			/5		3/	/2	1/	1/3		/1	13/7					1/3	20/24
Foreign			2/		7/			4/2	2/4			1/			1/		17/	34/6
Miscellaneous	11/5	6/3	/2		2/2	/1			1/10			51/9			2/3		3/	76/35
PARTICULARS OF PERSON DECEASED/INJURED																		
Papers of deceased/injured:																		
Licensed by Coast Guard	1/1			/2		/1	/3		/2	/1		6/3			8/1		/1	15/15
Documented by Coast Guard	/1			/2			/1		/1			3/1			21/1		1/2	25/9
No license or document	12/10	6/13	/3	1/7	13/5	7/7	/4	3/1	13/23	1/4	3/5	126/21	/1	1/	4/6	2/3	9/12	201/125
Other—unknown—foreign	/1		2/				2/	2/1	2/2			2/			1/		17/	28/4
Status or capacity on vessel:																		
Passenger	3/1	/9	/1		2/				1/6	/1	1/3	31/1					2/6	40/28
Longshoreman—harbor worker									3/					1/	/4		/2	4/6
Crewmember	8/9	6/4	2/2	1/11	11/5	1/6	/8	5/2	10/18	1/4	2/2	84/19	/1		32/3	2/3	25/6	190/103
Other	2/3					6/2	2/		1/4			22/5			2/1		/1	35/16
Activity engaged in:																		
Off duty	3/4			1/2	7/	/1			1/5			5/5			22/			39/17
Deck department duties	2/3	1/4	/2	/5	3/4	1/2	/1		3/4	/3	/2	15/7	/1		6/3		7/4	38/45
Engine department duties	/1			/2		/3	/3	5/2	1/7			1/2			4/	/3	1/1	12/24
Stewards department duties				/1					2/1	/1	/1	1/						3/4
Handling cargo														1/	1/5		/2	2/7
Fishing	3/3				1/1		/3		1/1	1/	3/	44/4				2/	1/1	56/13
Drills		/9	/1															/10
Passenger	3/				2/				1/5	/1	/2	19/2					1/6	26/16
Other and unknown	2/2	5/	2/	/1		6/2	2/1		6/5			52/5			1/		17/1	93/17
Location of vessel:																		
At dock			/1			5/2	2/		/2			/1						7/6
At anchor	6/3	1/9		1/1	/3	/1	/1		/3			9/3			29/		2/	48/24
Underway	7/10	5/4	2/2	/10	13/2	2/5	/7	5/2	15/23	1/5	3/5	128/21	/1	1/	5/8	2/3	25/15	214/123
Unknown																		0/0
PART OF BODY INVOLVED																		
Head and upper limbs	/3		/2	/4		1/2		1/	/4	/1		/7			2/1	/1	2/4	6/29
Back and lower limbs					/1		/1		/5	/1		/3					/2	/13
Chest	/1	/1		/1			/1		1/			/5	/1		/1			1/11
Extremities	/2	/2		/1	/2	/1	/3		/16	/2	/5	/4			/2	/1	/4	/45
Illness			/1			2/						1/						3/1
Drowning	11/8	6/			3/					1/	2/	75/			1/1	1/	3/	103/1
Miscellaneous and unspecified	2/7	/10	2/	1/5	10/2	4/5	2/3	4/2	14/3	/1	1/	61/6		1/	31/3	1/1	22/5	156/53

[1]Statistics concerning recreation and pleasure boating accidents are published in CG-357.
[2]Includes FY76 Transition Quarter.

Statistical Summary of Deaths on Board Commercial Vessels[1] (Not Involving a Vessel Casualty)

1 July 1975 to 30 Sept. 1976 Fiscal year 1976 [2]	Nature of death																							
	Natural cause	Homicide	Suicide	Disappearance	Slips and falls—Ladders	Slips and falls—Gangways	Slips and falls—On deck	Slips and Falls—Other	Falls from vessel—Into water	Falls into holds or tanks	Struck by objects; falling, dropped or moving	Exposure and asphyxiation	Struck against, crushed, bumped into objects	Operating machinery and tools	Burns and scalds (other than electrical)	Electrical shock and burns	Caught in lines, chains, or wire ropes	Pinching and crushing	Heavy weather	Overexertion, sprains and strains	Cuts, lacerations, bruises and punctures	Altercations and misconduct	Unknown or insufficient information	Total
Number of deaths	172	7	18	16	10	1	0	13	97	5	25	13	4	0	1	3	10	3	0	0	1	2	4	405
Number of inspected vessel deaths	127	1	13	2	8	1	0	8	19	5	9	4	1	0	1	0	3	3	0	0	1	1	2	209
Number of uninspected vessel deaths	145	6	5	14	2	0	0	5	78	0	16	9	3	0	0	3	7	0	0	0	0	1	2	196
CAUSE OF DEATH																								
Intoxication	0	1	1	1	2	0	0	1	13	0	0	0	0	0	0	0	1	0	0	0	0	0	0	20
Physical deficiency or handicap	72	1	1	0	0	0	0	0	2	0	0	2	0	0	0	0	0	0	0	0	0	0	2	180
Unsafe movement or posture	0	0	0	0	2	0	0	1	21	1	0	0	0	0	0	0	0	0	0	0	0	0	0	25
Psychological—immaturity, insanity	0	5	16	1	0	0	0	0	3	1	0	0	0	0	0	0	0	0	0	0	0	2	0	28
Unsafe practice	0	0	0	0	3	1	0	7	11	2	3	5	0	0	1	1	2	0	0	0	0	0	0	36
Violation of law or regulation	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Human errors	0	0	0	1	1	0	0	1	13	1	1	0	0	0	0	0	3	0	0	0	1	0	0	22
Decks—slippery or cluttered	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Weather conditions	0	0	0	2	0	0	0	0	3	0	1	0	1	0	0	0	0	0	0	0	0	0	0	7
Poor maintenance or housekeeping	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Inadequate lighting	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Inadequate rails or guards	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Failure of equipment	0	0	0	0	0	0	0	0	3	0	18	0	3	0	0	0	2	2	0	0	0	0	1	29
Inadequate supervision	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Inadequate life preservers	0	0	0	1	0	0	0	0	9	0	0	0	0	0	0	0	0	0	0	0	0	0	0	10
Inadequate tools or equipment	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Inadequate protective equipment	0	0	0	0	1	0	0	1	0	0	1	4	0	0	0	0	0	0	0	0	0	0	0	7
Improper use of tools or equipment	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1	0	0	0	0	0	2
Miscellaneous causes	0	0	0	10	1	0	0	2	19	0	1	2	0	0	0	2	1	0	0	0	0	0	1	39
TYPES OF VESSELS INVOLVED																								
Inspected vessels:																								
Passenger and ferry—large	18	0	4	0	0	0	0	0	4	0	0	0	0	0	0	0	0	0	0	0	0	0	0	26
Passenger and ferry—small	33	0	4	0	0	0	0	0	4	0	1	0	0	0	0	0	0	0	0	0	0	0	0	42
Freight ships and barges	44	0	5	2	6	1	0	3	6	3	4	2	0	0	1	0	2	2	0	0	1	0	1	83
Tankships and barges	22	1	0	0	1	0	0	5	5	2	1	1	0	0	0	0	1	1	0	0	0	0	0	40
Public	1	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	-2
Miscellaneous	9	0	0	0	1	0	0	0	0	0	3	0	1	0	0	0	0	0	0	0	0	1	1	6
Uninspected vessels:																								
Fishing	13	5	1	7	0	0	0	0	29	0	4	5	1	0	0	1	2	0	0	0	0	0	1	60
Tugs	15	0	1	3	0	0	0	2	21	0	4	0	0	0	0	2	2	0	0	0	0	0	0	50
Foreign	9	1	3	0	1	0	0	1	4	0	2	2	0	0	0	0	1	0	0	0	0	1	1	26
Miscellaneous	8	0	0	4	1	0	0	2	24	0	6	2	2	0	0	0	2	0	0	0	0	0	0	51
TIME OF DAY																								
Daytime	119	2	9	8	4	1	0	7	49	3	19	6	4	0	1	3	9	2	0	0	1	0	2	249
Nighttime	40	5	6	7	6	0	0	5	41	2	6	4	0	0	0	0	1	1	0	0	0	2	2	128
Twilight	13	0	3	1	0	0	0	1	7	0	0	3	0	0	0	0	0	0	0	0	0	0	0	28
PARTICULARS OF DECEASED																								
Papers of deceased:																								
Licensed by Coast Guard	19	0	1	1	1	0	0	1	5	0	2	1	0	0	0	0	0	0	0	0	0	0	0	31
Documented by Coast Guard	64	1	4	3	6	1	0	8	14	5	3	2	0	0	1	0	2	2	0	0	1	0	2	119
No license or document	83	5	9	12	2	0	0	3	75	0	18	10	4	0	0	3	7	1	0	0	0	1	1	234
Other—unknown—foreign	6	1	4	0	1	0	0	1	3	0	2	0	0	0	0	0	1	0	0	0	0	1	1	21
Status or capacity on vessel:																								
Passenger	55	0	8	2	0	0	0	0	9	0	0	0	0	0	0	0	0	0	0	0	0	1	0	75
Longshoreman—harbor worker	2	0	1	0	2	0	0	2	2	1	2	0	0	0	0	0	2	1	0	0	0	0	0	15
Crewmember	103	7	8	13	6	1	0	11	78	2	22	11	4	0	1	3	6	2	0	0	1	1	3	283
Other	12	0	1	1	2	0	0	0	8	2	1	2	0	0	0	0	2	0	0	0	0	0	1	32
Activity engaged in:																								
Off duty	50	4	4	1	2	0	0	1	6	1	1	0	0	0	0	0	0	0	0	0	0	1	2	73
Deck department duties	24	1	4	7	3	1	0	4	37	1	16	3	3	0	0	2	3	3	0	0	0	0	0	112
Engine department duties	8	0	1	0	1	0	0	4	2	1	2	1	0	0	1	0	0	0	0	0	0	0	0	21
Stewards department duties	6	0	0	0	1	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	1	0	0	9
Handling cargo	1	0	0	1	0	0	0	1	1	1	2	0	0	0	0	0	2	0	0	0	0	0	0	9
Fishing	34	2	1	4	0	0	0	0	25	0	2	1	1	0	0	1	2	0	0	0	0	0	0	73
Drills	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Passenger	29	0	7	1	0	0	0	0	5	0	0	0	0	0	0	0	0	0	0	0	0	0	0	42
Other and unknown	20	0	1	2	3	0	0	3	20	1	2	8	0	0	0	0	3	0	0	0	0	1	2	66

See footnotes at end of table.

Statistical Summary of Deaths on Board Commercial Vessels[1] (Not Involving a Vessel Casualty)—Continued

1 July 1975 to 30 Sept. 1976 Fiscal year 1976[2]	Natural cause	Homicide	Suicide	Disappearance	Slips and falls—Ladders	Slips and falls—Gangways	Slips and falls—On deck	Slips and Falls—Other	Falls from vessel—Into water	Falls into holds or tanks	Struck by objects; falling, dropped or moving	Exposure and asphyxiation	Struck against, crushed, bumped into objects	Operating machinery and tools	Burns and scalds (other than electrical)	Electrical shock and burns	Caught in lines, chains, or wire ropes	Pinching and crushing	Heavy weather	Overexertion, sprains and strains	Cuts, lacerations, bruises and punctures	Altercations and misconduct	Unknown or insufficient information	Total
	Nature of death																							
PARTICULARS OF DECEASED—Continued																								
Location of vessel:																								
At dock	8	0	0	1	2	0	0	1	16	1	2	0	0	0	0	0	1	1	0	0	0	0	0	33
At anchor	8	0	2	3	0	0	0	1	13	0	1	0	0	0	0	0	0	0	0	0	0	0	0	28
Underway	156	7	16	12	8	1	0	11	68	4	22	13	4	0	1	3	9	2	0	0	1	2	4	344
Unknown	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
PART OF BODY INVOLVED																								
Head	0	1	2	0	6	0	0	7	3	2	18	0	3	0	1	1	1	1	0	0	0	0	1	47
Back	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	2
Chest	0	0	0	1	2	1	0	0	0	0	1	2	0	0	0	0	0	1	0	0	0	0	0	8
Extremities	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	1	0	0	2
Illness	139	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	139
Drowning	0	0	11	2	1	0	0	0	70	0	0	1	0	0	0	0	5	0	0	0	0	1	0	91
Unspecified and miscellaneous	32	6	5	13	1	0	0	6	24	3	5	10	1	0	0	2	4	1	0	0	0	1	2	116

[1] Statistics concerning recreation and pleasure boating accidents are published in CG-357.
[2] Includes FY76 Transition Quarter.

Statistical Summary of Personnel Injuries on Board All Commercial Vessels[1] (Not Involving a Vessel Casualty)

1 July 1975 to 30 Sept. 1976 Fiscal year 1976[2]	Slips and falls—ladders	Slips and falls—gangways	Slips and falls—on deck	Slips and falls—other	Falls from vessel—Into water	Falls into holds or tanks	Struck by objects; falling, dropped or moving	Exposure and asphyxiation	Struck against, crushed, bumped into objects	Operating machinery and tools	Burns and scalds (other than electrical)	Electrical shock and burns	Caught in lines, chains or wire ropes	Pinching and crushing	Heavy weather	Overexertion, sprains and strains	Cuts, lacerations, bruises and punctures	Altercations and misconduct	Unknown or insufficient information	Total
	Nature of injury																			
Number of injuries	132	29	195	115	8	21	205	10	97	4	54	8	67	58	3	111	53	37	17	1224
Number of inspected vessel injuries	123	24	169	95	1	16	155	7	86	3	42	7	42	49	0	100	45	35	14	1013
Number of uninspected vessel injuries	9	5	26	20	7	5	50	3	11	1	12	1	25	9	3	11	8	2	3	211
CAUSE OF INJURY																				
Intoxication	6	2	4	1	0	0	0	0	3	0	1	1	0	0	0	0	1	2	2	23
Physical deficiency or handicap	2	0	3	2	0	0	0	2	3	0	0	0	0	0	0	15	2	2	4	85
Unsafe movement or posture	9	2	20	10	0	3	11	0	11	1	5	0	4	4	1	45	3	0	0	129
Psychological—immaturity, insanity	2	0	0	1	0	0	1	1	1	0	0	0	0	0	0	1	2	26	2	37
Unsafe practice	17	4	25	18	3	3	46	0	8	0	6	1	18	7	0	17	10	0	1	184
Violation of law or regulation	0	0	0	0	0	0	0	0	0	0	3	0	0	0	0	0	1	5	0	9
Human errors	78	16	110	58	4	14	101	1	55	3	29	4	36	39	1	26	24	2	4	605
Decks—slippery or cluttered	6	2	23	3	0	0	0	0	2	0	0	0	0	0	0	2	0	2	0	38
Weather conditions	2	0	7	6	0	0	4	0	7	0	1	0	1	1	0	2	0	0	0	38
Poor maintenance or housekeeping	1	0	0	2	0	0	2	0	0	0	1	0	0	1	1	2	2	0	0	34
Inadequate lighting	1	0	1	1	0	0	0	0	1	0	0	0	0	1	0	0	0	0	1	8
Inadequate rails or guards	0	0	1	0	0	0	1	0	0	0	1	0	1	0	0	0	0	0	0	4

See footnotes at end of table.

Statistical Summary of Personnel Injuries on Board All Commercial Vessels[1] (Not Involving a Vessel Casualty—Continued

1 July 1975 to 30 Sept. 1976 Fiscal year 1976[2]	Nature of injury																			
	Slips and falls—ladders	Slips and falls—gangways	Slips and falls—on deck	Slips and falls—other	Falls from vessel—into water	Falls into holds or tanks	Struck by objects; falling, dropped or moving	Exposure and asphyxiation	Struck against, crushed, bumped into objects	Operating machinery and tools	Burns and scalds (other than electrical)	Electrical shock and burns	Caught in lines, chains or wire ropes	Pinching and crushing	Heavy weather	Overexertion, sprains and strains	Cuts, lacerations, bruises and punctures	Altercations and misconduct	Unknown or insufficient information	Total
CAUSE OF INJURY—Continued																				
Failure of equipment	5	3	1	8	0	0	27	3	3	5	2	3	2	0	1	4	0	0	0	67
Inadequate supervision	0	0	0	1	0	1	5	0	1	0	1	0	2	1	0	1	0	0	0	13
Inadequate life preservers	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	1
Inadequate tools or equipment	0	0	0	1	0	0	0	0	0	0	1	0	0	0	0	1	0	0	0	3
Inadequate protective equipment	0	0	0	0	0	0	2	0	0	0	0	0	1	2	0	0	3	0	0	8
Improper use of tools or equipment	3	0	0	2	1	0	2	3	2	0	0	0	0	0	0	0	1	0	3	17
Miscellaneous causes	0	0	0	1	0	0	0	0	2	0	0	0	1	1	0	0	0	0	0	5
TYPES OF VESSELS INVOLVED																				
Inspected vessels:																				
Passenger and ferry—large	2	1	4	5	1	0	1	2	0	0	1	0	0	0	0	2	0	0	0	19
Passenger and ferry—small	2	0	6	10	0	2	2	0	1	0	0	0	2	1	0	0	1	0	0	27
Freight ships and barges	90	19	125	49	0	11	116	2	73	2	26	6	33	37	0	79	35	23	8	734
Tankships and barges	21	4	32	20	0	2	21	3	10	1	12	1	5	6	0	14	4	11	4	171
Public	1	0	0	0	0	0	1	0	1	0	0	0	0	0	0	1	0	1	0	5
Miscellaneous	7	0	2	11	0	1	14	0	1	0	3	0	2	5	0	4	5	0	2	57
Uninspected vessels:																				
Fishing	1	0	6	3	4	3	26	0	4	0	6	0	16	4	2	3	7	2	3	90
Tugs	7	1	13	11	3	2	21	0	4	0	5	0	7	4	1	6	1	0	0	86
Foreign	1	4	1	1	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	8
Miscellaneous	0	0	6	5	(	0	3	3	3	1	0	1	2	1	0	2	0	0	0	27
TIME OF DAY																				
Daytime	101	14	127	76	6	15	153	9	64	2	43	7	56	45	3	85	42	13	9	870
Nighttime	24	11	56	30	2	5	45	1	27	1	11	0	5	8	0	19	8	22	7	282
Twilight	7	4	12	9	0	1	7	0	6	1	0	1	6	5	0	7	3	2	1	72
PARTICULARS OF PERSON INJURED																				
Papers of person injured:																				
Licensed by Coast Guard	8	1	4	9	0	2	18	0	5	0	4	1	4	5	0	14	2	1	2	80
Documented by Coast Guard	107	23	153	61	1	12	124	6	80	3	37	6	36	36	0	83	38	34	11	851
No license or document	16	2	37	44	6	7	63	4	12	1	12	1	27	17	3	14	13	2	4	285
Other—unknown—foreign	1	3	1	1	1	0	0	0	0	0	1	0	0	0	0	0	0	0	0	8
Status or capacity on vessel:																				
Passenger	2	2	9	15	1	2	2	0	1	0	2	0	2	2	0	0	1	0	0	41
Longshoreman—harbor worker	2	0	0	1	0	2	2	3	0	1	1	0	0	0	0	0	0	0	0	12
Crewmember	121	23	178	87	5	17	196	5	92	2	49	7	65	54	3	107	47	35	16	1108
Other	7	4	8	12	2	0	5	2	4	1	2	1	1	2	0	4	5	2	1	63
Activity engaged in:																				
Off duty	10	8	12	10	0	0	1	1	10	0	2	0	0	2	0	6	4	11	1	78
Deck department duties	52	4	102	40	3	13	133	1	46	1	21	1	45	28	1	57	14	4	9	575
Engine department duties	47	2	31	19	0	2	39	3	27	1	17	6	8	15	0	31	14	4	4	270
Stewards department duties	9	6	24	8	0	1	5	0	4	1	9	0	0	5	0	10	12	5	1	100
Handling cargo	1	0	1	1	0	2	1	0	0	1	0	0	0	0	0	2	0	0	0	9
Fishing	1	0	8	6	2	1	14	0	2	0	3	0	12	2	2	1	6	0	1	61
Drills	0	0	0	1	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	2
Passenger	1	2	5	12	0	2	2	0	1	0	0	0	1	1	0	0	0	0	0	27
Other and unknown	11	7	12	18	3	0	10	5	7	0	2	1	1	4	0	4	3	13	1	102
Location of vessel:																				
At dock	5	0	4	11	0	0	9	1	3	0	1	0	5	1	0	4	0	0	0	44
At anchor	3	0	7	4	1	2	4	0	1	0	3	1	1	1	0	3	0	0	2	33
Underway	124	29	184	100	7	19	192	9	93	4	50	7	61	56	3	104	53	37	15	1147
Unknown	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
PARTS OF BODY INVOLVED																				
Eye	0	0	1	0	0	0	22	2	2	0	4	1	1	0	0	0	4	6	1	44
Head	15	3	16	11	0	1	28	0	17	0	2	0	1	1	0	0	3	12	3	113
Back	21	4	34	18	1	0	3	0	8	0	1	0	2	0	0	61	0	1	1	155
Neck and shoulder	6	1	18	6	0	0	5	1	4	0	2	0	1	0	0	4	1	1	0	50
Chest	10	0	10	5	0	2	5	1	9	0	1	0	1	0	1	2	0	1	1	49
Abdomen and hip	9	0	7	8	0	3	4	0	8	0	7	0	1	1	1	19	0	4	4	76
Extremities	63	21	100	57	7	13	129	1	46	2	26	6	60	56	1	24	43	10	5	670
Unspecified and miscellaneous	8	0	9	10	0	2	9	5	3	2	11	1	0	0	0	1	2	2	2	67

[1] Statistics concerning recreation and pleasure boating accidents are published in CG-357.
[2] Includes FY 76 Transition Quarter.

maritime sidelights

(*Continued from page 47*)

susceptible to galvanic corrosion. The corrosion may not be visible unless the coupling is disconnected.

As a result of these problems, the Coast Guard is withdrawing approval of the aluminum couplings and any that have been installed must be replaced with brass or bronze couplings.

CONTAINER CONVENTION

On 6 September 1976, the Ukrainian SSR and the Belorussian SSR officially ratified the International Convention for Safe Containers, putting the total number of ratifications over the 10 needed to start the countdown toward the Convention's entry into force. Czechoslovakia, Hungary, Spain, the German Democratic Republic, France, New Zealand, Rumania, the Federal Republic of Germany, and the U.S.S.R. had earlier completed their acts of ratification.

So on 6 September 1977, the Convention will become effective for those 11 nations' own containers, and 5 years later, on 6 September 1982, that same group of nations will require that all containers entering their territories bear evidence that they have been approved in accordance with the requirements of the Convention.

The International Convention for Safe Containers (CSC) was written at Geneva in December of 1973 with the full participation of the United States. It specifies the structural requirements to be met by containers used in international trade to assure that they are safe, provides for the periodic examination and reexamination of each container, and requires that the owner of each container accept responsibility for maintaining it in a safe condition.

The Convention applies to multimodal cargo containers used in international trade. A container is defined as an article of transport equipment which is:

(a) of a permanent character and accordingly strong enough to be suitable for repeated use;

(b) specially designed to facilitate the transport of goods, by one or more modes of transport, without intermediate reloading;

(c) designed to be secured and/or readily handled, having corner fittings for these purposes;

(d) of a size such that the area enclosed by the four outer bottom corners is either:

(i) at least 14 sq. m. (150 sq. ft.), or

(ii) at least 7 sq. m. (75 sq. ft.) if it is fitted with top corner fittings.

Every new container will be proven, either by physically testing a prototype of its design series or by an individual test, and a Safety Approval Plate will be affixed at the place of manufacture. Existing containers will be approved and have the Safety Approval Plates installed when the owner presents evidence showing that the container has been operating safely in maritime or inland transport for at least 2 years; or that the container is one of a design type for which a prototype has been tested and found to be approvable, or that the container was constructed to standards that, in the opinion of the approval authority, are equivalent to the standards set forth in the Convention. Existing containers must be approved within 5 years from the date on which the Convention entered into force in the country of ownership.

The impact will be felt throughout the world because every nation trading with the signatory nations will need to have its containers approved by 6 September 1982 if those containers are to be used in that trade, whether or not it has itself ratified the Convention. Those container owners who reside in nonsignatory nations will need to secure approvals from the authorities of one of the signatory nations.

Accordingly, the United States is now moving rapidly toward ratification. On 15 September, the U.S. Senate gave its advice and consent. Now, in due course, the President will forward to the Congress a plan of implementation in the form of a draft bill. Upon enactment of a final bill, the instruments of ratification will be deposited.

With the advice and assistance of the SOLAS Subcommittee Working Group on Container Operations, the Coast Guard has prepared to implement the Convention quickly once it is ratified by the United States. Most of the issues that have been recognized have been resolved, and it is expected that the rulemaking procedures will go forward without delay.

The administration of the CSC will be a rather big job. When the number of American-owned containers reaches 600,000, if the average life is 15 years, 40,000 units will be reaching the end of their useful life each year. Thus, at any given time, about 7 or 8 percent of the container population will be approaching the end of service; the same number or more will be coming off of the production line, and about 15 percent of the total number, or 90,000 units, will be due for examination or reexamination.

The necessary work will be accomplished at reasonable cost by delegating to qualified private organizations the authority to witness tests and approve new containers while a small organization in Coast Guard Headquarters will complete the remainder of the administrative work. ⚓

Nautical Queries

The following items are examples of questions which are included in the First Assistant Engineer and Second and Third Mate multiple choice examinations.

Engineers

1. A leak in the intercooler of an air compressor can cause the
   - A. compressor capacity to drop suddenly.
   - B. compressor capacity to drop gradually.
   - C. intercooler safety valve to blow.
   - D. after cooler safety valve to blow.

2. The condensate temperature in a marine condenser may be used to determine
   - A. condenser absolute pressure.
   - B. total condensate subcooling.
   - C. barometric pressure.
   - D. turbine efficiency.

3. When air is at its dew point it
   - A. will contain no additional moisture.
   - B. has the lowest relative humidity.
   - C. cannot give up its moisture.
   - D. has a low absolute humidity.

4. Prolonged operation of a hydraulic pump in a cavitating condition can cause
   - A. hydraulic fluid breakdown.
   - B. fluid pressure surges.
   - C. relief valve chatter.
   - D. pump seal failure.

5. The emitter to base junction of a transistor is always
   - A. forward biased.
   - B. over biased.
   - C. reverse biased.
   - D. under biased.

Deck

1. Before welding can be done in a tank that has carried petroleum products, a certificate must be obtained from
   - A. the Coast Guard.
   - B. the American Bureau of Shipping.
   - C. the shipyard fire department.
   - D. a certified gas chemist.

2. The small circle of the celestial sphere parallel to the celestial equator and transcribed by the daily motion of the body is called the
   - A. hour circle of the body.
   - B. parallel of declination.
   - C. vertical circle of the body.
   - D. parallel of altitude.

3. Which of the following would list the lifesaving equipment required for a vessel?
   - A. Certificate of Inspection
   - B. American Bureau of Shipping Classification Certificate
   - C. International Convention for the Safety of Life at Sea Certificate
   - D. Certificate of Registry

4. An authorized light to assist in the identification of submarines operating on the surface consists of
   - A. a blue rotating light.
   - B. an amber rotating light.
   - C. a flashing white light.
   - D. flashing side light.

5. Most propellers on merchant vessels are constructed of
   - A. manganese bronze.
   - B. cast iron.
   - C. mild steel.
   - D. improved plow steel.

Answers

Engineers

1. A 2. A 3. A 4. A 5. A

Deck

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

Correction

The October "Nautical Queries" included a question and answer which indicated that "a reverse action proportional controller in a pneumatic control system will . . . close on air failure." It was pointed out to us by a reader that that ain't necessarily so. Our exam experts at the Coast Guard Institute agree. They say the answer more accurately describes the characteristics of a "reverse action *diaphragm control valve,*" and that the question will be revised accordingly in their exams.

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.. 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 Combusible 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.
*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 JANUARY 1977

CG–172, Federal Register of January 13.

CG–123, 257, & 323, Federal Register of January 31.

*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.