



U.S. Department  
of Transportation

Research and  
Special Programs  
Administration

# ***ADA Access to Passenger Vessels: Finding Safety Equivalence Solutions for Weathertight Doors with Coamings***

## ***Phase 1: Background and History***

---



*Prepared for:*

Architecture and Transportation Barriers Compliance  
Board

Washington, D.C.

*Prepared by:*

U.S. Department of Transportation  
Research and Special Programs Administration  
John A. Volpe National Transportation Systems Center

Cambridge, Massachusetts

September 2003

---

# **ADA Access to Passenger Vessels: Finding Safety Equivalence Solutions for Weathertight Doors with Coamings**

## **Phase 1: Background and History**

Michael G. Dyer

Revised, October 2004

*Prepared by*

U.S. Department of Transportation  
Research and Special Programs Administration  
John A. Volpe National Transportation Systems Center

*Prepared for*

Architecture and Transportation Barriers Compliance Board

## **NOTICE**

Neither the United States Government nor any agency thereof, nor any of their employees, makes any warranty, express or implied, or assumes any legal liability or responsibility for the accuracy, completeness, or use of any information, apparatus, product, or process disclosed. Reference herein to any specific commercial product, process, or service by trade name, trademark, manufacturer, or otherwise, does not necessarily constitute or imply its endorsement, recommendation, or favoring by the United States Government or any agency thereof. The views and opinions of authors expressed herein do not necessarily state or reflect those of the United State Government or any agency thereof.



**REPORT DOCUMENTATION PAGE***Form Approved  
OMB No. 0704-0188*

Public Reporting burden for this collection of information is estimated to average 1 hour per response, including the time for reviewing instructions, searching existing data sources, gathering and maintaining the data needed, and completing and reviewing the collection of information. Send comment regarding this burden estimates or any other aspect of this collection of information, including suggestions for reducing this burden, to Washington Headquarters Services, Directorate for information Operations and Reports, 1215 Jefferson Davis Highway, Suite 1204, Arlington, VA 22202-4302, and to the Office of Management and Budget, Paperwork Reduction Project (0704-0188,) Washington, DC 20503.

1. AGENCY USE ONLY (Leave Blank)		2. REPORT DATE October 2004, revised	3. REPORT TYPE & DATES COVERED	
4. TITLE AND SUBTITLE ADA Access to Passenger Vessels: Finding Safety Equivalence Solutions for Weathertight Doors with Coamings  Phase 1: Background and History			5. FUNDING NUMBERS	
6. AUTHORS Michael G. Dyer				
7. PERFORMING ORGANIZATION NAME(S) AND ADDRESS(ES) U.S. Department of Transportation Research and Special Programs Administration John A. Volpe National Transportation Systems Center 55 Broadway Cambridge, MA 02142			8. PERFORMING ORGANIZATION REPORT NUMBER	
9. SPONSORING/MONITORING AGENCY NAME(S) AND ADDRESS(ES) U.S. Architecture and Transportation Barriers Compliance Board 1331 F Street, NW, Suite 1000 Washington, DC 20004 -1111			10. SPONSORING AGENCY REPORT NUMBER	
11. SUPPLEMENTARY NOTES				
12a. DISTRIBUTION/AVAILABILITY			12b. DISTRIBUTION CODE	
13. ABSTRACT This report examines possible approaches to provide for both marine safety and disability access at doors into passenger accommodation spaces on U.S. passenger vessels. The Architecture and Transportation Barriers Compliance Board's ultimate objective is to assist designers and operators in improving wheelchair access without compromising the vessel safety provisions of the sills at these doorways. This report contains the results of "Phase 1" of the project, which are 1) to examine the application of the current governing safety regulations; and 2) to present several brief technical case studies examining the design and regulatory review of weathertight doors on K and T boats.				
14. KEY WORDS Passenger vessel, ADA, ADAAG, access, coaming, weathertight door, Subchapter T, Subchapter K			15. NUMBER OF PAGES	
			16. PRICE CODE	
SECURITY CLASSIFICATION OF REPORT None	SECURITY CLASSIFICATION OF THIS PAGE None	SECURITY CLASSIFICATION OF ABSTRACT None	LIMITATION OF ABSTRACT	

NSN 7540-01-280-5500

Standard Form 298 (Rev. 2-89)  
Prescribed by ANSI Std. Z39-18  
298-102

---

### *Acknowledgements*

The authors wish to thank the numerous organizations and individuals who graciously provided their time, knowledge and guidance in the development of this report. Our sponsors at the Architecture and Transportation Barriers Compliance Board have been supportive. We owe thanks to many in the Coast Guard who responded to our inquiries and contributed their time, their knowledge, and their experience. They include Mr. Tom Jordan and Mr. Al Penn (Coast Guard Headquarters), LT Jason Hall and CWO4 Jim Hinde (Marine Safety Office, Boston), CWO Ray Rock (Marine Safety Office, Providence), and LCDR Tony Wiest (Marine Safety Center).

---

## Table of Contents

### 1 Introduction

#### 1.1 Purpose of Report

#### 1.2 Organization of Report

### 2 Background

#### 2.1 Relevant Coast Guard Regulations and Practice

##### *2.1.1 Code of Federal Regulations*

2.1.1.1 Passenger vessels definitions

2.1.1.2 Areas of operation

2.1.1.3 Watertight integrity regulations for Subchapter H passenger vessels

2.1.1.4 Watertight integrity regulations for Subchapter K and T passenger vessels

2.1.1.5 Watertight integrity regulations for Subchapter C passenger vessels

2.1.1.6 “Good marine practice”

##### *2.1.2 Hazards and Risks*

2.1.2.1 Hazards associated with stability

2.1.2.2 Regulations and risk

##### *2.1.3 “Equivalents” and “Special consideration”*

#### 2.2 ADAAG Standards and Topical Studies

#### 2.3 Current Practice in the U.S. Passenger Vessels Fleet

### 3 U.S. Fleet Case Studies

#### 3.1 The *Flying Cloud* (Harbor Express)

*3.1.1 Description*

*3.1.2 Discussion*

#### 3.2 Other Vessels

### 4 Summary

#### 4.1 Regulations Review and Case Studies

#### 4.2 Recommendations for Phase 2

---

## Figures

- 2-1 PVAAC Coaming and Ramp Solutions
- 3-1 Bow Loading on the *Lightning*, August 14, 2003
- 3-2 Access Through the Passenger Cabin Bow Doors
- 3-3 *Flying Cloud* Passenger Cabin, Plan View
- 3-4 *Flying Cloud* Bow Doors, Deck Plan
- 3-5 Bow Doors, *Flying Cloud*
- 3-6 Drainage Detail Forward of Doors, *Lightning*
- 3-7 Access to “Main Deck” Manhole, *Lightning*

## Tables

- 2-1 Coast Guard Designations of “Waters”

## Appendix

- A. Coast Guard Documentation for Inspected Passenger Vessel



---

## ACRONYMS

<b>ADA</b>	Americans with Disabilities Act, 1990
<b>ADAAG</b>	ADA Accessibility Guidelines for Buildings and Facilities (2003)
<b>ATBCB</b>	Architecture and Transportation Barriers Compliance Board
<b>CFR</b>	Code of Federal Regulations
<b>COI</b>	Certificate of Inspection
<b>COTP</b>	Captain of the Port
<b>ILLC</b>	International Load Line Convention
<b>IMO</b>	International Maritime Organization
<b>MBTA</b>	Massachusetts Bay Transit Authority
<b>OCMI</b>	Officer in Charge of Marine Inspection
<b>PVA</b>	Passengers Vessels Association
<b>PVAAC</b>	Passenger Vessel Access Advisory Committee



## **1 Introduction**

### **1.1 Purpose of Report**

The purpose of this report is to examine possible approaches to provide for both marine safety and disability access at doors into passenger accommodation spaces on U.S. passenger vessels. The sponsoring organization is the Architecture and Transportation Barriers Compliance Board (“the Board”, or ATBCB), an independent Federal agency, whose mission is to improve accessibility for people with disabilities. The Board’s objective here is to assist designers and operators in improving disability access without compromising the vessel safety provisions of the high sills at some doorways. The high sills are known as coamings in marine parlance and their purpose is to prevent the entry of water into the passenger spaces served.

This report includes the results of “Phase 1” of the project, which are:

1. The need for and application of the current governing safety regulations; and
2. Brief technical case studies examining the design and regulatory review of weathertight doors on K and T boats.

Phase 2 is to follow and will be a research project to develop Americans with Disability Act (ADA) Access Guidelines for complying manual door designs which provide an equivalent coaming protection.

The focus of this study is on the small-sized classes of regulated U.S. passenger vessels, known as Subchapter T and Subchapter K boats, named after the relevant sections in Title 46 (“Shipping”) of the Code of Federal Regulations (CFR). These boats generally are less than 100 gross tons and carry more than six passengers. Other sections of Title 46 regulate smaller boats carrying up to six passengers and larger vessels of greater than 100 gross tons. T and K boats make up the overwhelming majority of passenger ferries and excursion vessels, such as dinner boats and whalewatchers, which are available to the general public. Vessels operating in international waters and subject to international marine safety codes are not included in the study.

### **1.2 Organization of Report**

Chapter 2 is a brief description of the relevant safety regulations and the underlying safety philosophy and the ADA Accessibility Guidelines mobility-impaired access guidelines, as well as the current practice in the U.S. passenger fleet. Chapter 3 presents the case studies on passenger vessels with weathertight doors having no coamings. Chapter 4 is a summary of findings and recommendations.



## **2 Background**

Under Coast Guard domestic regulations, certain doors in passenger vessels leading from the outside (“the weather”) into passenger accommodation spaces must have sills (also known as coamings) of varying heights to prevent the entry of water. However, under the American with Disabilities Act Accessibility Guidelines (ADAAG), an accessible door cannot have a threshold that is higher than 1/4 inch or 1/2 inch, if beveled. If ADAAG threshold provisions were applied to passenger vessels, at certain doors, the coaming requirement and ADAAG threshold requirement would conflict. The following sections detail the provisions of the Coast Guard regulations and the ADAAG guidance, as well as summarizing the current practice in the U.S. passenger fleet.

### **2.1 Relevant Coast Guard Regulations and Practice**

It is useful at the outset to set the U.S. passenger fleet and the Federal regulations within the larger context of the international fleet and its safety codes, and to provide some definitions of marine safety concepts as they relate to the most elemental need: to keep water out of the boat and preserve the integrity of the “watertight envelope” provided by the hull. The hull structure consists of the shell, its bottom and sides, and the main deck, and it carries the payload by displacing water (except in cases of “lift” craft such as hydroplanes and hovercraft, a very small minority of passenger vessels). Its geometric and loading configuration defines its stability and provides reserve buoyancy for safe responses to external forces such as waves, wind, and water on deck.

The very first marine safety regulations resulted from the Merchant Shipping Act of 1871 (Great Britain), which addressed seaworthiness and later were substantially adopted as the first international code, the International Load Line Convention (ILLC). The essence of the ILLC was to provide for adequate hull structure and reserve buoyancy, prevent overloading, and to ensure watertight integrity. A significant feature of the latter was to address water that gets on the “weather decks”, by rain, spray, and, most importantly, boarding waves. For merchant cargo ships, storm-driven waves sweeping the deck (also known as “green water”) are a serious hazard to this day. The danger is twofold: accumulation of water on deck and downflooding into spaces below. Both degrade reserve buoyancy and stability.

The ILLC addresses this hazard through the “conditions of assignment”, a detailed set of specifications for all structures above the main deck and all openings into the hull and superstructure, including cargo hatches, doorways, ventilator pipes, port holes, and others. The conditions of assignment aim to provide topside design features that will prevent entry of water and shed it quickly over the side; many of these are adapted for use in the CFR’s subchapters addressing ship safety in general and passenger vessel safety in particular. The CFR covers nearly all of the United States passenger vessels operating in United States waters. The ILLC pertains only to a handful of United States vessels operating on international voyages, as well as all of the foreign flagged cruise ships operating from U.S. ports.

Properly designed topside structures and openings are “weathertight”. The distinction between watertight and weathertight is the following:

- “Watertight means designed and constructed to withstand a static head of water without any leakage” (46 CFR 114.400 and 175.400). This refers to structures that must withstand hydrostatic loading for extended periods of time, including the hull bottom and sides, main deck plating, tanks, and “subdivision bulkheads”. The latter are meant to contain the spread of water that enters the hull as a result of hull breach due to collision, grounding, etc. All weldments and penetrations of such structures are subject to strict testing requirements to ensure that no leakage occurs under the particular design conditions of the vessel.
- “Weathertight means that water will not penetrate in any sea condition” (46 CFR 114.400 and 175.400). This refers generally to topside structures subject to occasional and short exposure to water on deck, from boarding waves or wind driven rain and spray. Regulations specify arrangement and height for weathertight appurtenances, as well as load and welding specifications, which are generally less stringent than for watertight structures.
- In short, the watertight hull envelope keeps water out from below where the sea’s hydrostatic pressure supports the vessel’s weight, and the weathertight structure keeps it out from above, where access and operations necessitate openings of many kinds into the hull and superstructure.

It should also be borne in mind that most marine regulations, including international codes, take account of the vessel’s area of operation, that is, some safety requirements vary according to the severity of conditions anticipated. Many U.S. T and K boats operate in relatively benign waters, as defined and certificated by the Coast Guard, and therefore, in some cases, meet less stringent requirements than those for boats in harsher environments, in ocean operations, for example.

### *2.1.1 Code of Federal Regulations*

The relevant issues in the CFR for these purposes are the definitions for all types of passenger vessels, areas of operation as applied to Certificates of Inspection (COI) and for the purposes of stability requirements, and the weathertight door coaming regulations themselves.

#### *2.1.1.1 Passenger vessel definitions*

The definitions for passenger vessels are found first in 46 CFR, Part 70, Table 70.05-1(A) “Classes of vessels examined or inspected under various Coast Guard regulations. Discussion for these purposes is confined to vessels whose primary purpose is carriage of passengers and does not include oceanographic research vessels and other commercial vessels that sometimes carry passengers for hire, for example, tankers or fishing boats. The table defines, in descending order of size, Subchapter H, Subchapter K, Subchapter T, and Subchapter C passenger boats.

The definitions and particular subchapter citations follow, along with examples of each:

## **ADA Access to Passenger Vessels: Finding Safety Equivalence Solutions for Weathertight Doors with Coamings**

---

- Subchapter H (46 CFR 70.05) – Vessels of 100 gross tons or more, carrying more than twelve passengers. Examples: Staten Island Ferries (vessels up to 3,335 gross tons and 6,000 passengers) and passenger/vessel ferries of the Washington State Ferry service (up to 4,988 gross tons and 2,500 passengers). Subchapter H vessels are inspected by the Coast Guard.
- Subchapter K (46 CFR 114.110) – Vessels of less than 100 gross tons, carrying more than 150 passengers, or has overnight accommodations for more than 49 passengers. Examples: New York Waterways passenger only ferries carrying up to 350 passengers. Subchapter K vessels are inspected by the Coast Guard.
- Subchapter T (46 CFR 175.110) – Vessels of less than 100 gross tons, carrying 150 or less passengers, or has overnight accommodations for 49 or less passengers. Examples: most catamaran and monohull whalewatchers, Harbor Express (Boston) catamaran ferries. Subchapter T vessels are inspected by the Coast Guard.
- Both Subchapters K and T exempt vessels operating exclusively on non-navigable inland waters (e.g., landlocked lakes), certain research vessels, lifeboats, and foreign vessels subject to acceptable international or national inspection laws.
- Subchapter C (46 CFR 24.05) – Subchapter C includes all uninspected passenger vessels. Those less than 100 gross tons are allowed to carry six or fewer passengers, at least one of whom is for hire. Representative examples are charter sailing vessels, charter fishing vessels, and small water taxis. Uninspected vessels of more than 100 gross tons are allowed to carry twelve or fewer passengers, at least one of whom is for hire. Large charter yachts, also known as mega-yachts, are the best known representatives of this class of vessels. The Coast Guard does not formally inspect these vessels, although they may be boarded for safety examinations.

### 2.1.1.2 Areas of operation

The CFR and Coast Guard certification and inspection regime takes a dual approach to areas of operation, affecting all passenger vessel types, and in addition allows for a certain amount of judgment by the Officer in Charge of Marine Inspection (OCMI) in the relevant Captain of the Port (COTP) zone.

Most importantly for the aim of this study, the CFR defines “exposed”, “partially protected”, and “protected” waters, for the purpose of applying the stability criteria and regulations to H, K, and T boats. These terms describe the sheltered versus exposed nature of the waters, that is, the severity of waves and swells likely to be encountered therein, as well as the proximity to safe refuge of vessels operating therein. The OCMI has the authority to designate waters as seen fit to account for local conditions. Many of the stability regulations vary in application depending upon the waters plied, for example, the specified “wind heel” load that the vessel must sustain. Included among

these are the “Watertight Integrity” regulations, which regulate openings in the hull and superstructure, including weathertight doors; these are discussed in detail below.

The Coast Guard conducts a regulatory stability assessment for each inspected passenger vessel, the result of which is the stability letter issued to the owner. This letter identifies the type of waters (e.g., “partially protected”) upon which the vessel may operate, given its design and stability characteristics, as well as any loading restrictions deemed appropriate. The stability letter is generally not posted onboard in public view. An example of this document appears in Appendix A.

The Coast Guard also issues a certificate of inspection (COI) for each inspected passenger vessel. The COI addresses many safety aspects including manning and certification of crew, and stability, and specifies operations in well defined areas, including “rivers”, “limited coastwise”, “coastwise”, “Great Lakes”, “lakes, bays, and sounds”, and “oceans”. The COI is posted on board by regulation and is the document that the traveling public are most likely to see. Again, the COTP has discretion to re-designate any area in his zone based on environmental conditions and safety considerations. The COTP can also impose limitations or grant extensions of operating routes based upon stability criteria and unique construction or operating characteristics of the vessel (Coast Guard Marine Safety Manual). An example of the COI also appears in Appendix A.

These two operating area designations are not linked in the regulations. Table 2-1 provides a general guideline as to how they match up in practice. There is a correlation in a general sense only, e.g., the stability designation “partially protected” to COI designation “limited coastwise”, or “exposed” to “oceans”. It is important for the reader to keep in mind that the COTP can alter this correlation depending on local conditions and the design and construction of the individual boat. It should be held foremost that designations for stability purposes are what matter for the purposes of this study.

### 2.1.1.3 Watertight integrity regulations for Subchapter H passenger vessels

Subchapter H passenger vessels are the largest sized regulated class and are generally subject to the most stringent structures and stability requirements, in both Subchapter H and Subchapter S (“Stability”). Subchapter H specifies plan approval for a wide array of hull structure drawings and annual inspection of watertight doors and subdivision bulkheads. Subchapter S addresses “Watertight integrity above the margin line in a vessel 100 gross tons or more” (46 CFR 171.122), by specifying weathertight closures and coamings for “each opening in an exposed weather deck”. The interpretation is that those openings include only hatches, and not doors into superstructure on the weather decks. The reason for this omission is not clear, although Coast Guard experts felt that such doors would generally be higher above the waterline (and less likely to be exposed to boarding waves) and that the relatively large size of H vessels would preclude a safety problem due to wind driven rain or spray<sup>1</sup>. H vessels subject to the International Load Line Convention would have to meet superstructure and deckhouse door coaming requirements. These, however, are vessels operating in international waters only and

---

<sup>1</sup> Telephone conversations with LT Parker, Coast Guard Marine Safety Center, and with Tom Jordan, Coast Guard Headquarters, October 2, 2003.



**ADA Access to Passenger Vessels: Finding Safety Equivalence Solutions for Weathertight Doors with Coamings**

would not include most of the Subchapter H vessels currently documented in the United States.

**Table 2-1  
Coast Guard Designations of “Waters”**

	<b>Designation of Waters for Purposes of Stability Regulations</b>		
	<b>Exposed waters</b>	<b>Partially protected waters</b>	<b>Protected waters</b>
<b>Definition</b>	Waters more than 20 nautical miles from harbor of safe refuge; applies on Great Lakes from Oct. 1 to April 15.	Waters not more than 20 nautical miles from harbor of safe refuge; applies on Great Lakes from April 16 to September 30.	Sheltered waters with no special hazards, e.g., rivers, harbors, and lakes.
<b>Examples</b>		Puget Sound	Boston Harbor, New York Harbor
<b>Roughly Corresponding COI Designations</b>	<u>Oceans</u> – any route more than 20 nautical miles offshore.	<u>Limited coastwise</u> – any route not more than 20 nautical miles from a harbor of safe refuge.	<u>Lakes, Bays, and Sounds</u> – route on same.
	<u>Coastwise</u> – any route not more than 20 nautical miles offshore on oceans, gulfs, and seas.	<u>Coastwise</u> – as designated by OCMI	<u>Rivers</u> – route on same.
	<u>Great Lakes</u> – includes St. Lawrence River, from Oct. 1 to April 15.	<u>Great Lakes</u> , from April 16 to September 30.	

2.1.1.4 Watertight integrity regulations for Subchapter K and T passenger vessels

The watertight integrity regulations addressing weathertight doors are identical for Subchapter K and T boats (46 CFR 116.1160 and 179.360, respectively). The relevant citations for weathertight doors in Subchapters K and T are identical and read as follows:

\*\*\*

“(d) A weathertight door must be provided for each opening located in a deckhouse or companionway. Permanent watertight coamings must be provided as follows:

1. “On a vessel on an exposed or partially protected route, a watertight coaming with a height of at least 150 mm (6 inches) must be provided under each weathertight door in a cockpit or a well, or on the main deck of a flush deck vessel.
2. “On a vessel on a protected route, a watertight coaming with a height of at least 75 mm (3 inches) must be provided under each weathertight door in a cockpit or a well.
3. “The height of a watertight coaming for a hinged watertight door need only be sufficient to accommodate the door.”

\*\*\*

A cockpit or well, as described in sub-paragraph (a), is an area of deck set below the weather deck, with the same weather-tightness requirement for all its boundaries. They are given special mention because of the potential for water to become entrapped therein and the necessity to prevent downflooding through doors giving access to spaces below. Cockpits and wells are uncommon on the whole in the inspected passenger vessels fleet, and are usually found on passenger sailing boats. A flush deck denotes continuity of the weather deck from bow to stern at the upper limit of the hull sides.

The paragraph allowing substitution of a watertight door with no required coaming height provision is specifically for vessels with licensed crew and other capable personnel (e.g., offshore drilling rig workers) aboard, who know how to operate a watertight door and can do so in emergency egress situations<sup>2</sup>.

*Subchapter S “Stability” considerations*

Discussions with naval architects and Coast Guard personnel revealed some redundancy and confusion arising from the watertight integrity and coaming provisions of Subchapter S, also part of the Coast Guard’s Title 46 regulations. Subchapter S addresses coamings among many stability matters, and applies to all vessels less than 100 gross tons, not just passenger vessels. The design of a small passenger boat requires attention to both Subchapter S and Subchapter T or K. The regulations are

---

<sup>2</sup> See footnote #1.

## **ADA Access to Passenger Vessels: Finding Safety Equivalence Solutions for Weathertight Doors with Coamings**

---

sometimes clear in the matter of integrating those requirements (see following paragraph), but are not so with regard to coamings.

One example of clear guidance is that Subchapters K and T explicitly cite Subchapter S intact stability standards (that is, the vessel's ability to stay upright under loading from wind, waves, passenger movement, etc.) for passenger boats with particular physical or operational characteristics. Subpart C of Subchapter T (parts 178.310 – 178.340) specifies compliance with four separate parts of Subchapter S for vessels more than 19.8 meters in length, carrying more than 12 passengers on an international voyage, and having more than one accommodation deck above the bulkhead deck. The point here is not to discuss the technical fine points of these particular provisions, but to illustrate how clearly in one instance Subchapter T guides the user.

The redundancy and differences between Subchapter K or T and S citations for weathertight doors and coamings is not specifically addressed in either Subchapter K or T. The relevant citation for weathertight doors and coamings in Subchapter S (part 171.124 "Watertight integrity above the margin line in a vessel less than 100 gross tons") is similar, but not identical, to those in Subchapters K and T (shown in the first paragraph of 2.1.1.4), and reads as follows:

\*\*\*

"(d) A weathertight door with permanent watertight coamings that comply with the height requirements in table 171.124(d) must be provided for each opening located in a deckhouse or companionway that –

- (1) "Gives access in to the hull; and
- (2) "Is located in –
  - (i) A cockpit;
  - (ii) A well; or
  - (iii) An exposed location on a flush deck vessel.

"(e) If an opening in a location specified in paragraph (d) of this section is provided with a watertight door, the height of the watertight coaming need only be sufficient to accommodate the door."

\*\*\*

There are several subtle differences in the definitions and interpretations of locations onboard where coamings are required. The Coast Guard itself has occasional problems in applying these provisions, as illustrated by an internal memorandum from the Headquarters Office of Design and Engineering Standards on the definition of "weather deck" for the purpose of applying the weathertight door provision<sup>3</sup>. The following points summarize the comparison of and difficulties among the relevant parts of the three subchapters:

---

<sup>3</sup> "Interpretation of "Weather Deck" as Used in 46 CFR 114.400", April 19, 2002.

- All three subchapters similarly specify 6” and 3” coaming heights for exposed or partially protected routes and for protected routes, respectively. The only perfect similarity among all three subchapters is that these coamings are required for doors in cockpits and wells.
- The differences for exposed and partially protected routes are the following:
  - Subchapters T and K only – “on the main deck of flush deck vessels”. This is fairly prescriptive. The term “flush deck” is clearly defined, but, as the Coast Guard memorandum notes, “unfortunately, there is no definition of ‘main deck’ in the subchapter”.
  - Subchapter S only – “for doors giving access into the hull or for exposed locations on flush deck vessels”. This definition requires interpretation by the user on two counts. The first appears to concern downflooding paths into the hull and prevention of water entry into spaces below decks. The second is the assessment of whether a door location is “exposed” (as distinct from the exposure of the boat’s operating route).
- The differences for protected routes are the following:
  - Subchapters T and K require coamings only for doors in cockpits or wells.
  - Subchapter S language is the same as for exposed and partially protected routes, “for doors giving access into the hull or for exposed locations on flush deck vessels”, again requiring interpretation by the user.
- There are several issues of vague or inconsistently used definitions:
  - The Coast Guard memorandum states: “One of the reasons for the perplexity on this issue is that 46 CFR defines ‘weather deck’ inconsistently in subchapters T, K, and S”. In any case, this term does not appear in the weathertight door provisions of any of the subchapters.
  - The term “exposed location” in Subchapter S, is not defined. The Coast Guard memorandum notes that the Subchapter K and T definitions (§ 114.400 and § 175.400) of “weather deck” could provide some guidance (“...a deck that is completely or partially exposed to the weather from above or from at least two sides”). These are two different terms, however. Furthermore, Subchapters K and T do not specify a door’s exposure as a means to determine the coaming requirement.
  - Subchapter S uses the term “above the margin line” in the title of § 171.124. Margin line is a damage stability term for the maximum allowed height of the waterline after damage is sustained. Most commonly, the “main deck” or “bulkhead deck” is immediately above the margin line. All or part of that deck may or not be “weather deck” depending on the design of the deckhouse, bulwarks, and other structures and enclosures.

In summary, the terms of reference in the weathertight door and coaming regulations in these three subchapters can be confusing and subject to various interpretations for particular boats by both industry and the Coast Guard. Subchapter S requires more interpretation by the naval architect and will in some cases be more stringent for

## ***ADA Access to Passenger Vessels: Finding Safety Equivalence Solutions for Weathertight Doors with Coamings***

---

passenger boats operating on protected waters; that is, a door's "exposed" location and/or proximity to a downflooding path might be interpreted to require a 3" coaming where Subchapters T and K require none. T and K are prescriptive in nature and may in some cases be more stringent for boats on exposed and partially protected routes. T and K could require a 6" coaming in a location where interpretation of Subchapter S would not.

Diligent naval architects and regulatory personnel seek safe and reasonable designs based on technical knowledge and experience. They must consider the owner/operator's intended use of the vessel and they will apply the regulations and their own best practice methods as appropriate.

The case studies in Chapter 3 herein include a sampling of anecdotal information on safety "equivalencies" to these regulations granted based on design particulars. The philosophy and safety precepts evident in Subchapters K, T, and S will be brought forward into the Phase 2 work of finding safe, accessible solutions for weathertight doors.

### **2.1.1.5 Watertight integrity regulations for Subchapter C passenger vessels**

Subchapter C covers "uninspected vessels", as described above. Such boats are subject to the construction and flotation requirements that apply to all uninspected boats, but the regulations in Subchapter C are limited to Parts 24–26, which include lifesaving and fire prevention and extinguishing equipment. Those under 100 gross tons include many "open deck" boats without the type of doors addressed herein. Weathertight doors are in any case not required for Subchapter C boats that have deckhouses with doors.

### **2.1.1.6 "Good marine practice"**

The term "good marine practice" describes commonly accepted marine design and construction methods in addition to the requirements of the CFR. Coast Guard regulations describe minimally acceptable features that can be and are often exceeded by the naval architect and the shipyard.

Good marine practice is in no way a universal standard, but varies by service, region, design operating conditions, and even preferences of the owner and the shipyard. In the case of doorway coamings, it is not uncommon to find them on vessels where the service and operations do not require them. It is possible that good "accessible" design practice can change this particular element, with improved awareness by designers and operators.

## ***2.1.2 Hazards and Risks***

### **2.1.2.1 Hazards associated with stability**

The hazard addressed by the watertight integrity regulations, and the coaming regulations in particular, is water ingress and downflooding. Protracted exposure to waves and ingress of water, even in incrementally small amounts, can degrade the

vessel from an “intact stability” to a “damage stability” situation. A brief explanation of the concepts of intact stability and damage stability is first in order.

Stability in both modes is the ability of the vessel to remain upright while sustaining applied loads. These loads can be external (e.g., waves, wind, water on deck) and internal (weight shifts such as passenger crowding, movements of liquid or solid cargoes). The vessel’s weight and buoyancy distributions determine its stability characteristics. The ultimate stability hazard is capsizing, a fast moving event with the potential to cause devastating loss of life. Prevention of capsizing is the aim of the stability regulations. Lesser hazards are associated with non-capsizing scenarios in which the vessel’s response to external loading can cause discomfort or injury to passengers, particularly those unused to marine travel. The naval architect addresses these hazards, and they are not covered by the regulations.

Intact stability addresses situations when the vessel is operating in the undamaged, normally loaded condition. The latter descriptor may be one of several conditions that must be checked by the naval architect; examples include 1) full load departure and 2) return with partially full fuel tanks.

Damage stability applies in abnormal conditions when water has entered the vessel following events such as groundings, collisions, and ingress of water due to storm conditions. Domestic and international damage stability regulations are most stringent for passenger vessels as compared to other types, but the reader must bear in mind that the stability and safety of a vessel in this state has been seriously degraded.

### 2.1.2.2 Regulations and risk

The Coast Guard now sees safety as a risk management process. Risk is the product of an event’s probability and its consequences. The consequences of ingress and downflooding are always serious, that is, the degradation of vessel’s stability. The potential consequences of the capsizing of a passenger vessel – tens or hundreds of lives lost – are unacceptable; therefore, the regulations are intended to minimize as much as possible the probability of that event. The coaming regulations are one element of watertight integrity requirements meant to reduce the probability of significant ingress of water.

This explains why the regulations are tied to definitions of exposure and protection that include a consideration of time, that is, proximity to a safe harbor. In protected waters, sea conditions are less likely to cause significant water on deck, and the proximity of land and emergency services assets further reduces risk, should flooding occur. In exposed or partially protected waters, water on deck and the conditions for downflooding are more likely and “safe harbor” is likely to be at greater distance. The regulations are more stringent in such cases because the likelihood of water on deck is higher and more time is needed to get to safe refuge.

### 2.1.3 “Equivalents” and “Special consideration”

The CFR allows for review and approval of engineering and design proposals, in both Subchapters K and T, from any regulations, based upon an equivalency of safety. “Equivalents”, described in 46 CFR 114.540 and 175.540 for K and T boats,

## **ADA Access to Passenger Vessels: Finding Safety Equivalence Solutions for Weathertight Doors with Coamings**

---

respectively, allow for the Commandant to “approve any arrangement, fitting, appliance, apparatus, equipment, calculation, information, or test, which provides a level of safety equivalent to that established by specific provisions of this subchapter”. The applicant is required to submit such requests to the Coast Guard Marine Safety Center (a Headquarters unit located in Washington, DC) via the local cognizant OCMI. All such proposals are evaluated strictly on a case-by-case basis.

The “Equivalents” regulations also allow for the Commandant to accept compliance by a high speed craft with the provisions of the International Maritime Organization (IMO) “Code of Safety for High Speed Craft” as an equivalent to compliance with applicable requirements of the relevant subchapter. These requests are also submitted to the Marine Safety Center via the cognizant OCMI. The IMO Code does not specify coamings, but addresses doors in a general way, as follows:

**“2.2.4** The means of closing openings in the boundaries of weathertight structures should be such as to maintain weathertight integrity in all operational conditions.”

“Special considerations”, described in 46 CFR 114.550 and 175.550 for K and T boats, respectively, empower the OCMI to “give special consideration to authorizing departures from the specific requirements when unusual circumstances or arrangements warrant such departures and an equivalent level of safety is provided”. The equivalent arrangement in these cases pertains only within the particular COTP zone under the OCMI’s cognizance and is for particular circumstances of a vessel’s design or operations. A special consideration request may in fact be for a particular voyage or event, for example, a boat approved for “oceans” service carrying extra passengers for an event (e.g., a fireworks display) in protected waters, with the appropriate added precautions such as sufficient lifesaving equipment.

Discussions with Coast Guard personnel reveal that there would be several factors to consider in an assessment of safety equivalency for doors without coamings, which are the following:

- Vessel’s route
  - COI area of operation
  - OCMI designation of waters in which the vessel may operate, for stability purposes, i.e., exposed, partially protected, or protected
- Door’s location – that is, the exposure to or protection from waves, spray, and precipitation
  - Height above design waterline
  - Proximity to bow
  - Proximity to deck edge
  - Purpose and use of weather deck accessed by the door, i.e., the type and frequency of use (e.g., evacuation, embarkation only, passenger seating), and the people who use the door (i.e., passengers or crew)

- Alternate access to interior space – that is, the ability to keep a particular door closed during operations while allowing the desired access through another. As an example, the embarkation doors, which may admit high numbers of passengers to the passenger cabin in short periods of time, may be closed during all operations while other weather doors from the cabin provide access to the evacuation deck.
- Downflooding potential through the interior space accessed and protected by the door
  - Size and configuration of the space
  - Drainage arrangements in the space
  - Downflooding path to lower deck spaces, in order of descending risk
    - Direct access to lower deck, by an unprotected downflooding path, e.g., a stairway
    - Indirect access to lower deck, e.g., protection by an interior door
    - No access to lower deck
- Stability consideration: can it be shown that downflooding can be sustained within the required stability safety margins?
- Doorway design
  - Alternate water barrier arrangements
  - Alternate deck drainage arrangements
  - Operational restrictions on use
  - Other engineering solutions

### 2.2 ADAAG and Advisory Committee Recommendations

The Americans with Disabilities Act of 1990 (ADA) applies to most passenger vessels. Yet, as of October 2004, no ADA standards or guidelines have been promulgated which specifically address passenger vessel access. However, the ADA Accessibility Guidelines for Buildings and Facilities (ADAAG) does exist and is found in the Appendix to 36 CFR Part 1191. Per ADAAG, the essentials of accessible doorway design are the following:

- Clear width of 32".
- Maximum threshold height of 1/2", 3/4" for sliding doors.
- Specific maneuvering clearances for many types of doors and approaches to the doors.
- 48" minimum distance between two doors in series.
- Reach range 48" max height for door hardware. Force to operate hardware of less than 5 pounds. Interior doors and exterior sliding doors opening force also less than 5 pounds.

In 1998, the Access Board established a 21-member Federal advisory committee to provide recommendations to assist the Board in developing passenger vessel accessibility guidelines. The committee included disability organizations, industry

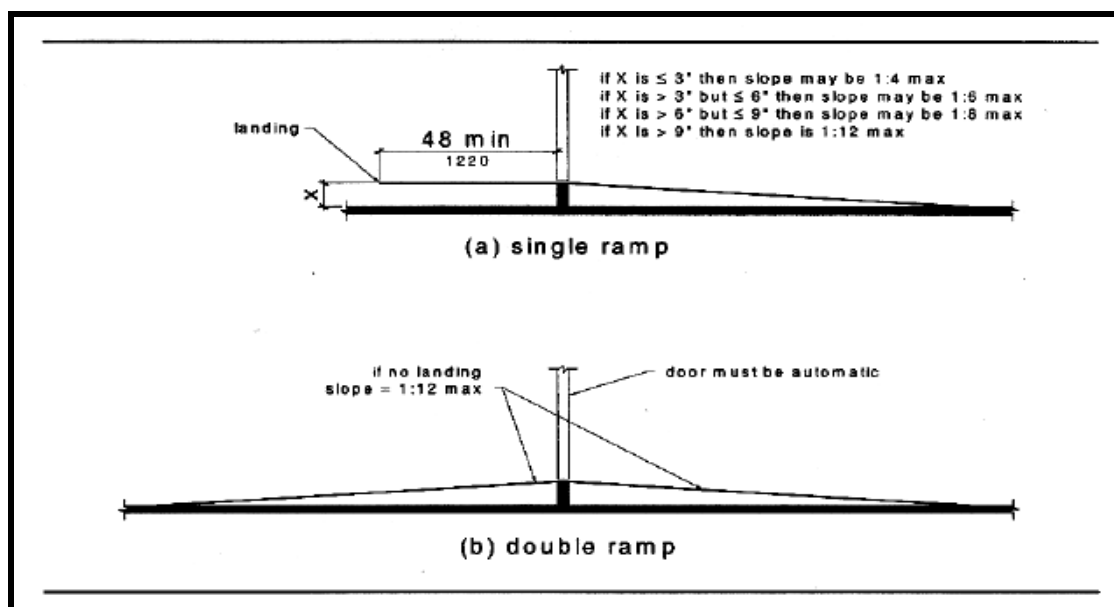


## ADA Access to Passenger Vessels: Finding Safety Equivalence Solutions for Weathertight Doors with Coamings

trade groups, State and local government agencies, and passenger vessel operators. The Passenger Vessel Access Advisory Committee (PVAAC) submitted a final report "Recommendations for Accessibility Guidelines for Passenger Vessels" in December 2000 (<http://www.access-board.gov/pvaac/status.htm>). The report mainly addressed Subchapter H and K vessels, with one chapter devoted to certain Subchapter T and C issues. Door specifications for both H and K vessels followed those from ADAAG very closely, with the important exception that PVAAC recognized the conflict between access and safety inherent in the weathertight door coaming regulations.

The Committee developed solutions only for ramping over the coamings, including the double ramp and single ramp methods (see Figure 2-1). Both methods modified a number of ADAAG door requirements to allow coamings and some degree of access to co-exist.

**Figure 2-1**  
**PVAAC Coaming and Ramp Solutions**



The PVAAC report did not include solutions eliminating coamings from weathertight doors, but in their meetings the Committee noted that ADAAG complying door designs could be developed which also provide an equivalent level of vessel protection as the coamings. The only specific design discussed by PVAAC involved having two doors in series, with the required separation and the operational requirement that one door always be closed.

The PVAAC report specified, without explanation or elaboration, the following for H and K boats:

**“206.5.3 Weather Deck Access.** Where the main deck of a passenger vessel is greater than 3,000 square feet (280 m<sup>2</sup>) at least one exterior door on each accessible weather deck shall comply with 404.2.5 (maximum threshold height of ½”) and shall be located on an accessible route that provides access between the weather deck and the interior of the passenger vessel, except where prohibited by an administrative authority having jurisdiction.”

The minutes of PVAAC meetings and subsequent discussions with members indicate that the reasons for this specification may be that larger vessels would have doors higher above the water the waterline and that small amounts of ingress from rain and spray could be sustained (similar to the Coast Guard’s interpretation of H boat weather deck closure requirements). The size may also allow better opportunities for placing a single accessible door in a low risk location, relative to water and wind.

### **2.3 Current Practice in the U.S. Passenger Vessels Fleet**

The vast majority of publicly available passenger boats in the ferry and excursion trades operating on a regularly scheduled “common carrier” basis are T and K vessels. The age of boats in this fleet ranges up to 100 years, and the majority of those are conventional monohulls predating the ADA of 1990.

Access onto these boats follows, nearly without exception, the safety regulations in Title 46 of the CFR. Weather doors have coamings as specified for boats operating in partially protected and exposed waters. Many other boats have the coamings as a matter of good marine practice, even when the operating area may not require it. Operators and crews are solicitous of passengers’ needs in general and of the access needs of disabled people in particular. It has been common practice for crew members to assist passengers in wheelchairs onto the vessels, especially where traditional marine design elements, such as coamings, prevent independent access.

Passengers on K and T boats commonly use weathertight doors for entry into the accommodation area, because the embarkation deck is usually the “main” deck. Interior doors commonly have no coamings. Doors to the weather on decks above the main deck may have coamings, although this is a matter of the designer’s preference rather than the regulatory requirements. Passengers very seldom encounter watertight doors, as those doors are found below the main deck in watertight subdivision bulkheads between working spaces like the engine room.

### **3 U.S. Fleet Case Studies**

#### **3.1 The *Flying Cloud* and *Lightning* (Harbor Express)**

The *Flying Cloud* and *Lightning* were built at the Gladding-Hearn Shipyard in Somerset, Massachusetts in 1996 and 1997 for the Harbor Express Company. Harbor Express currently operates the boats for the new owner, the Massachusetts Bay Transit Authority (MBTA), in service between Quincy and Hull, Massachusetts, and downtown Boston and Logan Airport.

The particulars of these boats are: 23.3 meters (76.4 feet) in length, 30 knots service speed, 3 crew (captain and two deck hands), 1930 horsepower with waterjet propulsion, 149 passenger capacity, and certification for “Limited Coastwise” service. The Stability Letters rate the boats for service in partially protected waters. They are designed as “bow loaders”, that is, the vessel’s bow contacts the dock at approximately equal freeboards (height above water to deck) and passengers board directly after the crew opens the gates on the boat (see Figure 3-1). The passengers then proceed to the cabin through double weathertight doors in the forward bulkhead (see Figure 3-2). These doors do not have coamings and have been accepted by the Coast Guard as providing equivalent protection as coamings would.

**Figure 3-1**  
**Bow Loading on the *Lightning*, August 14, 2003**



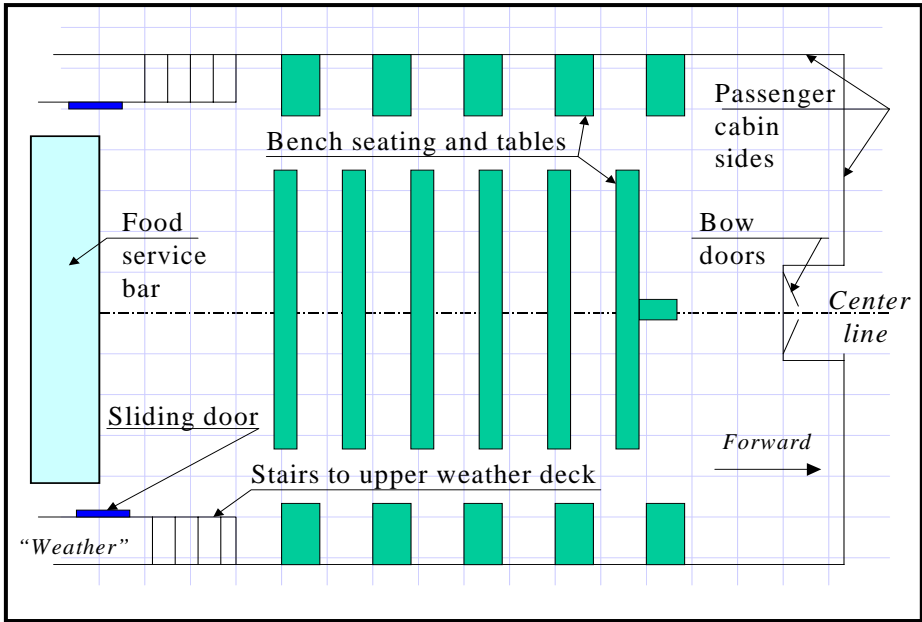
**Figure 3-2**  
**Access Through the Passenger Cabin Bow Doors**



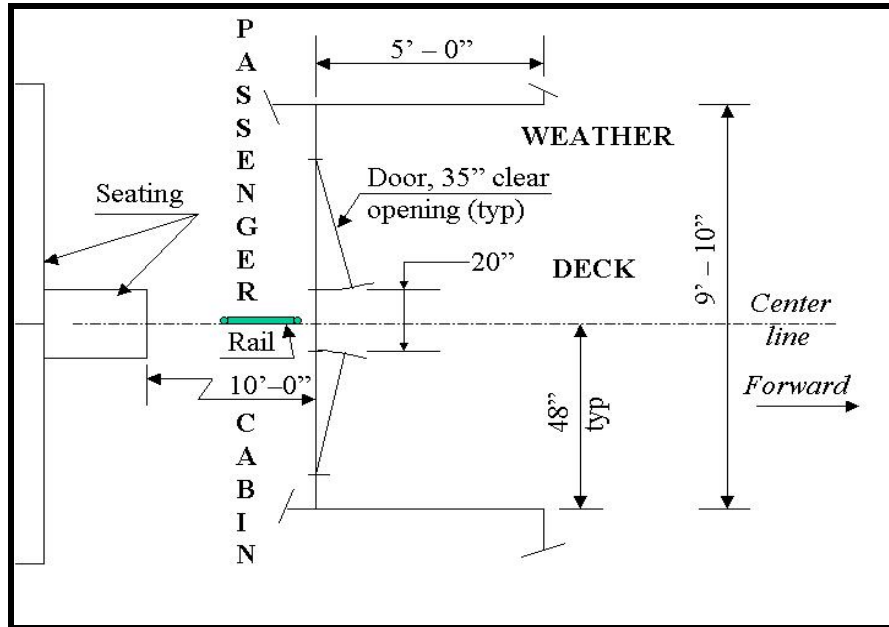
3.1.1 Description

The forward passenger cabin doors are approximately 36" wide each, and are symmetric about the centerline in the forward bulkhead of the passenger cabin, their inboard extremes about 18" apart (see deck layouts, Figures 3-3 and 3-4, and photograph, Figure 3-5). The doors are required to be closed at all times while the boat is operating.

**Figure 3-3**  
**Passenger Cabin, Plan View**



**Figure 3-4**  
**Flying Cloud Bow Doors, Deck Plan**



**Figure 3-5**  
**Bow Doors, Flying Cloud**



The status of the bow doors' compliance with the relevant ADAAG door specifications is as follows:

4.13.5 Minimum clear opening of 32 in (815 mm) with the door open 90 degrees.

Status: The clear opening of each of these doors exceeds 32".

4.13.6 Minimum maneuvering clearances at doors that are not automatic or power-assisted shall be as shown in Figure 25.

Status: Figure 25(a), "front approaches – swinging doors", pertains. The maneuvering space on the "pull side", that is, on the weather deck, complies. The maneuvering space on the "push side", that is, inside the cabin, does comply also. The lateral space requirement of 12 inches on the handle side of the door does not pertain because the door is not the "closer and latch" type.

The floor or ground area within the required maneuvering clearances shall be level and clear. The deck line has "sheer" in this area, that is, it declines towards the aft end; this angle also changes with the static attitude of the boat (known as trim and heel) as well as the dynamic motion (pitch and roll). Even in the static standard load condition, the bow doors on these boats do not meet the letter of this specification.

4.13.8 Thresholds at doorways shall not exceed 3/4 in (19 mm) in height for exterior sliding doors or 1/2 in (13 mm) for other types of doors. Raised thresholds and floor level changes at accessible doorways shall be beveled with a slope no greater than 1:2.

Status: The doors meet this standard.

4.13.9 Door Hardware. Handles, pulls, latches, locks, and other operating devices on accessible doors shall have a shape that is easy to grasp with one hand and does not require tight grasping, tight pinching, or twisting of the wrist to operate.

Status: The hardware for each of these doors includes two "dogs" (levered closing devices which secure the door at several points around its perimeter, operable from both sides of the door) in addition to the conventional door handle. These are intended for operation by the crew only and would not be ADAAG compliant in any case for the reason, among others, that one is mounted higher than the guidelines allow. These dogs are required for proper weathertight sealing of the door.

4.13.10 Door Opening Force. The maximum force for pushing or pulling open a door is 5 pounds.



## **ADA Access to Passenger Vessels: Finding Safety Equivalence Solutions for Weathertight Doors with Coamings**

---

Status: The design specifications for these doors do not include opening force; the specification does not apply to this exterior hinged door.

The doors rest on a very short sill plate (less than ¼” high) and are bounded on both sides by series of aluminum plates, laid transversely, with narrow (3/16”) intervening gaps for drainage (see Figure 3-5). Water entering those gaps drains into a segregated cofferdam structure below and then directly to the ocean between the catamaran hulls.

**Figure 3-6**  
**Drainage Detail Forward of Doors, *Lightning***



The deck structure in the passenger cabins of *Lightning* and *Flying Cloud* has one important feature: it is completely separate from the watertight envelope of the catamaran hulls. The weather deck (or main deck) is, in this case, the plating and structure forming the top of each hull and is watertight, not weathertight. Transverse structural frames connect the hulls, and all the superstructure, passenger cabin and deck included, sits on top of those frames. Figure 3-6 shows an open access cover and the manhole beneath and illustrates the separate deck structures. All service connections between hull and superstructure (e.g., wiring and piping) have watertight hull penetrations and the spaces within the hulls are unmanned (i.e., there is no regular access to them during operations). Access therein for maintenance and repair is via non-tight hatches in the passenger deck leading to watertight “manholes” in the hull tops.

**Figure 3-7**  
**Access to “Main Deck” Manhole, *Lightning***



The passenger cabins on these boats also have sliding doors toward the stern end of the passenger, both port and starboard, providing access for the passengers to the weather decks and stairways to the upper deck. There is very limited weather deck space on the cabin deck, essentially providing landings for the stairways (which are not accessible). The opening force of this door is not known.

The status of the aft sliding doors' compliance with the relevant ADAAG door specifications is as follows:

4.13.7 Minimum clear opening of 32 in (815 mm).

Status: The clear opening of each of these doors exceeds 32”.

4.13.8 Minimum maneuvering clearances at doors that are not automatic or power-assisted shall be as shown in Figure 25.

Status: Figures 25(d & e), “front” and “slide side” approaches for sliding or folding doors, pertain. The maneuvering spaces for both approaches are not sufficiently wide, because of the proximity of the snack bar inside and the deck edge on the weather deck.

The floor or ground area within the required maneuvering clearances shall be level and clear. The deck line has less “sheer” in this area, but the deck’s angle changes with the static attitude of the boat as well as the dynamic motion, as for the forward doors.

4.13.8 Thresholds at doorways shall not exceed 3/4 in (19 mm) in height for exterior sliding doors or 1/2 in (13 mm) for other types of doors. Raised thresholds and floor level changes at accessible doorways shall be



beveled with a slope no greater than 1:2.

Status: The sliding doors do not meet this standard on either count. The doors' tracks are 1" X 1" X ½" angles welded to the deck, slightly exceeding the height maximum. There is no beveling of the deck on either side of the tracks.

- 4.13.11 Door Hardware. Handles, pulls, latches, locks, and other operating devices on accessible doors shall have a shape that is easy to grasp with one hand and does not require tight grasping, tight pinching, or twisting of the wrist to operate.

Status: The sliding doors have push-type mechanisms mounted below the 48" maximum height.

- 4.13.11 Door Opening Force. The maximum force for pushing or pulling open a door is 5 pounds.

Status: The design specifications for these doors do not include opening force; it is therefore unknown whether the doors comply, particularly under the influence of ship's motion.

### 3.1.2 Discussion

Review of the *Flying Cloud's* file indicates that no equivalency or special consideration was approved for the forward deckhouse doors. Interviews with Coast Guard personnel involved<sup>4</sup> indicate that there are two keys to understanding the acceptance of these doors without coamings. The first is that the doors are always closed during operations, that is, once the boat leaves the dock.

The second, and most important, reason is the separate construction of the passenger cabin deck and of the watertight decks forming the upper bounds of the catamaran hulls. The structure connecting the two hulls, and supporting the superstructure of the cabin and pilot house, lies on top of the hulls' upper watertight boundaries. These hulls, which provide the boat's reserve buoyancy and stability, are strictly segregated from the overlying structure.

The clear reason for the acceptance of this design is that there is no opportunity for downflooding, even if water does enter the passenger cabin. Presuming that all manholes into the hulls' main decks are closed as required (all spaces below are unmanned), there are simply no downflooding pathways for the water to follow. There is a potential concern that the free surface effect of water trapped in the cabin could

---

<sup>4</sup> CWO Ray Rock currently serves at the Providence MSO, and conducted numerous surveys during construction of the *Flying Cloud*; he was interviewed over the telephone in August, 2003. LT Jason Hall of the MSO Boston Inspections Department was interviewed on September 8, 2003 at MSO Boston.

also significantly degrade stability; the *Flying Cloud* file does not address that scenario, probably because of the drainage and closure arrangements. It is likely, furthermore, that the excellent transverse stability provided by the catamaran's broad beam can sustain flooding of the passenger deck in the unlikely event that large amounts of water were to gain entry. The designers also took the extra precaution of providing an alternate drainage system both forward and aft of the doors.

### **3.2 Other Vessels**

Research into other passenger vessel operators reveals that many T and K boats have weathertight doors without coamings, located on the main deck. These craft, in fact, are certificated to operate on "lakes, bays, and sounds" waters, and have "protected waters" language in their stability letters. They are, therefore, not subject to the explicit coaming requirements in Subchapters K and T. In the absence of specific knowledge of the designer's intentions and the Coast Guard's review, the likely scenario is that the Subchapter S provisions were not applied in these cases.

The New York Waterways ferries operation is a good example. Many of their boats are bow loaders in commuter service, similar to *Flying Cloud* and *Lightning* in this respect, designed to move large numbers of people on and off quickly. There are sliding double doors in the forward bulkheads of the deckhouses, with no coamings. These doors in the cases of their older, slower boats may even be left open during operations so that passengers can take the air on the bow.

Many of these boats have doors that serve to provide both embarkation access and deck access during operations. Some commuter ferries (e.g., *Flying Cloud* and *Lightning*) have separate doors for these purposes. In the latter case, embarkation and disembarkation are through doors only opened for that purpose, and which are always closed during operations.

Sayville Ferry Service reported operating vessels both with and without coamings, as well as another under construction without coamings, all in respect of the main deck weathertight doors. The COIs for these boats are for "lakes, bays and sounds" and the stability letters for "protected waters", as for New York Waterways boats. The Subchapter T coaming regulation does not apply and there is no "equivalent" or "special consideration" called for. The likely scenario again is that the Subchapter S provisions were not applied in these cases.

The Alaska Marine Highway (AMH) is constructing two high speed vehicle and passenger ferries, the *Fairweather* and *Chenega*, at Derecktor Shipyards in Mamaroneck, New York. These catamarans will be 73 meters in length and will each carry 250 passengers and 35 large vehicles at a continuous-rating service speed of 35 knots. They are classed with Det Norske Veritas (Maltese Cross 1A1 HSLC) and have been accepted by the Coast Guard as fully compliant with international Safety of Life at Sea (SOLAS) and High Speed Craft (HSC) Codes.

*Fairweather* and *Chenega* will operate between Sitka and Juneau, Alaska, with the DnV "R3" service restriction. R3 means that the vessel must operate within 20 nautical miles of a safe harbor or anchorage in winter conditions and within 50 nautical miles of a safe harbor or anchorage in summer conditions. Project staff has not learned which area of

## ***ADA Access to Passenger Vessels: Finding Safety Equivalence Solutions for Weathertight Doors with Coamings***

---

operation is to appear on these vessels' stability letters; R3 is the rough equivalent of "partially protected" waters.

The Coast Guard indicated to ATBCB that these craft have "minimal coamings". Correspondence with AMH and Derecktor indicates that the doors in question were designed with 1-½" coamings, with grated ramps and deck drains. The weather deck served by these doors is well above the vessel's main deck, at sufficient height that there is no chance of entry by waves on deck. An overhanging deck keeps rain and spray off the adjacent deck as well. Even in the most extreme listed damage condition, there is no chance of sea water entering through the doors in question.

*Fairweather* and *Chenega* do not require Coast Guard approval of equivalency or special consideration for the weathertight doors in question. The Subchapter K regulations state that coamings are required for doors "on the main deck of a flush decked vessel". The main deck for *Fairweather* and *Chenega* is the vehicle deck, and the passenger accommodation decks are considerably higher, with negligible risk of ingress through the weather doors. These doors would also satisfy the Subchapter S coaming regulation as they are not in an "exposed" location.



## **4 Summary**

### **4.1 Regulations Review and Case Studies**

The intent of the Coast Guard's watertight integrity regulations is to protect against water ingress into passenger accommodation spaces and downflooding into spaces below. The ultimate hazard that the regulations aim to prevent is capsizing, an event whose potential, and unacceptable, consequence is the deaths of many people. The regulations therefore aim to minimize the probability of capsizing to the greatest extent possible.

The regulations with regard to watertight integrity for Subchapter K and T passenger vessels include provisions for coamings at weathertight doors and are an important element of the vessel stability regulations found in Subchapters K and T and in Subchapter S "Stability". The two specified coaming heights of 6" and 3" correspond to exposed or partially protected waters and protected waters, respectively, as specified in each boat's Coast Guard Stability Letter.

The new Subchapters K and T post-date Subchapter S, which regulates all vessels under 100 gross tons, and do not specifically supersede Subchapter S's weathertight door coaming regulation. The K and T coaming regulation is prescriptive where S allows for interpretations based upon onboard door location and the associated downflooding potential. The terms of reference in these three subchapters differ and can be confusing. The interpretation of Subchapter S can in some cases result more stringent requirements for passenger boats operating on protected waters, while T and K prescription may in some cases be more stringent for boats on exposed and partially protected routes.

It is evident that different designers make different choices in the application of these coaming regulations. It is the author's opinion, however, that Subchapter T and K regulations are most commonly applied in the current fleet. For the "flush deck" vessels with doors on the "main deck" which make up most of the affected passenger fleet, those regulations allow for coaming-less weathertight doors in protected waters and require coamings in "partially protected" or "exposed" waters.

That state of affairs required re-examination of the premise of the scope of work, that Volpe Center conduct case studies of "exemptions" from the coaming regulation, in light of the intent and application of Coast Guard regulations and procedures. The Coast Guard does not exempt vessels from safety regulations, but will consider and may approve alternate designs or arrangements as providing equivalent safety to the regulation in question, under the "equivalents" or "special considerations" provisions found in both Subchapters K and T.

The correspondence with the Coast Guard by the Access Board and the Volpe Center did not reveal cases of specifically approved "equivalent" designs or "special considerations" in the matter of the coaming regulations for K and T boats. The results of the cases examined are nonetheless instructive, and are summarized below:

- The Coast Guard approved doors without coamings on the *Flying Cloud* and *Lightning*, catamarans operated by the Harbor Express in Boston on “partially protected” waters, without any special approval. The most important reason is the separate construction of the passenger cabin deck and of the watertight decks forming the upper bounds of the catamaran hulls, which allow no opportunity for downflooding, even if water does enter the passenger cabin. In addition, the doors are always closed during operations, and there is a specially designed drainage system both forward and aft of the doors.

The bow doors used for embarkation and disembarkation meet ADAAG specifications for width and threshold, but not for door hardware or level floor surface. They were, however, observed to be very effective for passengers in wheelchairs. The aft port and starboard sliding doors comply with the width and hardware specifications, but not the threshold and maneuvering space requirements.

- *Fairweather* and *Chenega*, catamaran car and passenger ferries under construction for the Alaska Marine Highway, have weathertight doors without coamings which did not require Coast Guard approval of equivalency or special consideration. The main deck for *Fairweather* and *Chenega* is the vehicle deck, and the passenger accommodation decks are considerably higher, with negligible risk of ingress through the weather doors in question. The ingress hazard is therefore abated due to the doors’ locations.
- Many K and T boats are approved for operation with coaming-less doors located on the main deck. The cases examined include several bow-loading ferries with doors in the forward end of the deckhouse, designed to move large numbers of passengers on and off quickly. These boats were found to operate in protected waters, where coamings are not required due to the low likelihood of boarding waves and the near proximity of safe harbors or anchorages.

#### 4.2 Recommendations for Phase 2

The apparent dearth of currently approved alternate designs for coamings does not imply that Phase 2 of this project should not go forward and indeed suggests that the need to develop such designs is more urgent. The task will, however, be more difficult without the guidance of successful examples. The following elements for execution of Phase 2 are suggested:

- Coast Guard participation – The cooperation and formal participation of the Coast Guard is crucial and may require a formal request from either the Board or the Office of the Secretary of Transportation. The Coast Guard should review the philosophical approach to the work in general and the technical approach to specific design solutions. The ultimate result would be their imprimatur on the technical guidance published by the Board, without which the acceptance and success of the document would be doubtful.

## ***ADA Access to Passenger Vessels: Finding Safety Equivalence Solutions for Weathertight Doors with Coamings***

---

- Reconfiguration solution – The work will include an outline of guidance as to where and under what operational conditions doors without coamings are acceptable without special approval, as in the cases described in Chapter 3. The project team will investigate modified arrangements of two passenger vessel types (to be approved by the Access Board), showing an adjusted layout which eliminates the coaming requirement for at least one door and provides the desired access to passenger accommodation areas.

Reconfiguration may entail more than the simple rearrangement of weathertight doors. Other considerations may include provision of alternate doorways and other modifications addressing downflooding potential.

- Doorway design – Candidate alternate design work should include:
  - Further development of the concepts proposed by the PVA Advisory Committee in their 2000 report.
  - Investigation of removable or hinged coamings and protocols for their use.
  - Investigation of doors without coamings requiring special approval and the development of associated water control and drainage arrangements suitable for common vessel types.
  - Identification of operational practices required for implementation in concert with the alternate designs, for example, the requirement that the door only be operated at certain times.
- Other arrangements, such as double deck construction, that address the hazards and risks in different ways and allow for redesign for accessible doors.
- Assistance from the Coast Guard as may be necessary to identify candidate passenger vessels for the doorway design and analysis. Most observed during the Phase 1 work do not have the weather deck doorway coamings for a variety of reasons, some alluded to above. Volpe Center will work with local Marine Safety Offices (e.g., Boston and Providence) to find such vessels nearby, in order to minimize travel costs. We suggest that monohull K boat and a catamaran (either T or K boat) should be the two types examined for Phase 2.

The Board should also consider an initial investigation of the need for water flow and control modeling, comparing the performance of compliant doors with coamings to alternate door designs. Doors without coamings or ramps could be acceptable if shown to provide equal protection by use of computer or scale modeling simulations. The consideration of such simulation work is beyond the scope of this project, but development of its technical framework could be undertaken in cooperation with Coast Guard safety experts.





## **REFERENCES**

Coast Guard Maine Safety Manual Chapter 3: Documentation of Vessel Inspections.

Code of Federal Regulations, Title 46, Subchapters C, H, K, S, and T.

Passenger Vessel Access Advisory Committee, "Recommendations for Accessibility Guidelines for Passenger Vessels: Final Report", December 2000.

#

APPENDIX A

**Coast Guard Documentation for Inspected Passenger Vessel**

- 1. Stability Letter**
- 2. Certificate of Inspection**

# ADA Access to Passenger Vessels: Finding Safety Equivalence Solutions for Weathertight Doors with Coamings

## 1. STABILITY LETTER

U.S. Department  
of Transportation  
  
United States  
Coast Guard



Commanding Officer  
United States Coast Guard  
Marine Safety Center

Washington, DC 20590-0001  
Staff Symbol: MSC-1  
Phone: (202)366-6481  
Fax: (202)366-3877

### STABILITY LETTER

16710/P002920  
Ser H1-9603368  
November 6, 1996

Master, FLYING CLOUD; O.N. 1047743  
82' 8" x 27' 6" x 8' 4" Catamaran Small Passenger Vessel (T-L)

You are responsible for maintaining this vessel in a satisfactory stability condition at all times and for following the instructions and precautions listed below.

A deadweight survey, witnessed by the U. S. Coast Guard, was conducted on the FLYING CLOUD, O.N. 1047743, at Somerset Massachusetts, on November 5, 1996. On the basis of that survey, and a conservative estimate of the vertical center of gravity, stability calculations have been performed. Results indicate that the stability of the FLYING CLOUD, as presently outfitted and equipped, is satisfactory for operation on Partially Protected Waters, provided that the following restrictions are observed.

### DAMAGE SURVIVAL

When operated as indicated below, calculations indicate this vessel will stay upright (no more than 7 degrees of list under ideal conditions) after bottom damage, when the bottom damage is limited to any one major compartment in either hull, and not more than

1 foot 0-1/4 inches upward from the bottom of either hull. A major compartment is the total space between any two adjacent Main Transverse Watertight Bulkheads (MTWB'S). For this vessel, these MTWB'S are located at the following longitudinal locations forward of the transom in each hull: 7 feet 10 inches (frame 2), 30 feet 10 inches (frame 8), 46 feet 7 inches (frame 12), and 65 feet 10 inches (frame 17). Calculations further indicate this vessel will stay upright when damage is limited to both hulls (concurrently) forward of the collision bulkheads, which are located in frame 17 of each hull.

Calculations indicate this vessel will stay upright (no more than 7 degrees of list under ideal conditions) after side damage when the side damage is limited to any one major compartment in either hull and not more than 3 feet inboard from the side of either hull. To maintain the vessel upright after flooding (damage), the heeling forces imposed by wind, wave, and passenger movements must be minimized. The calculations do not specifically account for high winds, heavy seas, or the movement of many passengers to one side.

### OPERATING RESTRICTIONS

1. ROUTE: Operation on Partially Protected Waters may be permitted. Since the vessel's route is based upon other considerations in addition to stability, you are cautioned that

16710/P002920  
Ser H1-9603368  
November 6, 1996

Subj: FLYING CLOUD, O. N. 1047743; STABILITY LETTER

the route may be further limited to that specified on the Certificate of Inspection.

2. PERSONNEL: A maximum of 153 persons may be carried on this two deck vessel, of which 149 may be passengers. Up to 100 persons may be carried on the uppermost passenger deck. Since the personnel capacity is based upon other considerations in addition to stability, you are cautioned that the number of persons carried may be further limited to that specified on the Certificate of Inspection.
  3. DRAFT AND TRIM: The vessel is limited to a maximum draft of 3 feet 10-1/2 inches above baseline. This corresponds to a minimum freeboard amidships measured from the top of the guard to the waterline of 5 feet 0-1/2 inches. Amidships is located 6-1/4 inches aft of frame 10. Trim shall be minimized.
  4. WATERTIGHT BULKHEADS: There are no watertight doors in any MTWB's. No watertight bulkheads shall be removed or altered without the authorization and supervision of the cognizant Officer in Charge, Marine Inspection (OCMI).
  5. HULL OPENINGS: Any openings that could allow water to enter into the hull or deckhouse should be kept closed when rough weather or sea conditions exist or are anticipated.
  6. TANKS: Any cross-connections between port and starboard tank pairs shall be kept closed at all times when underway.
  7. WEIGHT CHANGES: This stability letter has been issued based upon the following light ship parameters:

Displacement	42.91 Long Tons
VCG (Conservative Estimate)	10.60 Feet Above the Baseline
LCG	6.92 Feet Aft of Amidships
- Any alteration resulting in a change in these parameters will invalidate this stability letter. No fixed ballast or other such weights shall be added, removed, altered and/or relocated without the authorization and supervision of the cognizant OCMI. The vessel is not fitted with permanent ballast.
8. BILGES: The vessel's bilges and voids shall be kept pumped to minimum content at all times consistent with pollution prevention requirements.
  9. SCUPPERS AND FREEING PORTS: Cockpit scuppers and deck freeing ports shall be maintained operable and completely unobstructed at all times.

**ADA Access to Passenger Vessels: Finding Safety Equivalence Solutions for  
Weathertight Doors with Coamings**


---

16710/P002920  
Ser H1-9603368  
November 6, 1996

Subj: FLYING CLOUD, O. N. 1047743; STABILITY LETTER

10. LIST: You should make every effort to determine the cause of any list of the vessel before taking corrective action.

This stability letter shall be posted under glass or other suitable transparent material in the pilothouse of the vessel so that all pages are visible.



D. C. AURAND  
Commander, U. S. Coast Guard  
By direction of the Commanding Officer

2. CERTIFICATE OF INSPECTION

	United States of America Department of Transportation United States Coast Guard			IMO Number: _____																								
	Certificate of Inspection																											
Vessel Name FLYING CLOUD		Official Number 1047743	Call Sign WCW9486	Service Passenger (More Than 6)																								
Hailing Port BOSTON MA		Hull Material FRP	Horsepower 1930	Propulsion Diesel Reduction																								
Place Built SOMERSET MA, UNITED STATES		Delivery Date 08Nov1996	Date Keel Laid 20Jul1996	Gross Tons R-70 I-141	Net Tons R-47 I-54	DWT	Length R-75.8 I-75.8																					
Owner MASSACHUSETTS BAY TRANSPORTATION AUTHORITY ATTN GENERAL COUNSEL TEN PARK PLAZA BOSTON, MA 02116-3974 UNITED STATES		Operator WATER TRANSPORTATION ALTERNATIVES 703 WASHINGTON STREET QUINCY, MA 02169 UNITED STATES																										
This vessel must be manned with the following licensed and unlicensed personnel. Included in which there must be 0 certified lifeboatmen, 0 certified tankermen, 0 HSC type rating, and 0 GMDSS Operators.																												
1 Master	Master & 1st Class pilot	Radio Officer(s)	Chief Engineer	QMED/Rating																								
Chief Mate	Mate & 1st Class Pilot	Able Seamen/ROANW	1st Asst. Engr/2nd Engr.	Ollers																								
2nd Mate/OICNW	Lic. Mate/OICNW	Ordinary Seamen	2nd Asst. Engr/3rd Engr.																									
3rd Mate/OICNW	1st Class Pilot	2 Deckhands	3rd Asst. Engr.																									
			Lic. Engr.																									
In addition, this vessel may carry 149 passengers, 0 other persons in crew, 1 persons in addition to crew, and no others. Total persons allowed: 153																												
Route Permitted and Conditions of Operation:  ---Lakes, Bays, and Sounds plus Limited Coastwise---  BETWEEN CAPE ANN, MASSACHUSETTS AND MANOMET POINT, MASSACHUSETTS NOT MORE THAN TWENTY MILES FROM A HARBOR OF SAFE REFUGE UNDER REASONABLE OPERATING CONDITIONS.  IF THE VESSEL IS AWAY FROM A DOCK, OR PASSENGERS ARE ON BOARD OR HAVE ACCESS TO THE VESSEL FOR A PERIOD EXCEEDING 12 HOURS IN ANY 24 HOUR PERIOD, AN ALTERNATE CREW SHALL BE PROVIDED.  NO MORE THAN 54 PASSENGERS ARE ALLOWED ON THE UPPER DECK.  A CHILD SIZE LIFE PRESERVER SHALL BE PROVIDED FOR EACH CHILD ON BOARD.  ***SEE NEXT PAGE FOR ADDITIONAL CERTIFICATE INFORMATION***																												
With this Inspection for Certification having been completed at Quincy, MA, the Officer in Charge, Marine Inspection, MSO BOSTON certified the vessel, in all respects, is in conformity with the applicable vessel inspection laws and the rules and regulations prescribed thereunder.																												
Annual/Periodic/Quarterly Reinspections <table border="1" style="width: 100%; border-collapse: collapse;"> <thead> <tr> <th>Date</th> <th>Zone</th> <th>A/P/Q</th> <th>Signature</th> </tr> </thead> <tbody> <tr><td> </td><td> </td><td> </td><td> </td></tr> <tr><td> </td><td> </td><td> </td><td> </td></tr> <tr><td> </td><td> </td><td> </td><td> </td></tr> <tr><td> </td><td> </td><td> </td><td> </td></tr> <tr><td> </td><td> </td><td> </td><td> </td></tr> </tbody> </table>			Date	Zone	A/P/Q	Signature																					This certificate issued by:  B. M. SALERNO, CAPT, USCG Officer in Charge, Marine Inspection  MSO BOSTON Inspection Zone	
Date	Zone	A/P/Q	Signature																									