U.S. Department of Transportation
Federal Aviation Administration

Advisory Circular

Subject: HAND FIRE EXTINGUISHERS FOR USE IN AIRCRAFT	**Date:** 3/7/84 **Initiated by:** AWS-340	**AC No:** 20-42C **Change:**	

1. PURPOSE. This advisory circular (AC) provides methods acceptable to the Administrator for showing compliance with the hand fire extinguisher provisions in Parts 25, 29, 91, 121, 125, 127, and 135 of the Federal Aviation Regulations (FAR), and provides updated general information. In addition, the information in this AC is considered acceptable for use by the owners/operators of small aircraft.

2. FOCUS. Changes made to some of the FAR requirements for hand fire extinguishers used in aircraft are of utmost concern to both aircraft owners/operators and aviation maintenance agencies. 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 AC be updated.

3. CANCELLATION. AC 20-42B, Hand Fire Extinguishers for Use in Aircraft, dated August 25, 1982, is canceled.

4. RELATED FAR SECTIONS AND CODE OF FEDERAL REGULATIONS (CFR).

a. FAR 21.305.

b. FAR 23.561.

c. FAR 25.561; 25.851.

d. FAR 27.561.

e. FAR 29.561; 29.851; 29.853(e) and (f).

f. FAR 91.193(c).

g. FAR 121.309(c).

h. FAR 125.119(b) and (c).

i. FAR 127.107(c).

j. FAR 135.155.

k. Title 46 and 49 of the CFR.

5. 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 combustion chain reaction rather than by physically smothering.

b. Halon 1211. The chemical name is bromochlorodifluoromethane, $CBrClF_2$. 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, $CBrF_3$. 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 6 of this AC, which can be used by aircraft occupants to combat accessible, incipient, on-board fires.

6. APPROVED HAND FIRE EXTINGUISHERS. Hand fire extinguishers are acceptable under FAR Sections 25.851(a)(1), 29.851(a)(1), 121.309(c), 127.107(c) and 135.155 if they have been approved in accordance with FAR 21, Section 21.305. In accordance with Section 21.305(d) of the FAR the Federal Aviation Administration (FAA) accepts hand fire extinguishers approved by Underwriters' Laboratories, Inc., Factory Mutual Research Corp., or approved by the U.S. Coast Guard under Title 46 of the CFR for use in aircraft. Although Parts 91 and 125 do not require FAA approval of hand fire extinguishers, the information in this AC is considered acceptable for use by Parts 91 and 125 operators. Operators of nontransport category aircraft should become familiar with the information in this AC and the precautions listed in paragraph 8f for the different types of fire extinguishers. In addition, the recommendations of the extinguisher manufacturer should be considered.

7. 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 (as defined in the National Fire Protection Association (NFPA) Standard 10) that are likely to occur:

(1) 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.

(2) 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.

(3) Class C. Fires which involve energized electrical equipment and where the electrical nonconductivity of the extinguishing media is of importance.

(4) Class D. Fires which 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 7a 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) Specialized Dry Powder - Class D.

NOTE: Only "all purpose" or A, B, C dry chemical powder extinguishers containing monoammonium 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 labeled 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 1/2-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 labeled 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-38741.

(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 1/2 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 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 8f(5) of this AC 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. Detailed information on Halon 1211 agent characteristics, concentration requirements, health hazards, and extinguishing limitations may be found in NFPA Standard 12B, Halon 1211 Fire Extinguishing Systems.

(6) Halon 1211 extinguishers of less than 9 pounds (4 kg) capacity are not always furnished with a discharge hose. However, for access to underseat, 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 1301 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 1301 agent available from all the extinguishers should not be capable of producing a concentration greater than 5 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 10 percent by volume. For ventilated compartments the guidelines in paragraph 8f(5) of this AC 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. Detailed information on Halon 1301 agent characteristics, concentration requirements, health hazards, and extinguishing limitations may be found in NFPA Standard 12A, Halon 1301 Fire Extinguishing Systems.

(4) For occupied spaces on small aircraft where neat state (undecomposed) 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 1301 decompose when exposed to flame producing toxic products of decomposition. Halon 1211 produces some decomposition products which 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, electical 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-inch 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 required in Sections 23.561, 25.561, 27.561, and 29.561 of the Federal Aviation Regulations, with the hand fire extinguisher installed.

(b) The weight of the hand fire extinguisher and its mounting bracket should be added to the aircraft empty weight and a new empty weight center 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 flightcrew 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 capable of withstanding the inertia forces required by the FAR Sections listed in paragraph 7g(3)(a) of this AC.

8. GENERAL INFORMATION.

a. Extinguishing Agent Toxicity. Since the toxicity groupings of various fire extinguishing agents are no longer considered valid comparisions, the Underwriters' Laboratories, Inc., 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 expellent 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) Nonrefillable 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) Nonrefillable disposable fire extinguishers are exempt from the periodic hydrostatic test requirements.

(3) These type 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 CO_2 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 CO_2 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 compartments 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 vapors 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 undecomposed 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 odor, 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. See NFPA Standard 12A, Halon 1301 Fire Extinguishing Systems, and NFPA Standard 12B, Halon 1211 Fire Extinguishing Systems, for more detailed information.

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

(3) Under nonventilated conditions, Underwriters' Laboratories, Inc., recommends 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 habitated, nonventilated aircraft compartments. Due to oxygen deficiency, prolonged occupancy can produce unconsciousness and death at higher concentrations. A concentration of 9 precent 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. (Ref. NFPA Standard 12, Appendix A). Carbon dioxide must be at a 34 percent concentration to effectively extinguish a gasoline fire.

(5) For ventilated compartments, the nomographs shown in Appendix 1, Figures 1, 2, and 3 of this AC can be used to find safe extinguisher sizes when compartment volume and ventilation rates are known. The nomographs are based on allowable doses of 4 percent minutes, 10 percent minutes, and 25 percent minutes for Halon 1211, Halon 1301, and CO_2 respectively. Because of the effect of CO_2 on human respiration rate, the allowable CO_2 would have to be reduced by a factor of six from the amount allowed by the CO_2 nomograph to reduce changes in human respiration rates. The Halon 1211 and 1301 nomographs are entirely consistent with recognized standards. If extinguishers larger than those indicated by the selected nomographs are installed, use of protective breathing equipment should be considered. These nomographs are essentially for aircraft for which rates are controllable and known. To use a selected nomograph, extend a straight line across the three vertical scales, crossing the air change and compartment volume scales at the figures appropriate for the aircraft, and crossing the agent scale at weight appropriate for that air change time and volume.

(6) 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 7e(4), 7e(5), 8f(3), and 8f(5) of this AC. For all aircraft applications in habitated compartments, Halon 1211, 1301, and mixtures of the two should be agents of choice as compared to CO_2.

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.

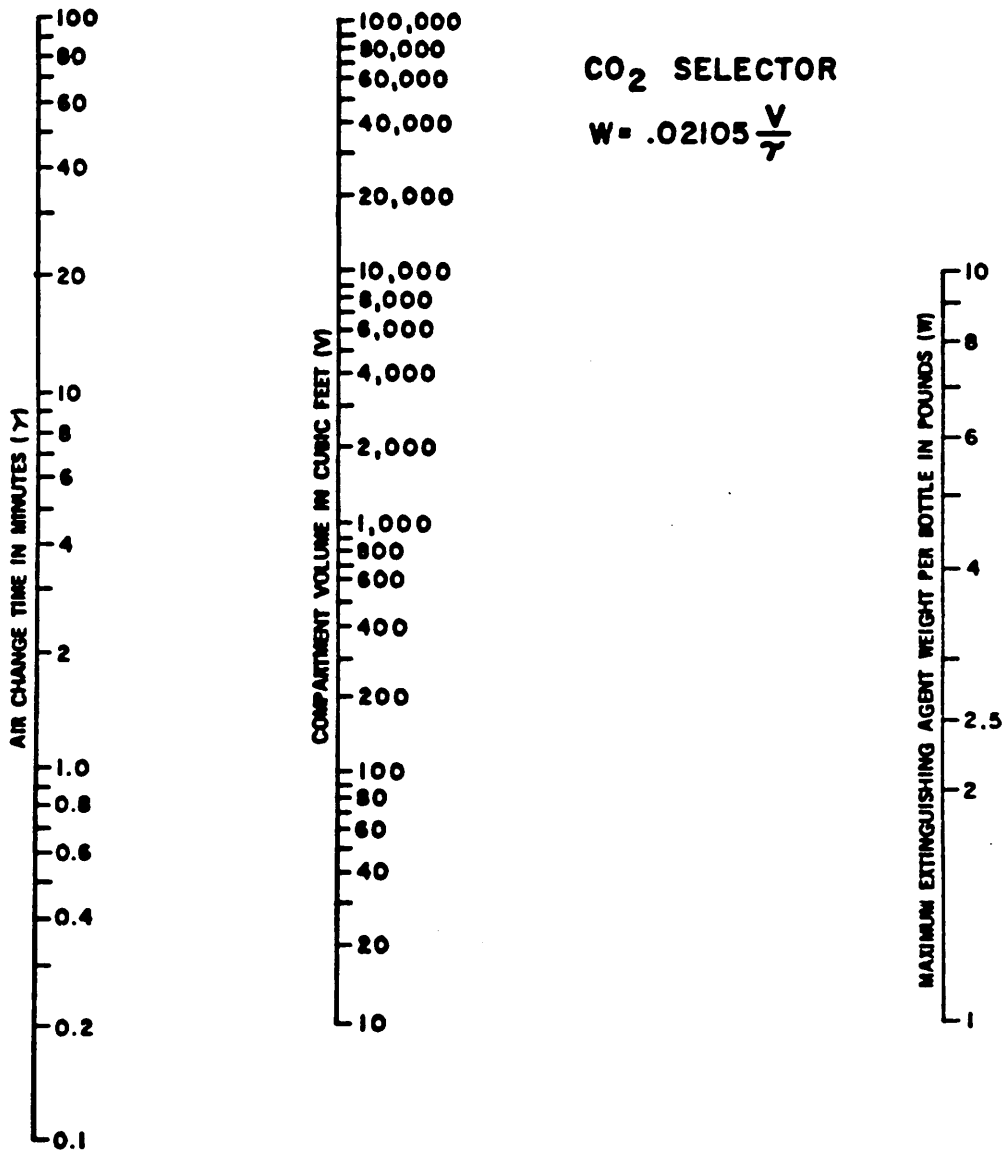
(3) Care must be taken not to direct the initial discharge at the burning surface at close range (less than 5-to-8 feet) because the high velocity stream may cause splashing and/or scattering of the burning material.

(4) Ventilate the compartment promptly after successfully extinguishing the fire to reduce the gaseous combustion and gases produced by thermal decomposition.

h. Inspection, Hydrostatic Test and Life Limits. Recommended procedures for the inspection, hydrostatic test and life limits of pressure cylinders are outlined in Part 173, Chapter 1, Subparts B, and G of CFR 49 currently in effect. See CFR 49, Part 173.306(c)(5) regarding retest intervals for fire extinguishers.

M. C. Beard
Director of Airworthiness

FIGURE 1. NOMOGRAPH



NOTE: Due to the effect of CO_2 on human respiration rate, the allowable CO_2 would be reduced by a factor of six from the amount allowed by the CO_2 nomograph to reduce changes in human respiration rates (Ref. Paragraph 8f(5) of this AC).