A MARINE VIEW OF FIRE PROTECTION

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Introduction

Ships have often been likened to long horizontal buildings with no unusual problems in protecting them from fire. While this may be true in many respects, abandoning a ship in case of fire is much different than exiting from a burning building.

The external environment (the sea) can be quite hostile so it is necessary to make the ship its own best lifeboat. And it must of necessity be completely capable of meeting any fire emergency without outside assistance. This is accomplished by passive and active fire protection in a multi-stage effort. The passive system involves structural fire protection such as insulation, fire divi-sions, etc. The active system includes portables, fixed extinguishing systems, fire main, etc.

Structural Fire Protection

A strong premise behind Coast Guard structural fire protection requirements is total noncombustibility so that a fire is contained within the space in which it began. The basic principles underlying fire protection requirements for merchant vessels are:

- Division into main vertical zones by thermal and structural boundaries (passenger ships only).
- Separation of accommodation spaces by thermal and structural boundaries.
- Restricted use of combustible materials.
- Detection of any fire in the zone of origin.
- Containment and extinction of any fire in the space of origin.
- Protection of escape routes or access for fire fighting.
- Ready availability of fire extinguishing appliances.

ABSTRACT

There are many similarities in principles and approaches between "land based" and "marine" fire protection; however, there are also many items unique to the marine field. This report will attempt to set forth the similarities as well as point out the differences. In addition, some general interest information on marine fire protection will be conveyed.
Minimizing possibility of flammable cargo vapor ignition (tank vessels mainly).

From a fire protection point of view, the ship is divided into 3 main areas:

- Accommodation and service areas (hotel spaces).
- Machinery spaces.
- Cargo areas.

History

The development of current vessel regulations can be traced to casualties in the early twentieth century. As a result of the sinking of the TITANIC in 1912, an International Conference for the Safety of Life at Sea was held in London in 1914. The recommendations of the Conference included nothing about fire protection. The Convention's provisions were never implemented because of the onset of WWI.

A 1929 Convention contained only one small requirement on fire protection, i.e., the fitting of fire-resisting bulkheads above the weather deck. This was the inception of the main vertical zone (MVZ) the purpose of which was to confine the outbreak of fire into zones of not more than 40 m in length. Bulkheads were required to be "constructed of metal or other fire-resisting materials effective to prevent for one hour, under the conditions for which the bulkheads are to be fitted in the ship, the spread of fire generating a temperature of 1500°F at the bulkhead."

The 1929 Convention was ratified by the United States in 1936. Impetus for ratification as well as development of structural fire protection requirements, came in 1934 when the MORRO CASTLE burned with a loss of 124 lives. The Senate Committee on Commerce convened a special subcommittee to develop recommendations for life safety on U.S. vessels. The subcommittee on Fireproofing and Fire Prevention noted "past experience having demonstrated the vulnerability of complex automatic and manually controlled systems of detection and extinction, ...the most foolproof solution to the problem would be construction of such a nature that it would confine a fire to the enclosure to which it originated."

The 1929 Convention required "fire-resisting bulkheads," however, there was no precise definition or standard test for these bulkheads. The Subcommittee conducted a series of full-scale shipboard fire tests to evaluate various methods of construction. The one configuration that stood out was steel plate with asbestos composite panels as recommended by the Marine Section of the NFPA. In addition the Marine Section recommended as a standard fire test the laboratory fire-endurance test of the National Bureau of Standards, which is now ASTM E-119. Using 5 lb. per sq. ft. (representing bedding, clothing, etc.) fire loading, the temperatures recorded aboard ship were very similar to those measured in the laboratory.

As a result, the U.S. Congress was able to ratify the 1929 Safety of Life at Sea Convention. In addition, the U.S. Code was amended to require "fire-retardant material for construction so far as is reasonable and practicable."

In 1940, specific requirements were created for insulated bulkheads:

- Class A-1, of steel with sufficient noncombustible insulation to prevent the average temperature on the unprotected side from rising more than 250°F or any single point temperature from rising more than 325°F in one hour in the standard fire test.

- Class A, of steel and able to withstand the fire test for one hour with no temperature limitations.
Class B, of noncombustible materials capable of withstanding the fire test for 30 min. and the aforementioned temperature rise for 15 min.

In 1949 a specific test for noncombustibility was developed and adopted by the Coast Guard. The test specification, 46 CFR 164.009, was based upon research conducted at the National Bureau of Standards by N. P. Setchkin and S. H. Ingberg.

Some stateroom fire tests were conducted in 1947 using aluminum in lieu of steel. These tests verified that a full-scale test is capable of generating the same temperatures as the laboratory test furnace. In addition these tests proved that uninsulated aluminum does not provide the same degree of fire protection as asbestos composition panels.

A third international conference on Safety of Life at Sea was held in 1948. The U. S. was not successful in selling the method of fire protection contained in 46 CFR as the sole method of protection. As a result, three separate methods of construction appear in the 1948 SOLAS:

Method I. Internal divisional bulkheading of 'B' Class divisions generally without the installation of a detection or sprinkler system in the accommodation and service spaces.

Method II. An automatic sprinkler and fire alarm system for the detection and extinction of fire in all spaces in which a fire might be expected to originate, generally with no restriction on the type of internal division bulkheading in spaces so protected.

Method III. Subdivision within each main vertical zone using 'A' & 'B' Class divisions distributed according to the importance, size and nature of the various compartments, with an automatic fire detection system in all spaces in which a fire might be expected to originate, and with restricted use of combustible and highly flammable materials and furnishings; but generally without the installation of a sprinkler system.


Definitions

'A' Class divisions are bulkheads or decks constructed of steel or equivalent metal, suitably stiffened and made intact with the main structure of the vessel. 'A' Class divisions are capable of preventing the passage of flame and smoke for one hour, and may include approved insulations, bulkhead panels, or deck coverings to limit the transfer of heat through the division.

Approved materials are those which meet the criteria set forth in the following Coast Guard regulations:

- Structural insulations - 46 CFR 164.007.
- Bulkhead panels - 46 CFR 164.008.

'B' Class divisions are constructed of noncombustible materials and made intact from deck to deck (or to a continuous 'B' Class ceiling) and to the vessel's shell or other boundaries. They
are required to prevent the passage of flame, but not smoke, for 30 min.

'C' Class divisions are constructed of approved noncombustible materials which meet no requirement relative to the passage of flame nor the limiting of temperature rise.

Noncombustible material is any material approved by the Coast Guard as having successfully passed the noncombustibility test in 46 CFR 164.009.

An interior finish is any coating or veneer applied to an approved bulkhead, noncombustible material, or structural insulation on a bulkhead or ceiling. This includes the visible finish, all intermediate materials, and all application materials such as adhesives. Within hidden spaces of accommodation and service areas and within stairwells this material is required to have a flame spread classification of 20 or less and smoke classification of 10 or less.

A "standard fire test" is one in which a specimen is exposed in a test furnace to temperatures corresponding to the standard time-temperature curve. The specimen resembles, as closely as possible the intended construction and includes, where appropriate, at least one joint. The time-temperature curve is a smooth curve drawn through the following points, starting at ambient temperature:

- At the end of 5 min. - 538°C (1000°F).
- At the end of 10 min. - 704°C (1300°F).
- At the end of 30 min. - 843°C (1550°F).
- At the end of 60 min. - 927°C (1700°F).

**General**

The type of fire fighting system varies with the nature of the hazard. Because of the passive fire protection provided, a nominal fire fighting system for the accommodation and services areas consists of a fire main system and portable fire extinguishers.

In machinery areas the approved systems include carbon dioxide, halogenated hydrocarbon and high expansion foam. The carbon dioxide system is a "total flooding" type with 85 percent of the quantity being required to be discharged within 2 min. The halon system (only Halon 1301 accepted) utilizes a 6 percent concentration with total discharge within 10 sec. High expansion foams, although none have been approved to date, would require foam at a fill rate of 1 m per min.

For the cargo areas, the hazard determines the system required. For example, CO₂ would be required for the hold of a general cargo ship. For a cargo hold specifically designated to carry vehicles a total flooding CO₂ system (100 percent in 2 min.) or Halon 1301 would be required. The use of Halon 1301 would be limited to those spaces to which passengers have no access and in which the vehicles carry no cargo. If the space is such that it cannot be made tight (an openended ferry vessel) a manually operated sprinkler system would be required.

**Firefighting Systems**

Fixed extinguishing equipment is not a substitute for required structural fire protection. Structural fire protection protects passengers, crew and essential equipment from the effects of fire long enough to permit escape to a safe location. Fire fighting equipment, on the other hand, is for the protection of the vessel. Requirements for structural fire protection vary with the type of vessel and are the most detailed for passenger vessels. However, approved fixed
extinguishing systems are generally independent of the vessel's type.

Fire extinguishing systems should be reliable and capable of being placed into service in simple, logical steps. The more sophisticated the system is; the more essential that the equipment be properly designed and installed. Improper design or installation can lead to a false sense of security and can be as dangerous as no installation. However, potential casualties and uses should be considered, especially as related to the isolation of equipment, controls, and required power from possible disruption.

On tank vessels there are basically two systems required. One, an inert gas system (IGS), is not considered a fire fighting system, but rather an explosion prevention system. The IGS requires the capability of producing inert gas with an oxygen concentration of 5 percent or less with a resultant maximum of 8 percent oxygen level in the cargo tanks. In addition to the IGS, a deck foam system is required. If polar solvents (alcohol, ether, etc.) are carried a polar solvent foam is required. The design rate is different than that prescribed by regular foam systems and varies with the products carried. The specific details with regards to marine firefighting systems are found in 46 CFR and a good explanation is found in NVIC 6-72 including Change I.

Automated vessels, having fewer available fire fighters, require special design considerations. Control of all systems or functions for protection of the machinery area should be centralized in a single accessible location outside the machinery casing. This station should be able to control the fixed fire extinguishing system, the ventilation, fuel pumps and fuel tank valves, the remote fire pump, and the bilge system.

Fire Main Systems

The fire main system is the backbone of all fire-fighting systems on a ship. It must be capable of quickly delivering an adequate supply of water to any portion of the vessel for combatting fires. Coast Guard regulations specify fire pump capacity, pipe sizes, hydrant locations, hose lengths, etc., usually based upon a performance specification of the final installation. Pumps are required to supply at least 2 hose streams at either 50 or 75 psi, depending on the vessel type.

Fire pumps may be used for purposes other than supplying the fire main provided one of the required pumps is kept available at all times. "Available for use" means that any or all of the required pumps may be used for non-vital services provided that control valves for the other services are at a manifold adjacent to the pump, so that in the event of fire any other service may be shut off as the valve to the fire main is opened.

Connections to the fire main for low water-demand services in the forward portion of the vessel (such as anchor wash, forepeak eductor, or chain locker eductor) have frequently been permitted. In such cases, each fire pump must be capable of meeting the hose stream requirements with these other-service connections open. The specific purposes for which use of the fire main is permitted by regulation, i.e. deck wash and tank cleaning, have one important factor in common: someone knows that the system is in use and is usually in attendance. Such usage should not be left unattended.

Fire Fighting

Sizing the fire pumps depends on what other system is installed and where it connects to the fire main system. If fire pumps are used for other fire-fighting systems, they must be sized as follows:

Foam System: When the foam system is connected at the fire pump manifold, one fire pump may supply the foam main and
one pump the fire main. When the foam is connected to the fire main at other than the fire pump manifold, one pump must meet the requirements of both systems simultaneously.

Sprinkler System: Regardless of where connected, combined capacity of all fire pumps must be capable of supplying the sprinkler system while meeting hose stream requirements. Great care must be taken when arranging more than one fire pump to discharge into a single fire main. Unless the pump curves are identical, each pump will not discharge at its rated capacity.

Water Spray: A pump room fire may reach 2000°F within 5 min. so a water spray system must operate rapidly. A pump must be reserved exclusively for the spray system or one of the required pumps increased by the capacity of the spray system. On tankers, the water spray system connection may be at the fire pump manifold if operation of the system does not interfere with simultaneous use of the fire main.

Carbon Dioxide: Carbon dioxide has many desirable properties. It will not damage cargo or machinery and leaves no residue to be cleaned up after a fire. Even if the ship is without power, a charged CO₂ system can be released. Since it is a gas, CO₂ will penetrate and spread to all parts of the space. It does not conduct electricity and therefore can be used on live electrical equipment. It can be effectively used on most combustible materials.

There are disadvantages to carbon dioxide. It has little cooling effect on materials that have been heated by the fire and the quantity available in a system is limited.

The CO₂ concentration must be maintained long enough to reduce the temperature below the autoignition point of the burning material. Carbon dioxide is most effective against flammable liquid fires. For most flammable liquids, reduction of the oxygen concentration to 15 percent (from the normal 21 percent) will be sufficient to extinguish the fire. In enclosed spaces, Class A combustible (wood, paper, etc.) fires may not be completely extinguished but may be controlled.

Depending on the hazardous material involved, there are two systems for protection with carbon dioxide: cargo and total flooding systems.

Cargo System: Fires in Class A combustibles in cargo holds generally start with some smoldering and production of large quantities of smoke. Only when sufficient heat is developed to reach the "flash over" temperature will rapid burning occur. Until this time the rate of burning is relatively slow. The correct technique with a cargo system is to seal all openings and manually release an initial charge of CO₂ sufficient to bring the fire under control. Additional CO₂ is released from time to time to maintain the concentration. The initial quantity release and follow-up release information are contained in an approved instruction book which is carried on the vessel. Extinguishment of a deep-seated Class A type fire with carbon dioxide is difficult due to the thermal insulating properties of the material. Therefore, the hold is kept closed until the vessel reaches a port where the hold can be opened, cargo removed, and final extinguishment accomplished. Usually this involves removing cargo not involved in the fire while retaining an inert blanket on the portion involved. The fire-space is then opened, with charged firemain nozzles and water spray applicators ready.

Cargo tanks aboard cargo and passenger vessels may be protected by a modified cargo system. Regulation calls for discharge of the required quantity of carbon dioxide within 5 min. The quantity of carbon dioxide required to protect a given space is based upon a volume
factor of 30 (1 lb. of CO₂ per 30 ft. of space).

**Total Flooding System:** Fires in machinery and similar spaces are generally Class B (flammable liquids). In this type of fire the heat build-up is rapid. The safety of the ship depends to a great extent upon the machinery. For this reason, it is important to introduce the extinguishing gas quickly. Quick release keeps structural members from reaching high temperatures. It also prevents updraft from carrying away the carbon dioxide, as well as limiting damage to equipment. Discharge of 85 percent of the required quantity of CO₂ should be completed within 2 min. Slow release might result in no extinguishment. Two separate and deliberate operations are required to avoid unintentional release of the gas. One control releases at least the required amount of CO₂ while another control is required to operate the stop valve or direction valve.

Systems protecting enclosed ventilation for motors and generators of electric propelling machinery are also of the total flooding type. The required concentration of CO₂ must be maintained until the machinery can be stopped; this may require release of additional gas at delayed intervals. Such systems are described as "delayed discharge, total flooding" systems.

**Special Systems:** Ordinary cargo vessel extinguishing systems are not designed for flammable liquid fires. To protect against such a possibility, it is necessary to have the capability of releasing the required quantity of CO₂ within a relatively short period. This requires an increased amount of piping and carbon dioxide nozzles over normal extinguishing system requirements. The amount of CO₂ required is based upon the gross volume of the largest "tight" space divided by a factor of 22 (1 lb. of CO₂ per 22 ft.). Discharge of the required CO₂ is to be completed within 2 min. The "tight space" allows for small openings in hatches.

Cylinders shall be located outside the protected space except that a total-flooding system of 300 lb. or less, with approved automatic release, may be installed in the protected space. Cylinder storage must be designed and ventilated to keep the temperature below 130°F to prevent pressure in the cylinders from rising, and possibly breaking the rupture disc.

Table I shows the CO₂ systems required for cargo vessels. Other types of ships would be protected similarly.

**Foam Systems:** The primary use of foam is for protection of the cargo tank deck area on tank vessels. Foam is produced by introducing foam concentrate into a flowing stream of water and aspirating with air. Aboard ship, the concentrate is normally introduced by proportioning equipment at some central location on the vessel. The foam solution is pumped through fixed piping to nozzles, monitors, etc., at the area to be protected. Air is mixed with the foam solution at the nozzle and foam produced.

The majority of approved systems consist of either protein or fluoroprotein foam concentrate which is acceptable for most hydrocarbons. For polar solvents the Coast Guard requires an alcohol-resistant foam. The Coast Guard has also approved foam concentrates which are acceptable for both alcohol and hydrocarbons. The required foam rate is whichever of the following:

1. 0.16 gpm/ft² of protected area (cargo area) or

2. 0.24 gpm/ft² of horizontal sectional area of the single tank having the largest such area.
### TABLE I

Carbon Dioxide Systems for Cargo Vessels

**Abbreviations:**
- R - Required
- O - Optional in lieu of other systems
- RII - CO₂ only system permitted, but not required
- e - Some exceptions see regs

<table>
<thead>
<tr>
<th>Space Protected</th>
<th>Type of System</th>
<th>Flooding Factor</th>
<th>Required or Optional</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cargo Compartments</td>
<td>Cargo</td>
<td>30</td>
<td>R*</td>
</tr>
<tr>
<td>Spaces for Vehicles</td>
<td>Total Flooding</td>
<td>²/²²</td>
<td>R**</td>
</tr>
<tr>
<td>Cargo Tanks</td>
<td>Cargo Tank</td>
<td>30</td>
<td>O</td>
</tr>
<tr>
<td>Lamp and Paint Lockers and Similar Spaces</td>
<td>Total Flooding</td>
<td>varies with volume of space protected</td>
<td>R</td>
</tr>
<tr>
<td>Oil Fired Boilers and Associated Equipment</td>
<td>Total Flooding</td>
<td>varies with volume of space protected</td>
<td>O</td>
</tr>
<tr>
<td>Internal Combustion Propelling Machinery</td>
<td>Total Flooding</td>
<td>varies with volume of space protected</td>
<td>RII</td>
</tr>
<tr>
<td>Enclosed Ventilation for Motors and Generators of Elec. Propelling Machinery</td>
<td>Delayed Discharge, Total Flooding</td>
<td>10 (2000 ft³ or less), 12 (over 2000 ft³)</td>
<td>R</td>
</tr>
</tbody>
</table>

* If accessible during voyage may be considered living space and sprinklers required.
** If space partially open, sprinklers may be required.

o In addition, must maintain 25 percent concentration until equipment can be stopped.
For polar solvent systems the rate varies depending on the chemicals carried. A 20 min. foam supply is required.

**Water Spray**: Spray systems, by breaking the water into small droplets allows it to vaporise more readily, thus absorbing more of the fire's heat. The objective of shipboard installations is complete extinguishment of the fire. In special purpose spray systems, as may be installed aboard LPG carriers, the function may be to reduce the quantity of heat absorbed by the tank or surrounding structure.

Water spray is often preferred for protection of pump rooms because there is no danger of asphyxiation as with CO₂ and no mop-up as with foam. The supply of water is inexhaustible.

The differences between sprinkler systems and water spray systems are primarily in water discharge pattern, water velocity, density of water application, and water droplet size. Sprinklers have only one basic water discharge pattern, based upon the Underwriters Laboratories requirements. There are well-defined rules for sprinkler spacing and size of supply piping, geared to this standard distribution pattern.

Water spray nozzles may have any water capacity and discharge pattern. Pipe sizing and nozzle location must be individually engineered, based upon the nozzle characteristics. Water spray nozzles discharge water at a lower velocity and in smaller drop sizes. Nozzles are approved by the Coast Guard upon the basis of tests conducted in mock pump room installations using diesel oil fuel. Water spray systems are installed aboard vessels to extinguish pump room fires.

**Manual Sprinkler System**: Aboard U. S. vessels, sprinkler systems are employed in only very limited locations; primary dependence is placed upon structural fire protection rather than automatic sprinkler protection. This is in contrast to the system in which combustible construction is permitted in combination with a complete sprinkler system.

A sprinkler system will accomplish two things:

1. It will extinguish fires in Class A (wood, etc.) combustibles, as well as high flash point (above 200°F) combustible liquids.

2. It will control the heat output from flammable liquid (e.g., gasoline) fires and at the same time offer protection to the overhead of the protected space.

In installations protecting vehicular decks, the system should be designed to protect the structural integrity of the vessel, confine the fire to the location of origin, and wash the flammable liquid to a safe location. Installation on vehicular decks, such as aboard ferry vessels, is the primary marine use of sprinkler systems in this country.

Consideration should be given to drainage of water from water spray and sprinklered spaces. Gasoline will float on the surface of the water and, although suppressed, will continue to burn. Drainage should be to overboard drains which will not allow the burning liquid to flow into openings below. Drainage must also be adequate so as to preclude a stability problem.

If properly designed and maintained, a sprinkler system can be among the most effective fire fighting mediums aboard a vessel. However, long experience has demonstrated that because of the difficulty of testing, proper maintenance is seldom performed and the system will not operate as designed.

**Halon Systems**: Total flooding Halon fire extinguishing systems are appropriate for enclosed spaces where fires involving electrical equipment, machinery,
or gaseous and liquid flammable materials may occur. Halon 1301 is the only halogenated agent currently accepted by the Coast Guard for fixed shipboard fire extinguishing systems. Other Halons are unacceptable because they are either highly toxic themselves, or they can form unacceptable amounts of toxic products of decomposition when exposed to fire.

Portable fire extinguishers widely used in the past contained Halon 104 (carbon tetrachloride) or Halon 1011 (bromochloromethane). Due to the toxicity of both these agents, their marine use was banned by the Coast Guard in 1958. Currently, both Halon 1301 and Halon 1211 portable extinguishers are available, which carry Coast Guard Marine approval.

Halon 1301, even though acceptable for shipboard use, is somewhat toxic; however, if discharged properly, the toxic effects are minimal. Halon 1301 is a colorless, odorless gas which chemically interacts with the combustion process to inhibit combustion. Although it is similar to carbon dioxide in application and storage, its extinguishing action is produced by an entirely different process. Halon 1301 chemically interrupts the process which produces combustion, while carbon dioxide extinguishes flames by displacing the atmosphere to effectively reduce the oxygen content below a point where combustion can occur. Halon 1301 should not be used to protect hazards involving chemicals capable of rapid oxidation in the absence of air, combustible or reactive metals, and metal hydrides. Additionally, the use of Halon 1301 on Class A materials has not been thoroughly researched by the U. S. Coast Guard at present and is therefore not acceptable for the protection of cargo holds when carrying general cargoes.

Halon 1301 systems are designed to limit the production of the toxic products of decomposition. If Halon 1301 is heated above 900°F (482°C), it breaks down to form hydrogen fluoride, free bromine, and carbonyl halides. Full-scale tests involving flammable liquid fires, conducted at the Coast Guard Fire and Safety Test Facility have shown that if Halon 1301 in sufficient concentration is discharged into a burning machinery space in 10 sec. or less, the amount of toxic decomposition products formed are of less consequence than the normal combustion products such as carbon monoxide.

Coast Guard Approval of Halon 1301 Systems

At present, Title 46 of the Code of Federal Regulations does not contain any provisions for the design or requirements of Halon 1301 systems aboard commercial vessels. In essence, the approval of these systems is based upon a provision within the Code of Federal Regulations that grants to the Commandant of the Coast Guard the authority to allow new or unique systems, if it is adequately demonstrated that the proposed system is equivalent to the existing system required by the regulations. Carbon dioxide total flooding fire protection systems are the systems to which Halon 1301 systems must prove equivalence. Therefore, Coast Guard approved Halon 1301 systems are required to be designed with an equivalent degree of fire protection capability and reliability. Where basic deviations in design occur due to the use of the Halon 1301 agent, specific adaptation to the regulations have been developed.

The basic design philosophy of carbon dioxide systems, however, has been retained for Halon systems:

- The protected space must be evacuated before the system is discharged. Pre-discharge alarm is required.
- The agent storage containers must be located outside of the protected space, except for spaces less than 6000 ft³ and modular type Halon systems.
Two separate and distinct actions must be performed to discharge the agent.

Manual type release devices are required; automatic release is permitted only for spaces less than 6000 ft\(^3\).

Detailed instructions must be provided at the remote release station to explain alternate means of discharging the system.

International

The Coast Guard actively participates in the International Maritime Organization (IMO) formerly IMCO, which is a specialized U.N. agency. IMO is the depository for the Safety of Life at Sea Treaty (SOLAS) which is international law for those party to the convention, with respect to merchant shipping. Within the structure of IMO is the Fire Protection Sub-Committee which looks after and improves upon the fire protection chapter within SOLAS.

Although for years there were many technical as well as philosophical differences between Coast Guard rules and international rules, these differences have become fewer and fewer. In fact 46 CFR and SOLAS 1974, as amended, are extremely close with respect to fire protection requirements. The U.S. has been quite successful in upgrading the SOLAS requirements to make them similar to ours.

To a lesser extent the Coast Guard participates in the International Organization for Standardization (ISO). Its concerns mostly have been in the fire protection materials area. It monitors ISO progress especially as it pertains to IMO.

Testing

Inasmuch as it is very difficult to relate small tests to what will occur on actual vessels, the Coast Guard established the Fire and Safety Test Detachment in Mobile, AL in 1969. Actual full-scale tests on two ships (cargo hold extinguishment, detection, deck foam systems to mention a few) have been conducted over the years with valuable information forthcoming. Testing at the facility is guided by a Test Advisory Group composed of marine and fire protection experts. Reports of all significant works are available through the National Technical Information Service, Springfield, VA 22161.
References

Title 46 Code of Federal Regulations, Parts 30-40 (Tank Vessels), Parts 70-89 (Passenger Vessels), Parts 90-109 (Cargo Vessels and Mobile Offshore Drilling Units) and Parts 156-165 (Specifications), Office of Federal Register, National Archives and Records Service, General Services Administration, Washington, DC 1981.


Preliminary Report of the Committee on Commerce Pursuant to S. Res. 7; 74th Congress; Report No. 184 — MORRO CASTLE and MOHAWK Investigations.


CG-227, Laws Governing Marine Inspection, U. S. Coast Guard, 1 July 1975.

Navigation and Vessel Inspection Circular No. 6-80, Washington, DC, 3 April 1980.


Navigation and Vessel Inspection Circular No. 6-72, Washington, DC, 22 August 1972.

Navigation and Vessel Inspection Circular No. 6-72, Change 1, Washington, DC, 28 February 1977.

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