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AIRWORTHINESS

ADVISORY

CIRCULAR

HAND FIRE EXTINGUISHERS FOR USE IN AIRCRAFT

**HAND FIRE EXTINGUISHERS
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1. PURPOSE.

This Airworthiness Advisory Circular (AAC) provides methods acceptable to the DCA for showing compliance with the hand fire extinguisher provisions in the Instrument & Equipment Regulation 40, and provides updated general information. In addition, the information in this AAC is considered acceptable for use by the owners/operators of all aircraft.

2. FOCUS.

Recent advancements in fire fighting technology and the proliferation of approved hand— held extinguisher models containing Halon 1211, 1301, and combinations of the two, require that this AAC be introduced.

3. DEFINITIONS

- a. Halon. A short derivation for “halogenated hydrocarbon” whose chemical structure is identified as a four digit number representing, respectively, the number of carbon, fluorine, chlorine, and bromine atoms present in one molecule. Halon fire extinguishing agents approved for use include Halon 1211, Halon 1301, and a combination of the two (Halon 1211/1301). Both are liquified gases and typified as “clean agents,” leaving no agent residue after discharge. Halons extinguish fire by chemically interrupting the chain reaction rather than by physically smothering.
- b. Halon 1211. The chemical name is bromochlorodifluoromethane, CBrClF₂. Halon 1211 is a multipurpose, Class A, B, C rated agent effective against flammable liquid fires. Due to its relatively high boiling point (-4°C/+25°F), Halon 1211 discharges as an 85 percent liquid stream offering long agent throw range.
- c. Halon 1301. The chemical name is bromotrifluoromethane CBrF₃. Halon 1301 is recognized as an agent having Class A, B, C capability in total flooding systems; however, Halon 1301 offers limited Class A capability when used in portable fire extinguishers.
- d. Hand Fire Extinguisher (Aircraft Hand Fire Extinguisher/Portable Fire Extinguisher) An approved, portable fire extinguisher as outlined in paragraph 4 of this AAC, which can be used by aircraft occupants to combat accessible, incipient, onboard fires.

4. APPROVED HAND FIRE EXTINGUISHERS.

Hand fire extinguishers are acceptable if they have been approved by FAA, JAA or Canadian Aviation Regulations. Other approvals may be acceptable if they meet the requirements of the above. The information in this AAC is considered acceptable for use by all public transport operators. Operators of non-public transport category aircraft should become familiar with the information in this AAC and the precautions listed in paragraph 6f for the different types of fire extinguishers

5. DISCUSSION

- a. Types of Fires. To properly select an appropriate extinguisher for use in an aircraft, it is recommended that consideration be given to the following classes of fires that are likely to occur: Class A. Fires in ordinary combustible materials, such as wood, cloth, paper, rubber, and plastics for which the quenching and cooling effects of quantities of water, or of solutions containing a large percentage of water, are of prime importance. Class B. Fires in flammable liquids, oils, greases, tars, oil base paints, lacquers, and flammable gases for which extinguishing agents having a blanket effect are essential.
- (1) Class C. Fires that involve energized electrical equipment and where the electrical non-conductivity of the extinguishing media is of importance.
 - (2) Class D. Fires that involve combustible metals, such as magnesium, titanium, zirconium, sodium, lithium, and potassium, and require extinguishing agents of the dry powder types. The recommendations of the manufacturer for use of those extinguishers should be followed because of the possible chemical reaction between the burning metal and the extinguishing agent.
- b. Extinguishing Agents Appropriate for Types of Fires: The following extinguishing agents are recommended, as appropriate, for use on the types of fires specified below and as defined in paragraph 5a of this AC:
- (1) Carbon Dioxide — Class B or C.
 - (2) Water — Class A.
 - (3) Dry Chemicals — Class A, B, or C.
 - (4) Halogenated Hydrocarbons — Class A, B, or C.
 - (5) Specialised Dry Powder — Class D.

NOTE: Only “all purpose” or A, B, C dry chemical powder extinguishers containing Mön ammonium phosphate have a UL Class A, B, C rating; all other powders have a Class B, C rating only.

- c. Numeral Ratings.
- Numerals are used with the identifying letters for extinguishers labelled for Class A and Class B fires. The “numeral” indicates the relative extinguishing effectiveness of the device on a given size fire which is dependent on the agent, the capacity of the device, discharge times, and design features. For example, an extinguisher rated as 4A should extinguish about twice as much Class A fire as a 2A rated extinguisher. A 2 ½ gallon water extinguisher is rated 2A. On an extinguisher rated for Class B fires, the numeral rating precedes the letter “B”. Numeral ratings are not used for extinguishers labelled for Class C or D fires. Extinguishers that are effective on more than one class of fires have multiple “numeral—letter” and “letter” classifications and ratings; for example, 5B:C.

d. Halogenated Agents.

For hand fire extinguishers employing halogenated agents, only Halon 1211, 1301, or mixtures of the two should be used. The following Military Specifications cover the requirements for halogenated agents:

- (1) Halon 1211 should meet the requirements of Military Specification MIL-B-33874
- (2) Halon 1301 should meet the requirements of Military Specification MIL-M-12218C.

e. Halon 1211 Extinguishers.

- (1) For occupied spaces on aircraft, Halon 1211 extinguishers should not be less than 2 ½ pounds (1.2 kg) capacity. These extinguishers should have a minimum 5B:C rating; not less than 8 seconds effective discharge time; not less than a 10—foot (3 m) range; and may be equipped with a discharge hose.
- (2) For occupied spaces on small aircraft only, with a maximum certificated occupant capacity of one to four persons, including the pilot, a Halon 1211 extinguisher may be used as an option in place of the recommended Halon 1301 extinguisher.
- (3) For accessible cargo compartments of combination passenger/cargo aircraft and cargo aircraft, Halon 1211 extinguishers should not be less than 13 pounds (5.9 kg) capacity, and have a minimum 2A, 40B: C rating.
- (4) If Halon 1211 extinguishers are installed in a nonventilated, passenger-occupied compartment, and the compartment cannot be vented, and the occupants cannot leave if the extinguishers are discharged, then the total Halon 1211 agent available from all the extinguishers should not be capable of producing a concentration greater than 0.2 percent by volume at 120°F (49°C) in the compartment. For compartments where egress is possible within one minute, the maximum design concentration can be 4 percent by volume. For ventilated compartments the guidelines in paragraph 6f (5) of this AAC can be used.
- (5) Halon 1211 extinguishers have their greatest effectiveness on Class B and C fires. Extinguishers with 9 pounds (4 kg) or greater capacity are also rated for Class A fires. Extinguishers with a capacity of less than 9 pounds (4 kg), although not rated for use on Class A fires, have been shown to be effective in extinguishing surface Class A fires.
- (6) Halon 1211 extinguishers of less than 9 pounds (4 kg) capacity are not always furnished with a discharge hose. However, for access to under-seat, overhead, and other difficult to reach locations, consideration should be given to using extinguishers equipped with a discharge hose of a minimum length of 12 inches (304 mm). An extinguisher with a discharge hose is more likely to result in the extinguisher being properly held in an upright position during use.

f. Halon 1301 Extinguishers

- (1) For occupied spaces on aircraft, Halon 1301 extinguishers should have a minimum 2B:C rating, and should have an effective discharge time of not less than 8 seconds.
- (2) If Halon 3301 extinguishers are installed in a non-ventilated, passenger occupied compartment, and the compartment cannot be vented, and the occupants cannot leave if the extinguishers are discharged, then the total Halon 1301 agent available from all the extinguishers should not be capable of producing a concentration greater than 5 percent by volume at 123°F (49°C) in the compartment. For compartments where egress is possible within one minute, the maximum design concentration can be 10 percent by volume. For ventilated compartments the guidelines in paragraph 6 f (5) of this AAC can be used.
- (3) Halon 1301 extinguishers are effective on Class B and C fires. Halon 1301 extinguishers are not rated for Class A fires at this time.
- (4) For occupied spaces on all aircraft where neat state (un-decomposed) halon concentrations will be approaching allowable limits, Halon 1301 is the halogenated agent of choice for the following reasons:
 - (a) Both Halon 1211 and Halon 3301 decompose when exposed to flare producing toxic products of decomposition. Halon 1211 produces some decomposition products that are not produced by Halon 1301 and is, therefore, also considered more toxic in the decomposed state.
 - (b) Health and safety advantages associated with similar volume occupied spaces on larger aircraft (flight decks) do not usually exist for the smaller aircraft. These advantages are a forced ventilation system, availability of oxygen masks, and availability of a second individual capable of flying the aircraft.

g. Location and Mounting of Hand Fire Extinguishers in Passenger Compartments.

It is acceptable to install fire extinguishers in passenger compartments according to the following criteria:

- (1) In general, locate hand fire extinguishers adjacent to the hazardous area (i.e., galleys, accessible baggage or cargo compartments, electrical equipment racks, etc.) they are intended to protect.
- (2) If no clearly defined hazardous area exists, locate the hand fire extinguishers as follows:
 - (a) When one extinguisher is used, locate it at the flight attendant's station or, where no flight attendant is required; locate the extinguisher at the passenger entrance door.

- (b) When two or more extinguishers are used, locate one at each end of the passenger compartment and space the remainder uniformly within the cabin area.
 - (3) Mount hand fire extinguishers so that they are readily available. If they are not visible in their mounted position, a placard (with letters at least 3/8 inches high) may be used to indicate their location.
 - (a) Due to the weight of hand fire extinguishers, the aircraft structure and extinguisher mounting brackets should be capable of withstanding the inertia forces with the hand fire extinguisher installed.
 - (b) The weight of the hand fire extinguisher and its mounting added to the aircraft empty weight and a new empty weight and a new empty weight centre of gravity computed.
 - (4) Fire extinguisher selection should be made with regard to the type of fire hazard (Class A, B, C or D) to be encountered. If extinguishers intended for different classes of fire are grouped together, their intended use should be marked conspicuously to aid in the choice of the proper extinguisher at the time of the fire.
- h. Location and Mounting of Hand Fire Extinguishers in Small Single Engine and Multiengine Aircraft.
 - (1) Locate hand fire extinguishers so that they are easily accessible to the flight crew and the passengers.
 - (2) Hand fire extinguishers should not be allowed to lie loose on shelves or seats. Fire extinguishers and mounting brackets should be properly mounted to the airframe structure.

6. GENERAL INFORMATION

a. Extinguishing Agent Toxicity.

Since the toxicity groupings of various fire-extinguishing agents are no longer considered valid comparisons, the classification of comparative life hazards of various chemicals has been eliminated.

b. Corrosion by Extinguishing Agents.

Carbon dioxide is not corrosive and will have no damaging effect other than cold shock effect on ceramic electronic components. Water itself is not corrosive, but may be rendered corrosive by the addition of antifreeze solutions. Various dry chemical agents are corrosive to most sensitive electronic components and instruments

c. Winterized Hand Fire Extinguishers.

Hand fire extinguishers may be winterized down to a -65°F (-54°C). Extinguishers containing plain water only can be protected to temperatures as low as -40°F (-40°C) by the addition of an antifreeze stipulated on the extinguisher nameplate. Some extinguishers that use nitrogen as an expellant gas rather than carbon dioxide are approved or listed for temperatures as low as -65°F (-54°C).

d. Factory Sealed (“Disposable Type”) Fire Extinguishers.

Disposable type fire extinguishers should be maintained and inspected in accordance with the nameplate instructions.

- (1) Non-refillable disposable fire extinguishers have plastic discharge heads installed. Care should be exercised in the location of this type of fire extinguisher to eliminate damage.
- (2) Non-refillable disposable fire extinguishers are exempt from the periodic hydrostatic test requirements.
- (3) These types of fire extinguishers are normally charged with a dry chemical extinguishing agent and have the same fogging effect and chemical reaction as standard dry chemical fire extinguishers

e. Advantages of Using Halogenated agent Extinguishers

- (1) Halon 1211, Halon 1301, or 1211/1301 is similar to CO₂ in that it is suitable for use in cold weather and leaves no residue.
- (2) Halon 1211, Halon 1301, or 1211/1301 is three times as effective as a CO₂ extinguisher having equal weight of agent.
- (3) Halon 1211 is a liquefied gas which leaves the nozzle in a stream that is about 85 percent liquid and 15 percent gas. This gives the agent a range of 9 to 15 feet and offers significant advantages in fighting fires in large aircraft cabins. Halon 1301 is gaseous upon discharge and has a more limited throw range. Mixtures of Halon 1211 and Halon 1301 have discharge characteristics dependent on the component weight ratio.
- (4) Because it is a gas, at normal temperatures, Halon 1211, Halon 1301, or 1211/1301 leaves no chemical residue behind to contaminate or corrode aircraft parts or surfaces.
- (5) Other advantages of Halon 1211, Halon 1301, or 1211/1301 are lower cold shock characteristics on electronic equipment, no degradation of visual acuity, and lower pressure.

f. Precautions

- (1) Dry chemical extinguishing agents when discharged in crew compartment or confined

areas may cause serious impairment to visibility. In addition, they may cause temporary breathing difficulty during and immediately after discharge.

- (2) Tests indicate that human exposure to high levels of Halon vapours may result in dizziness, impaired coordination, and reduced mental sharpness. Exposure to natural agents is generally of less concern than is exposure to the decomposition products. Exposure to un-decomposed halogenated agents may produce varied central nervous system effects depending upon exposure concentration and time. Halogenated agents will also decompose into more toxic products when subjected to flame or hot surfaces at approximately 900°F (482°C). However, unnecessary exposure of personnel to either the natural agent or to the decomposition products should be avoided. The decomposition products of the Halon have a characteristic sharp, acrid odour, and an eye irritating effect, even in concentrations of only a few parts per million. Generally, decomposition products from the fire itself, especially carbon monoxide, smoke, heat, and oxygen depletion, create a greater hazard than the thermal decomposition products of Halon.

NOTE: *Never discharge Halon 1211 on Class D (burning metal) fires*

- (3) Under non-ventilated conditions, it is recommended that the maximum concentration of Halon 1211 not exceed 2 percent in an enclosure, and the maximum concentration of Halon 1301 not exceed 5 percent. For sea level altitude and a temperature of 120°F (48.9°C), the compartment volume in cubic feet that will result in these concentrations, for a given weight of agent, is found by multiplying the agent charge weight in pounds by 124.7 in the case of Halon 1211, and by 52.6 in the case of 1301.
- (4) Carbon dioxide extinguishes fire by reducing the concentration of oxygen and/or the gaseous phase of the fuel in the air to the point where combustion stops. Carbon dioxide will not support life when used in sufficient concentration to extinguish a fire, and it should not be used in an occupied, non-ventilated aircraft compartment. Due to oxygen deficiency, prolonged occupancy can produce unconsciousness and death at higher concentrations. A concentration of 9 percent is about all most persons can withstand without losing consciousness within a few minutes. At concentrations above 9 percent, occupants would quickly lose consciousness. At concentrations of about 20 percent, death would follow in about 20 to 30 minutes, unless the victim was removed to a source of fresh air. Carbon dioxide must be at a 34 percent concentration to effectively extinguish a gasoline fire.
- (5) Extinguishers containing a given weight of a mixture of Halon 1211 and 1301 should be treated as if the total agent weight were completely Halon 1211 in terms of quantitative guidelines cited in paragraphs 5 e (4), 5 e (5), 6 f (3), and 6 f (5) of this AAC. For all aircraft applications in an occupied compartment, Halon 1211, 1301, and mixtures of the two should be agents of choice as compared to CO₂.

g. Helpful Hints

- (1) Best results in fire fighting are generally obtained by attacking the base of the fire at the

near edge of the fire and progressing toward the back of the fire by moving the fire extinguisher nozzle rapidly with a side-to-side sweeping motion.

- (2) The effective discharge time of most hand-held fire extinguishers ranges from 8 to 25 seconds depending on the capacity and type of the extinguisher. Due to this relatively short effective time span, the proper selection and use of the fire extinguisher must be made without delay.
- (3) Care must be taken not to direct the initial discharge at the burning surface at close range (less than 5-to-8 feet) because the high velocity stream may cause splashing and/or scattering of the burning material.
- (4) Ventilate the compartment promptly after successfully extinguishing the fire to reduce the gaseous combustion and gases produced by thermal decomposition.