



FLIGHT SAFETY FOUNDATION
CABIN CREW SAFETY

Vol. 31 No. 1

For Everyone Concerned with the Safety of Flight

January–February 1996

Tests Examine Techniques for Alternative Uses of Flotation Seat Cushions

Airlines' safety instructions to passengers note that seat cushions can be used as individual flotation devices after an emergency water landing. The U.S. Federal Aviation Administration Civil Aeromedical Institute sought to determine whether flotation seat cushions could be used more creatively to benefit the injured and children among survivors, and help keep groups of survivors together. Under test conditions, several specialized cushion-use techniques appeared to offer benefits.

*Robert L. Koenig
Aviation Writer*

When an aircraft makes an emergency landing in water, and there is no opportunity to distribute inflatable life vests, flotation seat cushions can help passengers survive by keeping them afloat. Nevertheless, the flotation seat cushions may be of little use to some injured survivors unless they have assistance. Moreover, survivors may have to share flotation seat cushions with other survivors.

Most airlines' safety information cards instruct passengers on how best to hold onto their flotation seat cushions in an accident. But such instructions do not explain how best to share flotation seat cushions with other passengers, or how to use the flotation seat cushions to help protect children or injured survivors in the water.

To understand such emergency situations, and to develop alternative methods for passengers to use flotation seat cushions, the U.S. Federal Aviation Administration (FAA) Civil Aeromedical Institute (CAMI) conducted a series of tests at the institute's heated "survival tank" and in the unheated wave pool of a nearby water-theme park in Oklahoma City, Oklahoma, U.S.

The researchers found that among suggested techniques for sharing flotation seat cushions, some methods are more useful

than others for rescuing children or badly injured survivors. In general, the tests showed the value of teamwork in optimizing the value of flotation seat cushions.

"Survivors [who] form and maintain groups should be able to assist others more efficiently by sharing responsibilities and resources," suggested the report, *Alternative Methods for Flotation Seat Cushion Use*, which was written by CAMI researchers Gordon E. Funkhouser and Mark H. George.

"Techniques that place and keep survivors in close proximity to each other should have the added benefit of maintaining a sense of emotional well-being, while decreasing the effects of shock and hypothermia," the report said.

Some techniques also helped survivors group in clusters. "Because individual floating objects tend to separate in moving water," the report concluded, "grouping prevents survivors from drifting away from each other and becoming lost. Groups also make a larger visual target for rescuers to identify."

U.S. Federal Aviation Regulations (FARs) set minimum design and performance standards for flotation seat cushions, and require large aircraft that operate over water to be equipped with such cushions or life preservers.¹

Typically, airlines' safety information cards include drawings that show passengers how to hold flotation seat cushions following an emergency landing in water. The recommendation is for a passenger to hold a single cushion to the chest.

But a safety study by the U.S. National Transportation Board (NTSB) noted that it is unlikely that every passenger needing the aid of a flotation seat cushion in an emergency will be conscious, uninjured and fully capable of using the cushion without help.² Aviation safety officials have expressed concerns that the instructions do not explain how survivors can share flotation seat cushions; use them to help unconscious or otherwise injured survivors; protect survivors from hypothermia in cold water; help infants or children; or help prevent survivors from drifting away.

Therefore, CAMI researchers proposed other methods of using the flotation seat cushions, and tested those techniques in Oklahoma City on volunteers from CAMI's Cabin Safety Workshops, as well as on participants hired by a local contractor to take part in the testing.

The test participants, adult men and women, were capable swimmers and in good physical condition. A flotation dummy the size and weight of a two-year-old child was used to simulate rescue techniques for children.

The flotation tests took place in water temperature of about 89 degrees F (32 degrees C) in CAMI's survival tank, and in water temperature of about 69 degrees F (21 degrees C) in the wave pool at Oklahoma City's White Water Bay theme park. Video cameras above the water surface recorded the tests.

The flotation seat cushions used in the tests were new and conformed to FAA Technical Standard Order (TSO) C-72c.³ They were made with parallel straps, 9.5 inches (24.1 centimeters) apart, that were sewn to the bottoms of the cushion covers (photo right, top).

The five cushion-use techniques tested were:

- **Technique 1.** Two persons face each other, hold two flotation cushions between them, and grasp the straps of the other person's cushion (photo right, center);
- **Technique 2.** The two persons in the situation described in technique 1 hold a third, cushion-less person between their two cushions (photo right, bottom);
- **Technique 3.** Two persons face each other while each holds his or her cushion behind the other person's back (photo, page 3, top);
- **Technique 4.** The two persons in the situation described in technique 3 hold a third, cushion-less person between them (photo, page 3, center); and,
- **Technique 5.** A number of people hold cushions and interlock their arms to form a large cluster in the water (photo, page 3, bottom).



Source: U.S. Federal Aviation Administration/Civil Aeromedical Institute
Flotation seat cushions



Source: U.S. Federal Aviation Administration/Civil Aeromedical Institute
Technique 1, CAMI Flotation Seat Cushion Study



Source: U.S. Federal Aviation Administration/Civil Aeromedical Institute
Technique 2, CAMI Flotation Seat Cushion Study

All five techniques were first demonstrated in a classroom, then in calm water in the CAMI survival tank and finally in the unheated wave pool to simulate open-water conditions.

"In all configurations, the subjects were asked to interlock ankles or legs to form a more stable unit and to conserve body heat," the report said.

The CAMI research staff observed the flotation tests, reviewed the videotapes and interviewed the test participants to assess the merits of each technique.



Source: U.S. Federal Aviation Administration/Civil Aeromedical Institute

Technique 3, CAMI Flotation Seat Cushion Study



Source: U.S. Federal Aviation Administration/Civil Aeromedical Institute

Technique 4, CAMI Flotation Seat Cushion Study



Source: U.S. Federal Aviation Administration/Civil Aeromedical Institute

Technique 5, CAMI Flotation Seat Cushion Study

The assessments included these observations:

- **Techniques 1 and 2** were found to be simple and effective. The first two methods, in which cushions are held between two people (with or without a third survivor in-between) “are beneficial when linking-up is difficult because of rough seas, and when heat loss is not a problem,” the report said.

Researchers determined that technique 1 “appeared to be easy to initiate and maintain. It was a simple maneuver to separate

and rejoin the two cushions around an ‘injured’ person to form [technique 2].”

Technique 2 (with the two persons in technique 1 holding a third, cushion-less person between the two cushions) also would be helpful in retaining body heat in cold water, researchers found. “Using this technique, the outer subjects’ chests were covered by the cushions and the ‘injured’ person in the middle was covered, both chest and back, by the cushions,” the report said. “This coverage should retard heat loss.”

Researchers also suggested that “very limited observations, using the small flotation dummy, suggest that the second technique could be used effectively to assist a child when he/she is placed between the adults’ cushions.”

- **Technique 3** was adjudged more difficult to accomplish. This technique (two persons face each other while each holds his or her cushion behind the other person’s back) “was somewhat more difficult for the subjects to achieve,” the report said.

“It also made it more difficult to hold the cushions down in the water. Similarly, it was more difficult to introduce an ‘injured’ person between the two people, while maintaining control of the cushions.”

- **Techniques 3 and 4** would help retain body heat. Despite the difficulties, researchers said, all the test subjects were able to accomplish techniques 3 and 4, both in the CAMI tank and in the wave pool. And both technique 3 and technique 4 — in which a third, cushion-less person was held between the other two persons — would help the survivors retain body heat in the water.

“The chest and back of the ‘injured’ survivor was covered by the chests of the cushion-holders,” researchers reported. “These were, in turn, covered front and back by either a cushion or by another member of the unit, further serving to retain body heat.”

- **Technique 5** would help groups survive. In general, researchers found that clustering survivors “allows for more support and help for injured and unconscious survivors. Because individuals tend to separate in the water, the cluster also presents a large visual target for rescuers.”

In most tests, researchers reported, the interconnected group became “a randomly formed cluster that used any means to stay together.” The methods that test participants used to keep close in the water included “interlocking arms, holding the straps on another’s cushion and grasping another’s clothing.”

Some groups of test participants formed short chains “by placing their cushions between their chests and the backs of others. These chains were then connected laterally by interlocking arms or reaching over to grasp the straps of another’s cushion.”

Such clustering tended to retard heat loss, the report said. "The subjects in the center of the group were covered on all sides with cushions and bodies of other people." In fact, some of the cluster-group participants in CAMI's heated survival tank "complained of being uncomfortably warm."

In all the cluster groups, researchers reported, "subjects had a tendency to continue moving their legs around, as if to tread water. With frequent reminding, they would link legs and cease movement, allowing them to remain buoyant and conserve energy and heat."

Flotation seat cushions "are unique among emergency flotation equipment, in that they cannot be used properly by a passive survivor," the CAMI report noted. "Inflatable devices allow the victim to relax at some point, but [flotation] seat cushions require diligent personal attention from the onset of crisis until rescue is completed." That is one reason why flotation seat cushions tend to be used only "when they are the only means of flotation available, or when there is no time to equip passengers with inflatable life vests."

But when flotation seat cushions are the only alternative, some of the techniques developed and tested by CAMI researchers can be effective in assisting badly injured persons and "less capable survivors" to stay afloat until rescuers arrive, the report indicated.

The CAMI researchers concluded that survivors who are able to form and maintain groups in the water will be able to help injured passengers or children with flotation seat cushions by sharing responsibilities and resources. Groups also help maintain "a sense of emotional well-being, while decreasing the effects of shock and hypothermia."♦

References

1. U.S. Code of Federal Regulations (CFR) Title 14, Aeronautics and Space. Washington, D.C., U.S.: U.S. Government Printing Office, 1994.
2. U.S. National Transportation Safety Board (NTSB). *Safety Study: Air Carrier Overwater Emergency Equipment and Procedures*. Report no. NTSB/SS-85/02. 1985.
3. U.S. Federal Aviation Administration (FAA). Technical Standard Order (TSO) C-72c, *Individual Flotation Devices*. Feb. 19, 1987.

Editorial Note: This article was adapted from *Alternative Methods for Flotation Seat Cushion Use*, Report no. DOT/FAA/AM-95/20, May 1995, written by Gordon E. Funkhouser and Mark H. George of the U.S. Federal Aviation Administration Civil Aeromedical Institute in Oklahoma City, Oklahoma. The five-page document includes several photographs and a brief bibliography.

About the Author

Robert L. Koenig is a Berlin, Germany-based correspondent who specializes in transportation and science issues. He has written on aviation matters for Science magazine and the Journal of Commerce. Before his move to Germany, he was a Washington, D.C., newspaper correspondent for the St. Louis Post-Dispatch, for which he covered transportation issues. He won the National Press Club's top award for Washington correspondents in 1994. Koenig has master's degrees from the University of Missouri School of Journalism and from Tulane University in New Orleans, Louisiana.

CABIN CREW SAFETY

Copyright © 1996 FLIGHT SAFETY FOUNDATION INC. ISSN 1057-5553

Suggestions and opinions expressed in FSF publications belong to the author(s) and are not necessarily endorsed by Flight Safety Foundation. Content is not intended to take the place of information in company policy handbooks and equipment manuals, or to supersede government regulations.

Staff: Roger Rozelle, director of publications; Girard Steichen, assistant director of publications; Rick Darby, senior editor; Karen K. Ehrlich, production coordinator; and Kathryn L. Ramage, librarian, Jerry Lederer Aviation Safety Library.

Subscriptions: US\$60 (U.S.-Canada-Mexico), US\$65 Air Mail (all other countries), six issues yearly. • Include old and new addresses when requesting address change. • Flight Safety Foundation, 601 Madison Street, Suite 300, Alexandria, VA 22314 U.S. • Telephone: (703) 739-6700 • Fax: (703) 739-6708

We Encourage Reprints

Articles in this publication may be reprinted in the interest of aviation safety, in whole or in part, in all media, but may not be offered for sale or used commercially without the express written permission of Flight Safety Foundation's director of publications. All reprints must credit Flight Safety Foundation, *Cabin Crew Safety*, the specific article(s) and the author(s). Please send two copies of the reprinted material to the director of publications. These reprint restrictions also apply to all prior and current articles and information in all Flight Safety Foundation publications.

What's Your Input?

In keeping with FSF's independent and nonpartisan mission to disseminate objective safety information, Foundation publications solicit credible contributions that foster thought-provoking discussion of aviation safety issues. If you have an article proposal, a completed manuscript or a technical paper that may be appropriate for *Cabin Crew Safety*, please contact the director of publications. Reasonable care will be taken in handling a manuscript, but Flight Safety Foundation assumes no responsibility for submitted material. The publications staff reserves the right to edit all published submissions. The Foundation buys all rights to manuscripts and payment is made to authors upon publication. Contact the Publications Department for more information.