A Report to Congress

EXPOSURE SUITS ON CERTAIN INSPECTED VESSELS:

ANALYSIS OF CHANGING WARM WATER CARRIAGE EXEMPTIONS TO 31° N AND 31° S WORLD-WIDE

U.S. Department of Transportation
U.S. Coast Guard

CONTENTS

EXECUTIVE SUMMARY

On August 6, 1984, new Coast Guard regulations came into effect that require certain inspected commercial vessels to carry exposure suits for the persons on board. Under the regulations, vessels operating exclusively in warm water areas would not have to carry exposure suits. These areas are defined in the regulations as the latitudes between 35° N and 35° S. Another exemption was provided for vessels with totally enclosed lifeboats with fast and efficient launching devices.

The Coast Guard Authorization Act of 1984 (P. L. 98-557), in effect, directed the Secretary of Transportation to remove the totally enclosed lifeboat exemption from the rules, and to revise the 35° latitude warm water exemption line to 32° in the Atlantic Ocean. The Act also directed submission of a report on the benefits and disadvantages of extending the regulations to require exposure suits on designated vessels operating in all waters north of 31° N latitude or south of 31° S latitude. The Coast Guard made the revisions to the regulations which were effective December 30, 1984. This report fulfills the requirement for the report to Congress. The benefits and disadvantages of the proposed change to 3l° latitude are discussed in the ANALYSIS section at the end of this report.

The report concludes that the boundary should be made uniform in the Atlantic and Pacific Oceans, preferably at 32° latitude.

HYPOTHERMIA AND THE HISTORY OF THE EXPOSURE SUIT

Hypothermia has claimed the lives of countless seamen over thousands of years, but the term has become familiar in sea survival only in the past few years. Water transfers heat from the human body 25 times faster than air at the same temperature. In cold water, the heat is removed faster than the body can make it up. The result is that the victim eventually becomes helpless and either drowns or succumbs to the effects of hypothermia itself. It was hypothermia that claimed those who died in the water in the TITANIC disaster. Even though many of those for whom there was no room in the lifeboats did manage to abandon ship successfully in their lifejackets, the frigid water quickly sapped them of their strength.

In 1982, some 70 years later and about 300 nautical miles north of the place where the TITANIC rests off the coast of Newfoundland, some 110 U.S., Canadian, and Soviet men lost their lives to the effects of hypothermia in one night. Bad weather and heavy seas claimed the U.S. drilling rig OCEAN RANGER and the Soviet ship MEKHANIK TARASOV. Thirty or forty of the men on the OCEAN RANGER abandoned ship in a lifeboat that was apparently damaged during launching. This boat capsized alongside a rescue ship. The frigid water rendered the men helpless almost immediately and all of them died just a few feet from rescue. In the case of the MEKUANIK TARASOV, the Soviet sailors apparently waited until their damaged ship was listing too heavily to launch the lifeboats. Only 5 of the 37 on board were saved. Rescuers reported that the survivors were dressed in heavy clothes and were in the water less than ten minutes. Others in the water only a few minutes longer did not survive.

In February 1983, the collier MARINE ELECTRIC sank off the coast of Virginia. There was not enough time to launch the lifeboats and only 3 of the 34 men on board survived the two hours it took for rescuers to pull them out of the 40°F water. Two of these had managed to get themselves out of the water and onto a lifeboat and a liferaft that were floating in the area.

In order to prolong the survival time of those that find themselves in cold water as the result of a casualty at sea, water must be prevented from coming into contact with the survivor’s skin and insulation must be provided between the water and the survivor. Attempts to provide this kind of personal hypothermia protection are not new. One of the first efforts may have been a lifesaving suit designed in 1877 by inventor Traugott Beek. The suit was made of heavy canvas and had a hood that could be pulled over the face to protect the wearer from wind and waves.[1] In 1917, the U.S. Navy tested a lifesaving suit at the Brooklyn Navy Yard. Rubber lifesaving suits were being carried on some ships as early as 1927.

During World War II, some U.S. ships on the run to Murmansk carried various types of rubber suits for the crew members. These suits were heavy and

1 Edwards, B.E.D., “Ordeal by water,” Safety at Sea, No. 187, Nov. 1984, p. 13.

required a lifejacket to be worn underneath to provide flotation. Although these suits were credited with saving lives, they tended to leak and fill with water. This water diminished the suit's thermal protective value and made it difficult to climb out of the water when rescue arrived. They eventually came to be considered as dangerous, and in 1943 a special government committee on emergency rescue equipment called for development of a lightweight suit. The approvals of old suits were withdrawn, and the six companies making lifesaving suits began producing them from synthetic rubber. These suits weighed about 6 lb., including the storage bag.

Very near the end of the war, a series of tests was conducted by the Royal Canadian Air Force that resulted in requirements for an aviation exposure suit which was apparently produced for both U.S. and Canadian armed forces. After the war, many of the special wartime safety measures, including exposure suits and lifesaving suits, faded into obscurity.

It took modern materials to make today's exposure suit a practical reality. The materials that made the difference were neoprene and polyvinyl chloride (PVC) foam sheeting that first came into use for diver's wet suits. These materials are closed-cell foams made up of individual air cells, so they float and also provide excellent thermal insulation. With a nylon fabric bonded to each side to protect the foam, these materials were ideal for the application. In the early 1970's, wet suit manufacturers began making "survival suits" for commercial fishermen. This coincided with the growing awareness that hypothermia was a major threat to the lives of survivors of accidents at sea. The lives of hundreds of fishermen have been saved by these suits since their introduction.

In the mid-1970's, studies and experiments conducted in both Canada and the United States indicated that the exposure suit (generally called "survival suit" at the time) could be an effective life-saver. (Appendix I contains a listing of relevant studies conducted in the United States and other countries, as well.) This early work was done as one of the Coast Guard's responsibilities under the Great Lakes Extended Navigation Season Demonstration Program. The work was intended to identify the hazards involved with extending the navigation season further into the winter months, and to develop ways to deal with the hazards. One of the findings was that the hypothermia hazard in the Great Lakes extended well into the normal navigation season, and that many of the deaths in previous Great Lakes casualties were undoubtedly due to the effects of hypothermia. The exposure suit that was gaining wide acceptance among commercial fishermen at this same time appeared to be one very good way to deal with the hypothermia problem.

On April 10, 1980, the Coast Guard published regulations that required exposure suits on large commercial vessels on the Great Lakes (45 FR 24478). On February 3, 1983, just 11 days before the MARINE ELECTRIC tragedy, the Coast Guard proposed regulations to require most large oceangoing cargo vessels, tank vessels, oceanographic vessels, and mobile offshore drilling units to carry the suits for everyone on board (48 FR 4837). The final regulations requiring carriage of exposure suits on these vessels were published on February 7, 1984 (49 FR 4479), and became effective August 6, 1984.

The exposure suit regulations that went into effect on August 6, 1984, paralleled the 1983 Amendments to the 1974 Safety of Life at Sea Convention (SOLAS) in many respects. (SOLAS is an international treaty that originated with the TITANIC disaster, and all major maritime nations are signatories.) The rules require exposure suits for all persons on board oceangoing cargo vessels, tank vessels, oceanographic vessels, and mobile offshore drilling units, and in addition require spare suits for persons on duty in work stations remote from the berthing area where the suits are normally stowed.

Under the regulations, vessels operating exclusively in warm water areas, defined in the regulations as those latitudes between 35° N and 35° S, would not have to carry exposure suits. In this area, water temperature is generally greater than 60^{0}F (15.5^{0}C). The 35° N demarkation line in the U.S. is near Cape Hatteras on the East Coast, and about 40 miles north of the Santa Barbara Channel, near Santa Maria, CA on the West Coast. The exempted area also includes the entire Gulf of Mexico.

Another exemption was provided for vessels with totally enclosed lifeboats with fast and efficient launching devices. The totally enclosed lifeboat arrangement reduces the probability that the crew will find themselves in the water before they have a chance to launch the boat. Once in the water, the boat's enclosure provides protection from hypothermia. One of the purposes of the exemption for vessels with totally enclosed lifeboats was to provide an incentive for shipowners to fit these lifeboats and launching systems, which are superior to presently required systems.

REGULATORY HISTORY

On June 9, 1983, Senators Trible and Stevens introduced S.1441, a bill “to require certain safety equipment on vessels and mobile offshore drilling units, and for other purposes.” The major effects of this bill would have been to remove the totally enclosed lifeboat exemption from the Coast Guard rules (still proposed rules at that time), and also to base the warm water exemption on a strict 6O° F water temperature criterion, rather than use 60° F only as a guideline.

The major provisions of S.1441 evolved into Sec. 22 of the Coast Guard Authorization Act of 1984 (P.L. 98-557) which in effect directed the Coast Guard to remove the totally enclosed lifeboat exemption from the rules, and to revise the 35° latitude warm water exemption lines to 32° in the Atlantic Ocean. It also directed the Coast Guard to report to Congress on the effect of changing the warm water exemption line to 31° world-wide. The Coast Guard was to make final regulations effective not later than 60 days after enactment and was to report to Congress not later than 6 months after enactment. President Reagan signed the bill October 30, 1984. The Coast Guard made the revisions to the regulations which were effective December 30, 1984 (49 FR 50722). This report fulfills the requirement for the report to Congress.

SURVIVAL TIME IN COLD WATER

Survival time is the key factor that must be considered in determining what waters should be included in an area where exposure suits should be required. Unfortunately, survival time can not be accurately predicted. Figure 1 appears in the National Search and Rescue Manual used by the Coast Guard, Navy, Army, and Air Force. This figure attempts to define the probability of survival for a certain period of time, as a function of water temperature. Although this figure is probably accurate for a narrow range of human subjects, it will vary widely based on a number of factors. Larger persons can be expected to survive longer than smaller persons. Persons in good physical condition will survive longer than those who are injured or have certain medical problems. Rough water will make survival more difficult than under calm conditions, and the individual's swimming ability, mental state, the amount of daylight or darkness may all affect survival chances.

A Coast Guard approved exposure suit should extend an individual's cold water survival time by a factor of about seven as compared to survival time in normal work clothes and a life preserver. This figure is subject to a number of complicating factors, but the research data available in several of the reports listed in Appendix I indicate that the factor of seven is reasonable. It must be remembered that the exposure suit may not be significantly better, and may even be worse than a life preserver in preventing drownings in situations where cold water is not the major hazard. Unlike a life preserver, an exposure suit will not automatically turn a helpless wearer face-up in the water.

In order to completely analyze the effects of moving the warm water exemption boundary to 31°, the validity of the 60° F water temperature guideline should be investigated. In order to do that, the Coast Guard surveyed available marine casualty reports for casualties that involved persons in the water between 5O° F and 7O° F, without flotation, or with a flotation device that was not an exposure suit. The casualties meeting the criteria and used for this purpose are listed in Appendix II. This survey was complicated by the following factors:

a. When bodies are recovered, the precise time of death is not or can not be determined.

b. Frequently, some persons are never found, and the reason for death can not be determined.

c. Other factors beside water temperature are often involved, including heavy seas, darkness, and personal injury.

d. Some casualty reports that might be of interest can not be used because some important factor was not recorded, such as sea water temperature, or the length of time persons were in the water.

Nevertheless, figures 2 and 3 were prepared using the available data. These figures represent the 50° F to 70° F portion of figure 1, with the number of hours extended to 12 and over. Figure 2 shows survivors including those with reportable injuries and figure 3 shows deaths. Figures 2 and 3 indicate that figure 1, despite its limitations, is probably a fairly good representation of survival time in the temperature range of interest and can be used for the purposes of this analysis.

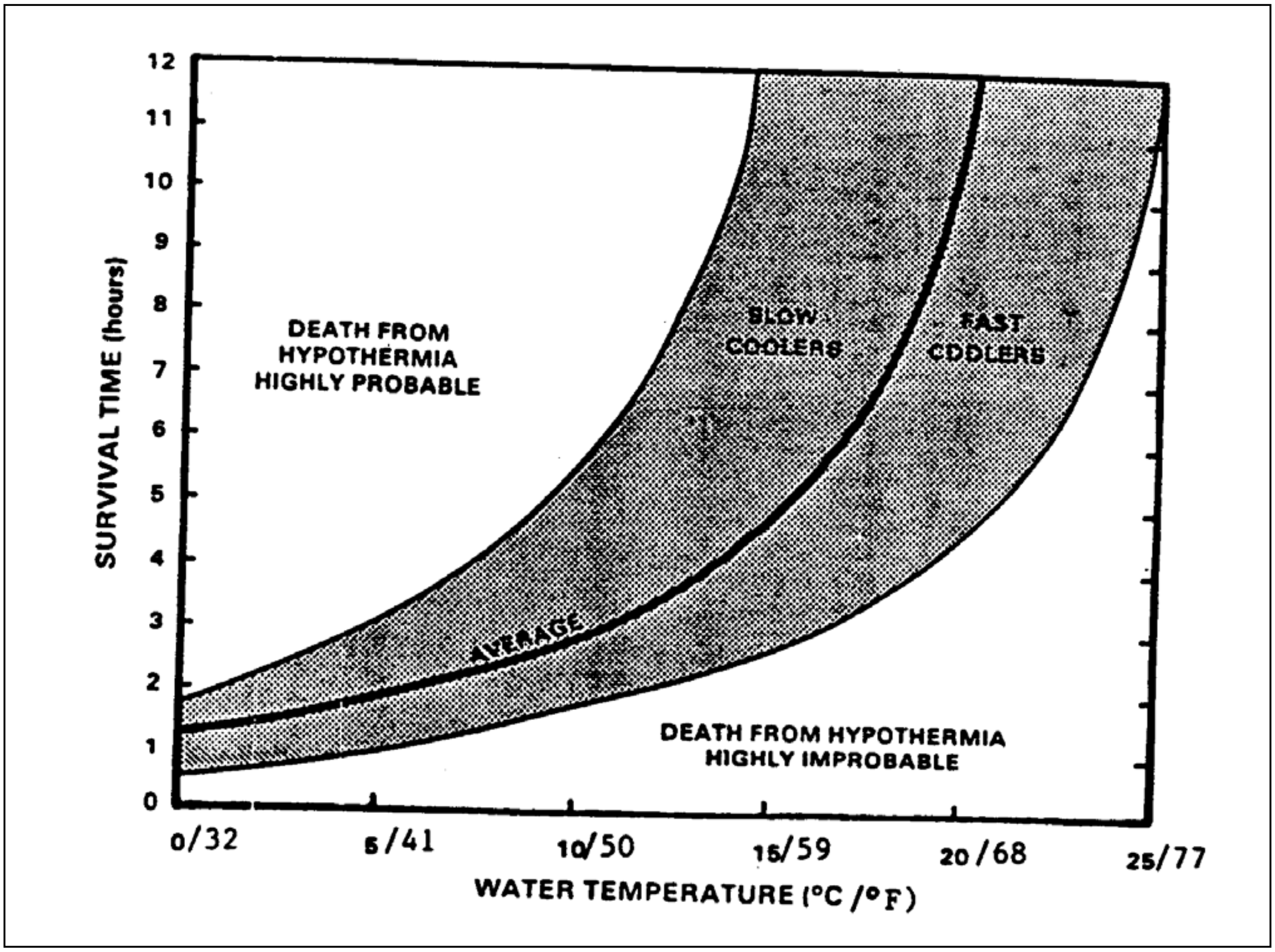

Figure 1. Effects of water immersion hypothermia on unprotected subjects.

FIGURE 2 IS UNAVAILABLE

Figure 2. Immersion Times of Unprotected Survivors of Selected Casualties (Points connected by a line indicate exact time unknown, but falls within indicated range. Number above each point represents number of persons.)

FIGURE 3 IS UNAVAILABLE

Figure 3. Immersion Times of Unprotected Decedents of Selected Casualties (Points connected by a line indicate exact time unknown, but falls within indicated range. Number above each point represents number of persons.)

Figures 2 and 3 also show that, with one exception, all of the casualties involved water temperatures of less than 57° F. That exception was the F/V FENWICK ISLAND which sank in 63° F water at night and in heavy seas. Seven of the 14 persons aboard died. One of the casualties was recovered within an hour, and the other six were recovered between two and ten hours after the accident. As an uninspected fishing vessel, the FENWICK ISLAND was not required to have any lifeboats or liferafts aboard.[1] The only lifesaving devices on board were the life preservers. Had these persons been wearing exposure suits, they may still have drowned under the heavy sea conditions and disorientation brought about by darkness and panic.

Figure 1 shows that 60° F water is “safe” for an unprotected person for just under 2 hours. The 50% rate of survival is estimated to be at least 4.5 hours. Therefore, water at 60° F should provide the unprotected survivor in the water with enough time to make it to a lifeboat or liferaft floating in the area. If no lifeboat or liferaft is in the area, it also provides some time for rescue to arrive.

The conclusion is that 60° F criterion is not risk-free, but is appropriate for inspected commercial vessels that are equipped with lifeboats and life-rafts. Two to three degrees variation below this figure is not unacceptable given the minimal change in survival time predicted by figure 1 for this temperature variation, and the uncertainty associated with the figure.

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[1] 46 U.S.C. 4102(b) requires only “one readily accessible life preserver or other lifesaving device, of the type prescribed by regulation, for each individual on board”.

EFFECT OF REVISING WARM WATER EXEMPTION LATITUDES

In Congressional hearings and in comments contained in the docket leading to the February 1984 final rule, there was much discussion about the water temperature at which exposure suits should be required, and where, geographically, that temperature was likely to occur. There was general consensus that temperatures of 60°F or below should be the criterion for requiring exposure suits, but experts disagreed as to where temperatures this low would occur for a significant portion of the year. This is not surprising, since the science of predictive oceanography is based on probability analysis of very sketchy data culled from a variety of sources, some of questionable accuracy.

The 35° N and 35° S boundary lines correlate remarkably well with the 60° F isotherms (lines of equal water temperature) in the open ocean, using the best sources available. It is only near shore that the isotherms begin to behave erratically. In the North Atlantic, for example, the influence of the Gulf Stream pushes a finger of the 68° F isotherm as far north as 37° N in January, but a countercurrent inshore of the Gulf Stream causes cold water to flow south parallel to the coast, pulling the 60° F isotherm all the way down to 33° N at its intersection with the coast. However, the closer to shore a casualty occurs, the sooner rescue forces can reach the scene, and the less time a victim will spend immersed in the cold water. The isotherms along the coasts of North and South Carolina and Georgia are virtually parallel to the shoreline, and so close together that the water temperature increases l° F for each additional 7-8 miles distance from the coast, out to about 80 miles. Furthermore, January is the only month in which any portion of the 60° F isotherm dips below 35° N latitude in the North Atlantic.

In the North Pacific, cold water reaches somewhat further south in winter than in the Atlantic. The 60° F isotherm swings as low as 33° N in mid-ocean in January, the only time of year it moves that far south. Near Japan, Korea, and the China Sea, there is a similar, though not as pronounced, irregularity to that on the East Coast of the U. S. The near shore isotherms close to the Asian continent dip below the 35th parallel during five months of the year. More significant is a larger, “U” shaped dip in the isotherm off the coast of California. Because the isotherms there are not closely spaced lines parallel to the shore as they are in the Atlantic, it is actually more dangerous to operate without exposure suits 100 miles off the coast of southern California in January than at an equal distance off the coast of North Carolina.

In the southern hemisphere the seasons are reversed. July and August are the most dangerous winter months, yet even during these months the 60° F isotherm does not move north of the 35° S parallel of latitude in the open ocean between South America and Australia. As in the northern hemisphere, there are convolutions of the isotherms near shore, but in August, the 60° F isotherm intersects the west coast of South America as far north as 13° South. Yet the isotherm runs almost due south, parallel to the coast, all the way down to 35° S latitude before swinging sharply out to sea. West of Australia, the 60° F isotherm swings north of 35° S latitude from June through October, but only by about 5° and in an area not traversed by many U. S. vessels in normal trade. Then the isotherm returns to the 35th parallel and follows it to the East Coast of Africa. Near the coast of Africa the isotherm swings northward.

In the South Atlantic, the 35° S latitude line is again an accurate approximation of the 60° F isotherm in the open ocean in winter. The isotherm turns sharply north before intersecting the west coast of Africa, behaving much like it does in the Pacific with respect to the West Coast of South America. It also swings slightly north as it intersects the East Coast of South America.

In summary, the 35th parallel of latitude is an accurate approximation of the 60° F. isotherm in winter in both the northern and southern hemispheres in the open ocean.

The final regulatory analysis prepared for the Coast Guard regulations is in Appendix III. It discusses several alternatives including a fixed geographic boundary, a constantly changing boundary based on actual water temperature at the time, and a seasonal boundary similar to that used in the load line regulations. In the end, it appeared that a single year-round geographic boundary was the most practical. That boundary was set at 35° N and 35° S latitudes, based on the best information available to us on water temperatures during the coldest months of the year in each hemisphere.

Appendix IV contains maps of the East and West Coasts of the U. S., showing the location of the 31°, 32°, and 35° N parallels of latitude to place the existing and proposed boundaries into perspective. Also included is a reduced copy of a U. S. Navy Hydrographic Office Sea Surface Temperature Chart for the Eastern Pacific Ocean in February. This chart was selected for inclusion because it shows the isotherms in the Atlantic and Pacific Oceans during the coldest month of the year in the northern hemisphere. The atlas containing this chart is large and does not reproduce well when reduced to 8 1/2 x 11 inch size, but is available in the DOT Library for reference.

Tables 1 and 2 summarize the water temperatures and estimated survival times for an unprotected person in the coastal waters of the United States in the months of coldest water temperature. The coastal areas are where the greatest variation from the 60° F criterion occurs. For both the Atlantic coast and the Pacific coast, the figures are for 35° N, which is the “world-wide” warm water exemption line used in the Coast Guard regulations published in February 1984, 32° N which is the latitude in the Atlantic Ocean mandated in the 1984 Authorization Act, and 3l° N which is the latitude required to be analyzed in this report.

The reliability of the water temperature data used in tables 1 and 2 needs to be considered. The sources of the data do not include any information on how the temperatures may vary. In order to get some idea as to what kind of variations may occur, the water temperature reported in six of the casualties listed in Appendix II was compared to the average temperature from the atlases. (The seventh casualty in the appendix occurred on a sound which was not covered in the atlas.) Four of the actual temperatures were 1° F below the average temperature in the atlas. One was 5° F below the atlas temperature, and the sixth was 8° F below the atlas temperature. All of these casualties were in coastal waters where the greatest variability would be expected. This information is not sufficient to make a general statement as to the reliability of the data, but it is clear that significant differences can occur.

U. S. Atlantic Coast
35° N, January

Miles from Shore	Mean Low Water Temperature	Unprotected "Safe" Time	Unprotected 50% Survival Time
Shoreline	59° F	1.7 hr.	4.0 hr.
25	60° F	1.8 hr.	4.6 hr.
50	64° F	2.8 hr.	6 + hr.
100	66° F	4.4 hr.	6 + hr.
200	69° F	6 + hr.	6 + hr.
500	68° F	6 + hr.	6 + hr.
1000	66° F	4.4 hr.	6 + hr.

U. S. Atlantic Coast
32° N, February

Miles from Shore	Mean Low Water Temperature	Unprotected "Safe" Time	Unprotected 50% Survival Time
Shoreline	61° F	2.0 hr.	5.0 hr.
25	62° F	2.2 hr.	6.0 hr.
50	63° F	2.5 hr.	6 + hr.
100	65° F	3.6 hr.	6 + hr.
200	7l° F	6 + hr.	6 + hr.
500	7l° F	6 + hr.	6 + hr.
1000	68° F	6 + hr.	6 + hr.

U. S. Atlantic Coast
31° N, February

Miles from Shore	Mean Low Water Temperature	Unprotected "Safe" Time	Unprotected 50% Survival Time
Shoreline	62° F	2.2 hr.	6.0 hr.
25	63° F	2.5 hr.	6 + hr.
50	64° F	2.8 hr.	6 + hr.
100	68° F	6 + hr.	6 + hr.
200	72° F	6 + hr.	6 + hr.
500	70° F	6 + hr.	6 + hr.
1000	68° F	6 + hr.	6 + hr.

Table 1. Water temperatures and survival times on Atlantic Coast in months of coldest water.
(Source: Oceanographic Atlas of the North Atlantic Ocean; U.S. Naval Oceanographic Office Pub. No. 700, 1967.)

U. S. Pacific Coast 35° N, February

Miles from Shore	Mean Low Water Temperature	Unprotected "Safe" Time	Unprotected 50% Survival Time
Shoreline	57° F	1.4 hr.	3.5 hr.
25	57° F	1.4 hr.	3.5 hr.
50	57° F	1.4 hr.	3.5 hr.
100	57° F	1.4 hr.	3.5 hr.
200	57° F	1.4 hr.	3.5 hr.
500	59° F	1.7 hr.	4.0 hr.
1000	61° F	2.0 hr.	5.0 hr.

U. S. Pacific Coast
32° N, February

Miles from Shore	Mean Low Water Temperature	Unprotected "Safe" Time	Unprotected 50% Survival Time
Shoreline	60° F	1.8 hr.	4.6 hr.
25	60° F	1.8 hr.	4.6 hr.
50	60° F	1.8 hr.	4.6 hr.
100	60° F	1.8 hr.	4.6 hr.
200	59° F	1.7 hr.	4.0 hr.
500	60° F	1.8 hr.	4.6 hr.
1000	63° F	2.5 hr.	6 + hr.

U. S. Pacific Coast
31° N, February

Miles from Shore	Mean Low Water Temperature	Unprotected "Safe" Time	Unprotected 50% Survival Time
Shoreline	61° F	2.0 hr.	5.0 hr.
25	61° F	2.0 hr.	5.0 hr.
50	61° F	2.0 hr.	5.0 hr.
100	61° F	2.0 hr.	5.0 hr.
200	61° F	2.0 hr.	5.0 hr.
500	61° F	2.0 hr.	5.0 hr.
1000	64° F	2.8 hr.	6 + hr.

Table 2. Water temperatures and survival times
on Pacific Coast in months of coldest water.
(Source: World Ocean Atlas, vol. 1, Pacific Ocean; Pergamon Press.) 17

ANALYSIS

Facts and Observations

The temperatures discussed throughout this report are average monthly temperatures and will vary from year to year. The extent of this variation is not known, but is expected to be greater in coastal areas.

Although the coastal water temperature variations are greater along some other continents than they are on the North American coasts, these do not need to be taken into account in determining the appropriate warm water exemption line, since few, if any, U.S. vessels not equipped for unlimited ocean service will operate in these waters.

35° Latitude Limit

The 35° N latitude line falls about halfway between Cape Hatteras, NC and Cape Lookout, NC on the East Coast of the United States, and about 40 miles north of the Santa Barbara Channel, near Santa Maria, CA on the West Coast (See maps in Appendix IV).

On the West Coast of the United States, average water temperatures at 31° N and 35° N in the coldest months of the year differ by 3° F to 4° F from the shoreline all the way out to 1000 miles.

On the East Coast of the United States, the average water temperature at 35 ° N in the coldest month (January) meets or exceeds the 60° F criterion except at the shoreline where the average temperature is 59° F. Water temperature near shore drops rapidly north of 35° N and Cape Hatteras as the Gulf Stream moves further offshore.

The 35° N and 35° S warm water latitude exemption lines in the Coast Guard’s final rules of February 7, 1984, correlate well with the 60° F average water temperature line in the open ocean for the coldest months of the year. Colder waters are found in all coastal areas, however.

On the West Coast of the United States, the average water temperature at 35° N in the coldest month (February) is 57° F from the shoreline to 200 miles offshore. It rises above 60° F between 500 and 1000 miles from shore.

32° Latitude Limit

The 32° N latitude line falls just south of Savannah, GA on the East Coast, and includes the entire West Coast of the continental United States, lying just north of Ensenada, Mexico (See maps in Appendix IV). Some of the ports and places inaccessible to vessels without exposure suits, under the 32° latitude boundary in the Atlantic mandated by section 22 of the Coast Guard Authorization Act of 1984 and published as a Final Rule in the Federal Register of December 31, 1984, include:

a. Charleston, SC.
b. Savannah, GA.
c. Bermuda.
d. Casablanca, Morocco.

e. Montevideo, Uruguay.
f. Buenos Aires, Argentina.
g. Cape Town, South Africa.

Some of the ports and places which would become inaccessible to vessels without exposure suits on board if the 32° latitude boundary were extended to all waters are:

a. Santa Barbara, CA.
b. Los Angeles/Long Beach, CA.
c. San Diego, CA.
d. Santiago, Chile.
e. Valparaiso, Chile.
f. Osaka, Japan.
g. Kobe, Japan.
h. Sydney, Australia.
i. Port Elizabeth, South Africa.

On the West Coast of the United States, the average water temperature at 32° N in the coldest month (February) meets or exceeds the 60° F criterion except at 200 miles offshore where the average temperature is 59° F.

There are few, if any, vessels operating on the East Coast of the United States that have their northernmost port of call between 31° N and 32° N (only significant port is Brunswick, GA). There are presently no offshore oil operations in this area.

3l° Latitude Limit

The 3l° N latitude line falls about 12 miles south of Brunswick, GA on the East Coast, and includes the entire West Coast of the continental United States (See maps in Appendix IV). In addition to those impacted by extending the 32° latitude boundary to all waters as listed above, the following ports and places would become inaccessible to vessels without exposure suits, under the proposed 31° latitude boundary in all waters:

a. Brunswick, GA
b. Ensenada, Mexico.
c. Shanghai, China.
d. Alexandria, Egypt
e. Tel Aviv, Israel
f. Perth, Australia

On the West Coast of the United States, average water temperatures at 3l° N and 35° N in the coldest months of the year differ by 3° F to 4° F from the shoreline all the way out to 1000 miles.

On the West Coast of the United States, the average water temperature at 31° N in the coldest month (February) is 61° F from the shoreline to 500 miles offshore where it begins to rise.

Benefits of a 31° latitude warm water exemption line

The inconsistency of the requirements between the U. S. East and West Coasts will be eliminated. Inconsistent regulations can sometimes be justified in the interest of safety where more hazardous conditions exist in one geographic area, but in this case the existing regulations are not so justified and are unnecessarily complex and confusing to the public. The Pacific Ocean is not warmer, at the same latitudes, than the Atlantic. On the contrary, the coastal water temperatures in February are lower on the West Coast even at 31° N than the temperatures at 32° N on the East Coast, yet the warm water exemption line is currently 35°N on the West Coast and 32° N on the East Coast.

An incrementally small number of additional lives may be saved. The Coast Guard cannot predict, with any degree of certainty, how many lives, if any, might be saved by this change.

The coastal area off southern California will be covered where average February water temperatures can be as low as 57° F.

Portions of the coastal areas on the West Coasts of South America and Africa, and on the East Coast of Asia will be more adequately covered, even though U.S. vessels operating in these waters would probably be equipped with exposure suits anyway.

An exemption line at either 31° or 32° would provide a margin for error and variation of the actual water temperatures compared with the monthly average temperatures that were used to establish the 35° line.

<u>Disadvantages of a 3l° latitude warm water exemption line</u>

Large areas of relatively warm water in the open ocean will be covered. The isotherm that best matches 31° latitude in the coldest months is approximately 65° F. On the East Coast of the United States, average water temperatures between 3l° N and 35°N in the coldest months of the year vary insignificantly beyond 50 miles from shore. In fact, some temperatures at 32° N and 35°N are the same as or higher than those at 31° N.

There are approximately seven mobile offshore drilling units operating in the Santa Barbara Channel off the coast of California. These units and the offshore supply vessels that service them are the vessels that would be most directly affected by a change to a 31° latitude line. Although the exact number of other vessels that might be affected is unknown, there are probably very few that have their northernmost port of call between 31° N and 35°N. Approximately 1,500 exposure suits would have to be purchased to comply with the change. The total cost would be about $350,000.

U.S. registered supply vessels servicing drill rigs in the Persian Gulf and the Red Sea would not be allowed to transit the Suez Canal and Mediterranean Sea to Alexandria, Egypt without placing exposure suits on board.

RECOMMENDATION

The 32° latitude boundary now in effect in the Atlantic Ocean should be made applicable to all oceans, worldwide.

The **32°** latitude line is the one that corresponds best with the near-shore 60° F average temperature isotherm on the West Coast of North America in the coldest month of the year.

On the U.S. East Coast at the 32° latitude line, average water temperatures exceed the 60° F guideline temperature in the coldest months of the year.

Since the entire U.S. west coast lies north of both the 31° N and 32° N lines, a 32° latitude warm water exemption line would have the same effect as 3l° there.

A change from 32° N to 31° N on the Atlantic Coast would only affect vessels whose northernmost port is Brunswick, GA. There are few, if any, such vessels.

A 32° latitude limit world-wide would avoid the problem involved with offshore supply vessels transiting the Suez Canal between the Red Sea and Alexandria, Egypt. These vessels are probably the only ones that would be affected by a 31° latitude limit, but not a 32° latitude limit. They use a route that lies between 31° N and 32° N in the Mediterranian Sea, but the coldest average monthly water temperature in this region does not go below 61° F.

The Coast Guard estimates the cost of providing exposure suits on board the affected mobile offshore drilling units off Santa Barbara, CA at $350,000.00. This is a relatively low cost to offset the uncertainty associated with the benefits of exposure suits between 35° N and 32° N latitude, and to provide a margin of safety for variations in average water temperature.

Studies relating to exposure protection and the effects of hypothermia

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Casualties used to develop figures 2 and 3

1. H/V SAN MATEO, February 16, 1983.

2. M/V JOAN LaRIE III, October 24, 1982.

3. M/V PEARL C, September 13, 1976.

4. P/C KAREN I, August 16, 1972.

5. P/C BOUNDING MAIN, August 16, 1972.

6. M/V MARYLAND, December 18, 1971.

7. F/V FENWICK ISLAND, December 7, 1968.