

 An SAE International Group	AEROSPACE INFORMATION REPORT	AIR5690	
		Issued	2006-08
Considerations for the Carriage and Use of Visual Distress Signals in Airline Overwater Survival Kits			

RATIONALE

The risk posed to aircraft ditching survivors by pyrotechnic signaling devices can be allayed by the use of TSO C-168 approved Aviation Distress Signals (ADSs) in lieu of the pyrotechnics devices currently required in airline overwater survival kits. In addition, the high-performance ADSs provide an equivalent level of signaling capability without the costs associated with hazardous pyrotechnic materials. This AIR provides the premise for the recommended use of ADSs.

1. SCOPE

This SAE Aerospace Information Report (AIR) is intended to promote awareness of the dangers associated with the carriage and use of pyrotechnic signaling devices in multi-place life rafts and slide/rafts on transport category aircraft. Also included is background information and a rationale for replacing these devices with alternative signaling devices, which offer effective signaling and reduced flammability, yielding an "equivalent level of safety," as required by the FAA for replacement of the required pyrotechnic signaling device.

2. REFERENCES

2.1 Applicable Documents

The following publications form a part of this document to the extent indicated herein. The latest issue of SAE publications shall apply. The applicable issue of other publications shall be the issue in effect on the date of the purchase order. In the event of conflict between the text of this document and references cited herein, the text of this document takes precedence. Nothing in this document, however, supersedes applicable laws and regulations unless a specific exemption has been obtained.

2.1.1 SAE Publications

Available from SAE International, 400 Commonwealth Drive, Warrendale, PA 15096-0001, Tel: 877-606-7323 (inside USA and Canada) or 724-776-4970 (outside USA), www.sae.org.

AS1282 Survival Kits

AS5134 Aviation Distress Signal

2.1.2 FAA Publications

Available from Federal Aviation Administration, 800 Independence Avenue, SW, Washington, DC 20591, Tel: 866-835-5322, www.faa.gov.

FAA Technical Standard Order C-168, Aviation Visual Distress Signals

FAA Advisory Circular 91-58A, Use of Pyrotechnic Visual Distress Signaling Devices in Aviation

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FAA Advisory Circular 120-47, Survival Equipment for Overwater Use

U. S. Code of Federal Regulations, Title 14, § 25.1415, Ditching equipment

U. S. Code of Federal Regulations, Title 14, § 121.339, Emergency equipment for extended over-water operations

U. S. Code of Federal Regulations, Title 49, Parts 100-185, Other regulations relating to transportation

U. S. Code of Federal Regulations, Title 29, § 1910, Occupational Safety and Health Standards

3. BACKGROUND

3.1 Development of AS5134

In 1996, the SAE S-9 Cabin Safety Provisions Technical Committee reviewed the concerns expressed by its membership regarding the safety of pyrotechnic signaling devices required for carriage aboard transport category aircraft by Title 14 of the Code of Federal Regulations, Part 25 (14 CFR 25). The committee concluded that pyrotechnics pose a potential risk to survivors of ditchings, in that improper use could significantly damage an inflatable life raft, rendering it useless. Inadequate or non-existent flotation would then expose survivors to hypothermia, predatory marine life, and drowning.

As a result, the S-9 Committee developed AS5134, the purpose of which is to "define a device that can be used in lieu of pyrotechnic devices in aviation survival kits." AS5134 establishes performance requirements for an alternative visual distress signal that eliminates the hazards posed by pyrotechnic devices. The alternative device is a high-intensity, handheld strobe light with a specific lighting signature designed to provide an equivalent level of safety to single-use pyrotechnic flares.

3.2 Current Regulatory Status

Regarding emergency equipment for extended overwater operations, 14 CFR 121.339(a)(3) requires "at least one pyrotechnic signaling device for each life raft" and, § 121.339(b) calls for a survival-type emergency locator transmitter (ELT). In addition, § 121.339(c) requires that "a survival kit, appropriately equipped for the route to be flown, must be attached to each required life raft." The transmitter and survival kit are also required ditching equipment designated in 14 CFR 25.1415.

FAA Advisory Circular (AC) 120-47 provides a "means, but not the only means for compliance with the pertinent regulations" regarding emergency equipment for extended overwater operations and emergency flotation means. It offers a comprehensive listing of survival items that "should be carried during aircraft extended overwater operations." The AC recommends carriage of at least one pyrotechnic signaling device, but also lists such items as magnetic compass, radar reflector, desalination kit, fishing kit, and a 1,000-calorie ration for each raft occupant. None of the latter items are currently provisioned in extended overwater survival kits by U.S. airliners.

The FAA issued AC 91-58A, "Use of Pyrotechnic Visual Distress Signaling Devices in Aviation," on February 10, 2000. The reader of this document is strongly urged to read AC 91-58A in its entirety. The following is an excerpt from the AC:

The Federal Aviation Administration (FAA) recognizes that many pilots and operators of aircraft are utilizing some distress signaling devices that are inherently dangerous, as well as ineffective, when used in actual emergencies. Typical of the problem is the use of "railroad or highway flares," which produce an excessive amount of high temperature slag, usually burn the user when hand held, and are easily extinguished when used in open bodies of water. Further, the incendiary nature of these and other pyrotechnics presents problems for their safe and proper storage in the aircraft environment. This advisory circular is written to guide the pilot/operator in the proper use and identification of pyrotechnic signaling devices.

After discussing the advantages and limitations of various pyrotechnic devices, Paragraph 7.a. of the document continues:

If young children are carried on board your aircraft, careful stowage of visual distress signals becomes especially important. Projected devices, such as pistol-launched and hand-held parachute flares and meteors, have many of the characteristics of a firearm and should be handled with the same caution.

The FAA has recently denied at least one request from a major U.S. airline for exemption from the operating rule cited above that requires the carriage of pyrotechnic devices. The airline's request applied for the replacement of pyrotechnic devices on its overwater-equipped fleet with handheld strobe lights. The significant technical objection in the FAA's denial of exemption was that the aviation distress signal did not include a viable daylight signaling capability. It should be noted here, however, that pyrotechnic signals currently used by the majority of U.S. airlines (small red meteor flares) also do not have an effective daylight visual signaling capability. Other devices carried within the kit, such as signaling mirrors and sea dye markers, fulfill this need.

On March 25, 2004, the FAA issued Technical Standard Order (TSO) C-168, "Aviation Visual Distress Signals," which referenced SAE AS 5134 as its technical basis.

4. HAZARDS AND COSTS ASSOCIATED WITH PYROTECHNICS

This section summarizes the views of the S-9 Committee, developed during the process of drafting AS5134, including experience and knowledge gained by committee members during actual life raft trials off the coast of Hawaii in 1998, involving deployment of pyrotechnic flares.

4.1 Primary Concern

Improper handling and/or deployment of pyrotechnic devices can result in potentially catastrophic damage to life rafts and slide/rafts, compromising the air-holding capability of these life-saving devices. Such an event could place some or all of the occupants into the water, exposing them to predatory marine life, hypothermia, and drowning. This problem can be exacerbated by the following contributing factors:

- a. Sea state will contribute to the hazards of handling and deploying pyrotechnics aboard multi-place life rafts by creating an unstable platform for the operator holding a burning pyrotechnic. Wind can worsen this situation by blowing burning effluents back into the raft and/or onto occupants.
- b. A life raft overcrowded with emotional and panicked occupants would be a high-risk environment for deploying a pyrotechnic, particularly a ballistic-type device.
- c. The absence of individuals trained in the deployment of pyrotechnic devices, even in a well-organized life raft/survivor environment, is a potential danger. A survey of airline crew members and trainers, conducted early in the S-9 Committee project, indicated that airline flight and cabin crews do not conduct live-fire training in the deployment of pyrotechnic devices.
- d. The deployment of recommended pyrotechnic devices, even by aviation industry safety experts, can create unsafe and hazardous conditions in relatively mild sea and wind states.

4.2 Secondary Concern

Unrelated to the physical dangers the use of pyrotechnics poses to survivors of ditchings, there is a significant threat imposed on the traveling public by the existence of and potential access to dangerous pyrotechnics within the aircraft cabin during flight.

- a. Pyrotechnics are currently installed in survival kits packed within portable life rafts located in overhead, closet, or ceiling compartments accessible from the aircraft cabin. Pyrotechnics installed within some door-mounted slide/raft devices are also accessible from the cabin interior.

- b. In at least one major passenger aircraft configuration (Boeing 757), remote survival kits that include pyrotechnic devices are located in unsecured overhead bins near exits. These bins can and have been opened during passenger enplaning/deplaning, with the survival kits in full sight.
- c. If unauthorized individuals gain command of an aircraft cabin in flight, it would be relatively easy for knowledgeable accomplices to gain access to life rafts (or separately installed survival kits), retrieve the pyrotechnics, and then use those devices for threat or harm during flight.
- d. Deployment of any of the types of pyrotechnics common to airline overwater survival kits within an aircraft cabin, with or without intent, can cause combustion of aircraft interior materials and initiate an in-flight cabin fire with well-understood consequences. The manufacturer of the most popular pyrotechnic device, currently used by airlines, markets a smaller version of the device specifically as a fire-starter.

4.3 Other Concerns

There are several issues that pose both potential and actual non-value-added cost burdens on the airline industry, unrelated to the physical dangers the use of pyrotechnics poses to survivors of ditchings or the danger associated with access to and use of such devices in an in-flight environment.

- a. The well-known dangers of pyrotechnics make any accident, harm, loss of property or life associated with their use by untrained or unauthorized individuals in an in-flight or overwater emergency a potential legal liability and cost to the carrier.
- b. Pyrotechnics are classified as hazardous materials and as such are governed by strict shipping, handling, and disposal restrictions (e.g., 49 CFR Parts 100-185, 29 CFR 1910). These restrictions and regulations create significant non-value-added cost to the airline industry. Elimination of these costs would have a measurable and positive impact on all airlines that conduct overwater operations.

5. EMERGENCY SIGNALING DEVICES

This section provides information on distress signaling devices that are carried within and/or are available for use in survival kits. These devices support both day and night signaling. The types of pyrotechnic signaling devices common in current airline overwater survival kits are also discussed.

5.1 Pyrotechnic Devices

Rafts and standard airline survival kits generally contain these signaling items to meet the "suitability" requirement in 14 CFR 121.339(c). The FAA recommends the carriage of some or all of these devices in survival kits (AC 120-47).

5.1.1 Survivor Locator Light

A one-candela incandescent light that radiates hemispherically from the center of its ground plane. This type of light is required by FAA TSOs covering life rafts, slides/rafts, and individual life preservers.

5.1.2 Whistle

Generally provided as a part of airline crew life vests, and in some survival kits, as aural signaling and survivor marshalling devices.

5.1.3 Sea Dye Marker

A bright green dye that stains the water surrounding a life raft to attract the attention of airborne personnel during daylight.

5.1.4 Signaling Mirror

One of the most valuable of the daylight signaling devices and, when used properly in conditions of reasonable visibility, can attract the attention of both seagoing and airborne personnel many miles away.

5.2 Commonly Used Pyrotechnics

5.2.1 Handheld Day/Night Flare

Historically, the most common pyrotechnic device provisioned in airline overwater survival kits was the military-type day/night combination flare and smoke device. This device comprises two pyrotechnic devices - one on each end of a tubular metal enclosure - each of which is designed to be deployed while being held by the operator. The device includes a brightly burning pyrotechnic for signaling at night, and a colored smoke-generating device for daylight signaling. Both pyrotechnics, even when properly used by trained individuals, develop burning or molten effluents that can harm the operator and burn holes in the inflatable chambers that constitute the structure of the life rafts. The "night" portion of the signal has an effective burn time of 20 to 30 seconds; the "day" or smoke function has a similar burn time, but the generated smoke has a longer effective life on clear, still days with relatively little wind dispersion. These devices are packed one or two to a survival kit.

5.2.2 Small "Meteor" Flares

Over the last few years, the relatively expensive and often hard-to-procure day/night flares have been replaced in airline survival kits by small, inexpensive devices that launch a brightly burning pyrotechnic projectile into the air. These devices, in the hands of untrained individuals, can result in serious harm to survivors and their life raft. Three of these devices are usually placed in each survival kit, although some kits have only one or two. Meteor flares do not have an effective "day" component; the launched pyrotechnic cannot be easily distinguished against a bright sky or the sun unless the searcher happens to be looking precisely in the right direction. Advertised performance for the type of device most commonly used in airline survival kits is 450 feet altitude with an effective burn time of 6.9 seconds.

5.3 Other Available Signaling Devices

5.3.1 Electronic Devices

Airlines are required to carry FAA-approved ELTs that transmit a distress signal on 121.5 and 243.0 MHz. These frequencies are monitored by civil and military search and rescue (SAR) organizations and are capable of being acquired by the international search and rescue satellite system, COSPAS-SARSAT (Cosmicheskaya Sistyema Poiska Avarynich Sudov...translated from the Russian language this means "space system for the detection of vessels in distress"/ Search and Rescue Satellite Aided Tracking). The devices are not sufficiently accurate for precision location definition by SARSAT, however. (One should note that after 2009, 121.5/243 satellite monitoring will cease.) Newer generation ELTs, operating on 121.5 and 406 MHz, provide a much higher level of location accuracy as well as registration coding that allows SAR forces to specifically identify the source. This technology has developed into compact personal locator beacons (PLBs), which provide essentially the same accurate location and ID information.

5.3.2 Strobe Lights

Strobe lights are used extensively in maritime and military operations as a universally accepted distress signal. Compact, handheld strobe lights were developed for military use as an essential survival and rescue item for downed airmen. These strobes are limited in light intensity and duration due to the small size and weight requirement. The Aviation Distress Signal Aerospace Standard (AS1354), created by the S-9 Committee and adopted by FAA TSO C-168, significantly expands the performance requirements of this earlier, proven strobe technology in a slightly larger package, suitable for use in a multi-place raft. Strobe lights are extremely effective with infrared night-vision equipment used by U.S. Coast Guard and military SAR forces.