FLIGHT SAFETY FOUNDATION
CABIN CREW SAFETY
Vol. 38 No. 6 *For Everyone Concerned With the Safety of Flight* November–December 2003

Mastery of Megaphones Reinforces Cabin Crew Control of Evacuations

Evolving standards and regulations reflect lessons learned from communication problems. Megaphones may provide the backup that enables instructions to be issued when a public-address system or interphone fails.

FSF Editorial Staff

Portable, battery-powered megaphones provide cabin crews a versatile method of voice amplification that can support effective passenger management during an aircraft evacuation. Megaphones complement the public-address (PA) system and the aircraft interphone system by enabling pilots and flight attendants to communicate safety information to passengers during aircraft emergencies and other non-routine situations. When PA systems have failed, use of a megaphone often has enabled a flight attendant's commands to be heard distinctively and authoritatively, helping to prevent panic. In some evacuations, however, passengers have rejected the commands/instructions communicated via megaphone. In others, one or more megaphones have been found to be inoperative.[1]

Several civil aviation authorities specify training requirements for cabin crews in the use of megaphones. For example, Transport Canada requires flight attendants to identify megaphones as one item of equipment available after an evacuation that will provide assistance and enhance survivability.[2]

Although the U.S. National Transportation Safety Board (NTSB) did not evaluate the effectiveness of megaphones during a 2000 special study of aircraft evacuations, the study's survey of crewmember actions during 24 airplane evacuations found that the PA system was used to initiate 18 evacuations and the interphone was used in nine evacuations. In three of the evacuations, the PA system was not functional, and flight attendants shouted commands. None of the respondents to the survey said that a megaphone had been used.[3]

The current international standard for megaphones, adopted by civil aviation authorities in the United States and some other countries, includes among others the following minimum characteristics:[4]

- Physical design and electronic design that minimize regenerative acoustic feedback (amplification of the sound output of the megaphone through its microphone, producing high-pitched whistling noises) when the megaphone is operated in the cabin;
- Maximum weight of six pounds (2.7 kilograms) including batteries (i.e., a self-contained power source with optional external indicator of power status);
- A power source that enables the megaphone to be operated continuously for not less than one hour while producing sound volume of 112 decibels (dB);[5]
- Distortion of sound limited to prescribed values;
- Handle size and balance that enable any flight attendant to operate the device with one hand (either the left hand or right hand) for one hour of continuous use;
- Obvious method of activation, such as pressing a trigger/button switch or squeezing a handle, and clockwise movement of a dial or knob to increase the volume of sound and counterclockwise movement to decrease the volume, with markings to indicate the volume setting (if optional volume control is provided);

- Megaphone construction of brightly colored materials that pass applicable fire-safety tests;
- Operation for not less than four hours after immersion for two seconds in salt water, and compliance with test requirements for resistance to operational shock, waterproofness, sand/dust infiltration, fungus and salt spray; and,
- Stowage bracket designed to prevent inadvertent operation, to enable release of the megaphone with one hand and to facilitate inspection during cabin-safety checks.

Some civil aviation regulations require megaphones but specifically exempt them from any requirement of compliance with an international performance standard. Individual countries also have provided megaphone standards in terms of functional tests. For example, the U.K. Civil Aviation Authority in 2002 provided a specification for portable battery-powered megaphones for use in emergency conditions in civil transport aircraft. The following requirements were included:[6]

- Intelligibility tested so that "under normal ground conditions in the cabin, messages spoken into the megaphone should be intelligible to at least 90 percent of the occupants in the passenger cabin in the aircraft in which it is expected to operate;"
- Sufficient acoustic power so that "when the megaphone is used in open country where a reasonably quiet sound background [not more than 40 dB] exists, it should be capable of providing intelligible speech at a distance of 100 meters [328 feet];"
- A recharging connection to the aircraft power-supply system when the megaphone is not in use;
- Minimal megaphone controls that are "self-evident and are easily operable by a crewmember even under conditions of stress." Two levels of volume preferably should be controlled by a switch — one setting for use inside the aircraft and one setting for use outside the aircraft — although continuous control of volume could be considered; and,
- Means of carrying the megaphone with hands free (such as a harness) should be provided.

"The acoustic conditions in aircraft interiors vary considerably and, according to the aircraft design, the number of passengers who may be expected to hear a particular message will vary in accordance with the internal arrangements of the aircraft and the corresponding crew training," U.K. CAA said. "Volunteers should be used to simulate the passenger complement. A number of messages should be broadcast containing occasional unexpected words, and the volunteers [should be] invited to write them down. … Experiments [also] have shown that there is a reasonable correlation between the performance of a megaphone in the highly absorbent acoustic environment of an aircraft and its ability to be heard at a distance in a quiet open-air environment."

Performance of specific models may exceed regulatory standards and provide optional convenience features.[7] Some models have tamper alarms that activate a siren-like sound when the megaphone is removed improperly from its bracket (silenced by operation of the megaphone on/off handle switch or other method). Some models provide switches to adjust microphone sensitivity, a light-emitting diode (LED) to indicate the battery condition and/or an audible warning of insufficient battery power for normal operation.

Joint Aviation Requirements (JARs) Part 25, *Large Aeroplanes,* 25.1421, "Megaphones," requires a method of restraining any installed megaphone in transport category airplanes to prevent release of the megaphone under the designed ultimate inertia forces that occupants could experience during an emergency landing (three times the acceleration of gravity [3 g] upward, 9 g forward, 3 g sideward on the airframe, 4 g sideward on the seats and their attachments, 6 g downward and 1.5 g rearward). This requirement is harmonized with U.S. Federal Aviation Regulations (FARs) 25.1421.

The International Air Transport Association (IATA) — recommending contents of a cabin crew safety manual — includes specific training on location, function and operation of megaphones as an item of evacuation equipment, and on equipment to be removed from the aircraft during an evacuation.[8] Moreover, IATA recommends that, prior to boarding of passengers, the cabin crew check all communications equipment with a checklist to ensure that this equipment is serviceable.

Crews of aircraft operated in the United States can expect FAA inspectors to include megaphones in their inspections and crew observations, specifically by observing that the correct number of megaphones are aboard, that their general condition complies with regulations, that the flight attendants include them in preflight checks and that each crewmember is knowledgeable about how to remove the megaphone from its bracket and how to correctly operate the megaphone.[9]

The role of megaphones has been cited in the following accident reports and safety recommendations:

- The U.K. Air Accidents Investigation Branch (AAIB) said in 2002 that as a Fokker F28 Mark 100 was taxied for takeoff at Manchester (England) International Airport, the cabin filled with smoke and the flight crew ordered evacuation. The report said, "After some difficulty, the [in-flight supervisor] managed to kick open the galley service door, and passengers were then able to leave the aircraft through both forward doors. Some passengers hesitated at the front exits and needed encouragement to use the evacuation slides. Some other passengers started to collect hand baggage before departing the aircraft. The [in-flight supervisor] made use of a megaphone to hasten the disembarkation of the [passengers that attempted to carry hand luggage]. A number [of passengers] congregated on the wing looking for a way down. Cabin crew eventually noticed the confusion and urged the passengers to get off

the wing. Some passengers slid or jumped from the wing tip and leading edge (a drop of some seven [feet] to 8 feet [2.0 meters to 2.4 meters]) instead of sliding off the wing trailing edge down the extended flaps;"[10]

- In one accident, a megaphone was not used, although procedures called for megaphone use if the PA system failed or if commands were to be given outside the aircraft after evacuation. "At [NTSB's] public hearing into the accident, the flight attendant in charge testified that he tried to use the aft PA microphone 'after the smoke subsided, and it didn't work.' He also testified that he had thought of using the megaphone; however, by that time the airplane was in a steep descent, the smoke was advancing rapidly, and he thought it would have been 'unwise to waste valuable time … to try and go back and get the megaphone.' … Even though the flight attendant in charge knew that the airplane PA system was inoperative, he did not remove the megaphone to make the announcements prescribed in the company briefing format. … NTSB concludes that had this been done, the emergency briefings probably would have been heard, by more, if not all, of the passengers, and in any event in greater detail;"[11] and,

- In a series of safety recommendations issued in 2000, NTSB said that its 1981 special investigation report underscored the difficulties that can result when emergency-communications devices in the cabin are not used, or they are inoperative. "In [the 1981] accident, a fire in the right landing gear (which was initially erroneously identified as an engine failure) caused the captain to order an evacuation after shutting down the engines. However, because the PA and interphone systems were inoperative, and the megaphones were not used, flight attendants and passengers in the rear of the cabin were not aware that an evacuation had been initiated in the front, resulting in what was described as 'an atmosphere of confusion and disorder among passengers and flight personnel.' … On May 9, 1997, the FAA issued Flight Standards Information Bulletin (FSIB) for Air Transportation [no.] 97-07, "Miscellaneous Cabin Safety Training and Procedure Items." The FSIB set forth several evacuation-related policies, including the following: [FARs Part] 121.417 requires crewmember training on emergency equipment, including megaphones. … In addition, crewmembers should be trained to follow specified procedures in the event that the [PA] system or the interphone do not work. This is especially important in large airplanes where crewmembers may need to communicate with each other without the aid of the interphone."[12]

Use of megaphones also influenced flight operations in the following reports from the Aviation Safety Reporting System of the U.S. National Aeronautics and Space Administration:

- A pilot of a Boeing 737-400 said that the aircraft experienced total failure of the direct-current electrical systems, requiring diversion to an alternate airport. The auxiliary power unit (APU) was operated during the remainder of the flight until engine shutdown at the gate. The report said, "Upon landing in Eugene [Oregon, U.S.], neither thrust reverser deployed, and the battery [charge-level indication] dropped to zero volts. Upon shutdown at the gate, we were unable to power the aircraft because the APU died [stopped operating] due to no battery power. The cabin megaphone was used to communicate to the passengers;"[13] and,

- Before engine start, a pilot of a McDonnell Douglas MD-80 Super 80 shut off electrical power supplied to the aircraft from an external power cart and told the cabin crew to deplane passengers at the gate because of smoke in the cabin. When the pilot opened the flight-deck door, however, he saw smoke in the cabin and then told the lead flight attendant "to get the people off as fast as possible." The report said, "The flight attendant grabbed a megaphone and told the passengers to get off the plane quickly and leave their belongings." The forward entry door and rear stairs were used. One passenger deployed and used the rear galley slide, and about three passengers then jumped down the rear galley slide, some carrying briefcases and suitcases."[14]

Civil aviation authorities typically use seating configuration as the determinant of the number of megaphones to be carried and, in some regulations, where the megaphone(s) must be carried in the aircraft.

For example, European Joint Aviation Requirements–Operations (JAR–OPS) 1.810 requires portable battery-powered megaphones to be readily accessible for use by crewmembers during an emergency evacuation if the aircraft has a passenger-seating configuration of more than 60 seats and is carrying one or more passengers. One megaphone is required for an aircraft with 61 seats to 99 seats, and two megaphones are required if the aircraft has 100 or more passenger seats. The requirement also says, "For airplanes with more than one passenger deck, in all cases when the total passenger seating configuration is more than 60, at least one megaphone is required."

FAA recommends, but does not require, that air carriers install a megaphone on the upper-deck passenger compartment of Boeing 747s if passengers are carried on this deck.[15]♦

Notes

1. Finland Accident Investigation Board. *Major Accident Report: Aircraft Accident at Kajaani Airport, Finland*. Report no. 2/1994. November 1994. The report said that the megaphone in the forward cabin was not operational, that batteries were missing from the forward-galley flashlight and that many items of emergency equipment were not restrained. "These faults had no effect in this [evacuation] because the emergency lights and the [public-address] system were operational. … It was dark during the evacuation."

2. Transport Canada. "Emergency Procedures." Flight Attendant Training Standard no. TP 12296E. May 8, 2003.

3. U.S. National Transportation Safety Board (NTSB). *Safety Study: Emergency Evacuation of Commercial Airplanes*. Report no. NTSB/SS-00/01, 2000.

4. SAE International. *Design and Performance Criteria, Transport Aircraft Portable Megaphones.* Aerospace Standard AS4950 Revision A, September 1998.

5. In acoustics, the decibel is a unit of sound measurement representing absolute power per unit of surface area. The lower threshold of human hearing is zero decibels (dB), and the sound near some jet engines at takeoff power is about 150 dB.

6. Safety Regulation Group, U.K. Civil Aviation Authority (CAA). *Portable Battery Powered Megaphones*. Airworthiness Information Leaflet no. AIL/0045, Issue 2, Jan. 16, 2002.

7. ACR Electronics. *ACR Product Support Manual — Portable Safety Megaphone EM-1A, EM-1DTM*. Manual no. Y1-03-0014. <www.acrelectronics.com> Accessed Dec. 10, 2003.

8. International Air Transport Association (IATA). *Inflight Management Manual.* Second edition. 1 July 2002–30 June 2003.

9. FAA. Order 8300.10, *Airworthiness Inspector's Handbook,* Change 9. "Introduction to Aircraft and Equipment," Section 1, "Background." Aug. 13, 1993.

10. U.K. Air Accidents Investigation Branch (AAIB). AAIB Bulletin no. 3/2003. The accident involved Fokker F28 Mark 100, G-UKFI, April 1, 2002, at 0516 hrs, at Manchester (England) International Airport.

11. NTSB. *Air Canada Flight 797, McDonnell Douglas DC-9-32, C-FTLL, Greater Cincinnati International Airport, Covington, Kentucky [U.S.], June 2, 1983*. Report no. NTSB IAAR–86102.

12. NTSB. Safety Recommendation A-00-72 through A-00-91. July 14, 2000.

13. U.S. National Aeronautics and Space Administration (NASA) Aviation Safety Reporting System (ASRS). Report no. 574028, February 2003. NASA ASRS is a confidential incident-reporting system. The ASRS Program Overview said, "Pilots, air traffic controllers, flight attendants, mechanics, ground personnel and others involved in aviation operations submit reports to the ASRS when they are involved in, or observe, an incident or situation in which aviation safety was compromised. … ASRS de-identifies reports before entering them into the incident database. All personal and organizational names are removed. Dates, times and related information, which could be used to infer an identity, are either generalized or eliminated." ASRS acknowledges that its data have certain limitations. ASRS *Directline* (December 1998) said, "Reporters to ASRS may introduce biases that result from a greater tendency to report serious events than minor ones; from organizational and geographic influences; and from many other factors. All of these potential influences reduce the confidence that can be attached to statistical findings based on ASRS data. However, the proportions of consistently reported incidents to ASRS, such as altitude deviations, have been remarkably stable over many years. Therefore, users of ASRS may presume that incident reports drawn from a time interval of several or more years will reflect patterns that are broadly representative of the total universe of aviation-safety incidents of that type."

14. NASA ASRS. Report no. 479535, July 2000.

15. FAA. Order 8400.10 *Air Transporation Operations Inspector's Handbook*, Volume 3, "Air Operator Technical Administration," Chapter 14, "Flight Attendant Training and Qualification Programs," Section 4, "Flight Attendant General Emergency Training." June 26, 2002.

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