MILITARY SPECIFICATION

EXTINGUISHING SYSTEM, FIRE, AIRCRAFT, HIGH-RATE-DISCHARGE TYPE, INSTALLATION AND TEST OF

This specification has been approved by the
Bureau of Naval Weapons, Department of the Navy

1. SCOPE

1.1 This specification covers the installation of high-rate-discharge type fixed fire extinguishing systems for engine spaces and other potential fire zones in aircraft.

2. APPLICABLE DOCUMENTS

2.1 The following specifications, standards, drawings and publication, of the issue in effect on date of inviation for bids, form a part of this specification:

SPECIFICATIONS

Federal

WW-T-787	Tubing, Aluminum Alloy 52S, Round, Seamless, Drawn

Military

MIL-V-6405	Valve, Check, Two-Way, Bromochloromethane, Aircraft Fire Extinguishing System
MIL-E-7080	Electric Equipment, Piloted Aircraft, Installation and Selection of, General Specification for
MIL-T-7081	Tubing, Aluminum Alloy 6061 and 6082 Seamless, Round, Aircraft Hydraulic Quality
MIL-T-8606	Tubing, Steel, Corrosion-Resistant (18-8 Stabilized)
MIL-B-12218	Bromotrifluoromethane (Liquefied)
MIL-C-22284	Container, Aircraft Fire Extinguishing System, Bromotrifluoromethane, CF_3Br
MIL-D-70327	Drawings, Engineering and Associated Lists

STANDARDS

Military

MIL-STD-203	Cockpit Controls; Location and Actuation of, for Fixed Wing Aircraft
MIL-STD-250	Cockpit Controls; Location and Actuation of, for Helicopters
MS25103	Switches, Toggle, Double Pole, Three-Hole mounting
MS25231	Lamp, Incandescent, Single Contact, Miniature Bayonet Base, T-3-¼ Bulb
MS26523	Handles, Control, Aircraft Fire Extinguisher
MS33586	Metals - Definition of Dissimilar
MS33611	Tube Bend Radii

DRAWINGS

Air Force-Navy Aeronautical Standard Drawings

AN742	Clamp, Plain, Support, Loop-Type, Aircraft
AND10104	Tubing, Steel, Corrosion-Resistant, Round, Standard Dimensions for

AND10106	Tubing - Standard Sizes for Aluminum Alloy (52SO) Round
AND10108	Tubing - Standard Sizes for Aluminum Alloy (61S) Round
AND10375	Colors - Fluid Line Identification

PUBLICATION

Air Force - Navy Aeronautical Bulletin

No. 143 Specifications and Standards; Use of

(When requesting specifications, standards and publications, refer to both title and number. Copies of this specification and applicable specifications may be obtained upon application to the Commanding Officer, Naval Aviation Supply Depot, Philadelphia 11, Pennsylvania, Attention: Code CDS).

3. REQUIREMENTS

3.1 Deviations - Deviations from this specification desired by the contractor (substitution of equipment, material or installation) shall be specifically brought to the attention of the Bureau of Naval Weapons by letter concurrent with or prior to forwarding the design data for approval.

3.2 Conflicting requirements - In case of discrepancies between this specification and the type or detail specification for a particular aircraft, the type or detail specification shall prevail.

3.3 Materials - Materials shall conform to applicable specifications and shall be as specified herein. Materials which are not covered by applicable specifications or which are not specifically described herein shall be of the best quality, of the lightest practicable weight, and suitable for the purpose intended.

3.3.1 Metals - Metals shall be of a corrosion-resistant type or shall be suitably treated to resist corrosion. Magnesium alloys shall not be used in the extinguishing system.

3.3.1.1 Dissimilar metals - Unless suitably protected against electrolytic corrosion, dissimilar metals shall not be used in intimate contact. The use of dissimilar metals separated by suitable insulating materials is permitted. Dissimilar metals are defined in Drawing MS33586.

3.4 Selection of materials - Specifications and standards for all materials, parts and Government certification and approval of processes and equipment, which are not specifically designated herein and which are necessary for the execution of this specification, shall be selected in accordance with ANA Bulletin No. 143, except as provided in the following paragraph.

3.4.1 Standard parts - Standard parts (AN, MS or JAN) shall be used wherever they are suitable for the purpose, and shall be identified by their part numbers on drawings and parts lists, in accordance with Specification MIL-D-70327. Commercial utility parts, such as screws, bolts, nuts, cotter pins, etc., may be used, provided they have suitable properties and are replaceable by standard parts without alteration. When a non-standard part is used where a suitable standard part exists, the contractor shall reference the standard part on drawings and parts lists, and the installation shall provide for use of the standard part.

3.5 Service life - As a design objective, the components used in assembly of the fire extinguishing system shall be so selected and installed that their expected service life is equal to that of the airframe. This requirement shall not apply to explosive actuators.

3.6 Potential fire zones - The aircraft shall be studied for potential fire zones and adequate fire extinguishing coverage shall be provided for each potential fire zone. The following shall be considered potential fire zones, but this paragraph shall not preclude

designation of additional zones, whether in engine spaces or not, as potential fire zones:

(a) The engine accessory section.

(b) The induction system of a reciprocating engine, unless the engine is a direct fuel injection type.

(c) The area surrounding the engine exhaust system when it is adjacent to a potential fire zone and is not separated from such zone by a fireproof structure. A fireproof structure under this specification shall be defined as capable of withstanding a 2000°F flame for five minutes without burn-through.

(d) The entire volume surrounding the compressor and combustion sections of turbojet and turboprop engines.

(e) The zone aft of the engine firewall when the presence of a combustible fluid and source of ignition makes this zone a potential fire hazard.

(f) Compartments in which exhaust turbosuperchargers are installed.

(g) Compartments containing flammable materials or flammable fluid lines or tanks, if such compartments also contain sources of ignition or if they are not separated from other potential fire zones by a tight-fitting fireproof structure.

(h) A coolant radiator containing a flammable fluid or the oil cooler, when these components or the duct leading to them are located adjacent to a potential fire zone and are not separated from such zone by a fireproof structure.

(i) Baggage compartments and compartments containing auxiliary power units, unless they are readily accessible to a crew member with a portable fire extinguisher during flight.

(j) The power zone of a radial reciprocating engine; however, a fire extinguishing system shall be installed in this zone only in experimental aircraft and in those aircraft where the value of the airplane or the personnel carried warrants increased weight for a nominal increase in safety.

3.7 Fire extinguishing agent - The extinguishing agent shall be bromotrifluoromethane (CF_3Br) in accordance with Specification MIL-B-12218.

3.8 Concentration of agent - Actuation of the extinguishing system shall produce a concentration of agent at least 15 percent by volume in all parts of the affected zone. This concentration shall persist in each part of the zone for at least 0.5 second at normal cruising condition.

3.8.1 Quantity of agent - As a design guide, the following formulas may be used to determine the minimum quantity (weight) of agent to be discharged into each engine:

(a) For rough nacelle interior with low airflow, and for smooth nacelle interior regardless of airflow, whichever of the following formulas provides the larger value of W: $W = 0.05V$
$W = 0.02V + 0.25Wa$

(b) For rough nacelle interior with high airflow: $W = 3(.02V + 0.25Wa)$

(c) For deep frame nacelle interior with high airflow: $W = 0.16V + 0.56Wa$

Where: W = weight of agent in pounds.
Wa = pounds of air per second passing through the zone at normal cruising condition.
V = net volume of the zone in cubic feet (gross volume of the zone less the volume of major items of equipment).

. Definitions:

(1) Low airflow signifies air flow rate of 1 pound or less per second at cruise.
(2) High airflow signifies air flow rate exceeding 1 pound per second at cruise.
(3) Smooth nacelle denotes no circumferential ribs protruding into nacelle.
(4) Rough nacelle denotes circumferential ribs protruding less than 6 inches into nacelle.
(5) Deep frame nacelle denotes circumferential ribs protruding 6 inches or more into nacelle, or nacelle configuration with cavities 6 inches or more in depth (measured transversely).

3.8.2 Zones outside of nacelles - For potential fire zones not located in nacelles, the formula of 3.8.1(a) may be used.

3.8.3 Added factor for agent loss - The value of W obtained in the formulas of 3.8.1 shall be increased by 15 percent to compensate for agent trapped in the container and lost in wetting the discharge tubing.

3.9 Duration of discharge - The period of time required to discharge the calculated amount of agent shall be 1 second or less, measured from the time the agent starts to leave the tubing ends until the required amount of agent has been discharged.

3.10 Reserve supply (second discharge) - Unless otherwise specified by the Bureau of Naval Weapons, a reserve supply (second discharge) shall be provided for each engine space of aircraft having 4 or more engines. The quantity of reserve supply shall be equal to that required for the initial discharge to obtain the concentration specified in 3.8.

3.11 Distribution of agent - All potential fire zones, as defined in 3.6, that are associated with one engine and its accessories shall be flooded with fire extinguishing agent simultaneously. The distribution system shall be designed to provide each particular zone with the concentration of agent specified in 3.8.

3.12 Arrangement of system - Fire extinguishing systems shall be furnished in one of the following arrangements.

3.12.1 Individual system - A supply of agent for one engine space or other protected zone.

3.12.2 Central supply system - A central supply of agent, capable of being directed to either of two potential fire zones. This system shall not be used to supply two engine spaces on opposite sides of the fuselage.

3.13 Fire emergency control - The fire emergency control arrangement shall be in accordance with Standard MIL-STD-203 or Standard MIL-STD-250, as applicable, except that the control handle design shall conform to Standard MS26523. Actuation of the fire emergency control shall select the engine or area to which the agent will be directed, but will not discharge the agent.

3.13.1 Reserve fire emergency control - Where a reserve supply (second discharge) of agent is provided, the fire emergency controls shall be so interlocked that actuation of a control handle will cut out any control handle that had been previously selected.

3.13.2 Fire warning indication - The fire warning light incorporated in the control handle shall be aviation red. The face of the control handle shall be marked in accordance with Standard MS26523, with lettering at least one-fourth inch high. The legend shall be opaque on a translucent background and shall not be readable when the warning lights are not actuated. The signal shall be indicated by two MS25231-313 lamps in each handle.

3.13.2.1 Brightness - The brightness of the translucent background of the warning light shall be at least 150 foot-lamberts when the two lamps are operated at rated voltage. A dimming circuit shall not be used.

3.13.3 Agent discharge switch - A single discharge switch shall be provided on the airplane adjacent to the fire emergency controls. Actuation of this switch shall discharge the agent to the engine or the area whose control handle had been pulled. For extinguishing systems of the single discharge type, the agent discharge switch shall be in accordance with Standard MS25103-28. Where a reserve supply (second discharge) of agent is provided, the agent discharge switch shall be in accordance with Standard MS25103-27.

3.13.4 Electrical components - The installation of electrical components shall be in accordance with Specification MIL-E-7080. Electrical power for the extinguishing system shall be supplied from the essential bus. Electrical wiring shall not be located within a potential fire zone, unless such wiring has been fireproofed.

3.14 Operating instructions - The fire emergency controls shall be conspicuously placarded with instructions as indicated below. Placards shall have a red background with white lettering.

3.14.1 Reciprocating and turbo-prop engines - The placard shall include the following information:

FIRE EMERGENCY INSTRUCTIONS

1. PULL LIGHTED HANDLE FOR FLUID SHUT-OFF.
2. ACTUATE AGENT DISCHARGE SWITCH WHEN PROPELLOR STOPS.

3.14.2 Turbojet engines - The placard shall include the following information:

FIRE EMERGENCY INSTRUCTIONS

1. PULL LIGHTED HANDLE FOR FLUID SHUT-OFF.
2. ACTUATE AGENT DISCHARGE SWITCH.

3.14.3 Other protected areas - The placard shall include the following information:

FIRE EMERGENCY INSTRUCTIONS

1. PULL FIRE EMERGENCY CONTROL FOR AFFECTED AREA.
2. ACTUATE AGENT DISCHARGE SWITCH.

3.15 Agent release - The release of agent from the container shall be electrically actuated by the agent discharge switch. The flow of agent from the container shall commence within one-half second following actuation of the agent discharge switch.

3.15.1 Directional control - For a central supply system, an agent container having dual outlets shall be used. Each outlet shall be directly connected by means of a separate feed line to one of the areas served by that container. Directional control of the agent shall be obtained by actuation of the emergency control handle, which will select the electrical circuit for subsequent discharge from the appropriate container outlet. Actual discharge from any container outlet shall be accomplished by actuation of the agent discharge switch.

3.15.2 Second discharge - Where a reserve supply (second discharge) of agent is provided, the outlets of the added agent container shall be teed into the outlets of the primary container, and check valves shall be used to prevent back flow of agent into the previously discharged container. Check valves shall be in accordance with Specification MIL-V-6405.

3.16 Discharge tubing - Lines shall be as short as practicable and the agent containers shall be as close as possible to the zones to be protected. Supply lines between the containers and the discharge openings shall not exceed 10 feet in length. Supply lines shall be direct, with the number of fittings and turns held to a minimum, since expansions and restrictions have adverse effects on the rate of discharge. In a supply line having many changes of direction, quantities of propelling gas may get past the liquid agent, thus reducing the discharge rate and making the discharge sporadic and ineffective. Low points where condensation may be trapped shall be avoided.

3.16.1 Prevention of inadvertent misconnection - Every effort shall be made in the design of the extinguishing system to prevent the possibility of backward installation of any component part or the inadvertent interchange of connecting lines.

3.16.2 Tubing material - Flexible lines and lines in the fire zone shall be of corrosion resistant steel. Other lines shall be of alluminum alloy or corrosion resistant steel. Steel tubing shall have a minimum wall thickness of .028 inch and shall be in accordance with Specification MIL-T-8606 and Drawing AND10104. Aluminum alloy tubing shall have a minimum wall thickness of .035 inch and shall be in accordance with Specification WW-T-787 and Drawing AND10106, or in accordance with Specification MIL-T-7981 and Drawing AND10108.

3.16.3 Pressure - Tubing, fittings and flexible lines shall be designed for 1500 psi minimum burst pressure.

3.16.4 Tubing mounting - Tubing shall be securely supported and, where necessary, protected against damage. Supporting clamps shall be of fire-resistant material and in accordance with Drawing AN742.

3.16.5 Bend radii - The minimum bend radii shall be in accordance with Standard MS33611.

3.16.6 Tubing cleanliness - Tubing shall be cleared of all metal chips and foreign matter before installation.

3.16.7 Marking - Tubing shall be identified in accordance with Drawing AND10375.

3.17 Discharge openings - Discharge lines shall terminate in open ends without nozzles. Perforated discharge lines shall not be used unless approved by the Bureau of Naval Weapons.

3.17.1 Discharge locations - Agent discharge locations are critical in zones of high airflow. Such outlets shall be located as far upstream of the airflow as practicable. The discharge should be directed across the airstream and slightly downstream in such a manner that a helical spray pattern is produced. In zones of little or no airflow, the locations of the agent discharge openings are not critical. A satisfactory location is at the center of the top of the zone, with the agent directed downward. For deep frame nacelles, outlets shall be arranged to discharge the agent directly into the deep frames.

3.17.2 Discharge in undrained areas - Where the presence of shelves, channels, ledges or similar structures results in accumulation of combustible fluids due to inadequate drainage, special distribution of agent shall be provided to such areas.

3.17.3 Discharge tubing dimensions - The cross-sectional areas of the supply lines are dependent upon the discharge rates desired and upon system-volume considerations. The minimum diameter of the supply line is established by the required rate of discharge, and the maximum diameter is limited by the need for keeping the system volume at a minimum.

3.18 Agent containers - The agent containers shall be in accordance with Specification MIL-C-22284. Containers shall include the full quantity of agent specified in Specification MIL-C-22284, Table I.

3.18.1 Quantity and size - The number and size of agent containers shall be adequate to obtain the agent concentration and duration specified in 3.8

3.18.2 Brackets - Brackets for mounting the containers shall be designed to withstand all loads to which they may be subjected due to recoil during discharge, gunfire damage or applied load factors.

3.18.3 Location - The containers shall be located in such a manner that they will be readily accessible for installation, removal and inspection without requiring removal of the engine or any major accessory. Containers shall be located in such a manner that the pressure gage is readily visible for inspection by maintenance personnel.

4. QUALITY ASSURANCE PROVISIONS

4.1 Inspection and test records - Unless otherwise specified, contractor's records of all inspection work and tests, giving the results of tests required to determine compliance with the requirements and tests specified herein, shall be kept complete and shall be available to the Government representative at all times. The tests shall be accomplished on articles to be supplied on the contract or order. The record or report of inspection and tests shall be signed or approved by a responsible person specifically assigned by the contractor. Contractors not having laboratory testing facilities satisfactory to the Bureau of Naval Weapons shall engage the services of a commercial testing laboratory capable of conducting tests to determine compliance with all the requirements and tests in the specification, and acceptable to the Bureau of Naval Weapons.

4.2 Inspection - Each installation shall be inspected to determine compliance with the requirements specified herein and shall be subjected to the following tests:

4.2.1 Pressure test - A pressure test of the system with dry air or nitrogen at 1000 psig to check the integrity of the tubing and fittings from the agent container to the firewall, or as near to the discharge outlet system as possible.

4.2.2 Outlets - A visual check of the discharge outlets to insure that they are free from foreign matter.

4.2.3 Container weight - A weight check of the container(s) prior to installation and a check of the pressure gage on the container(s) after installation, to determine that the containers are properly charged.

4.2.4 Electrical continuity - An electrical continuity check of the electrical wiring of the system.

4.3 Installation approval - Preliminary and final approval shall be required for the first or prototype installation of a fire extinguishing system in each model aircraft and following any change of the engine, nacelle configuration or fire extinguishing system.

4.3.1 Preliminary approval - Prior to the initial installation of the fire extinguishing system, and when applicable after any changes in the engine, nacelle configuration, or fire extinguishing system, the contractor shall submit to the Bureau of Naval Weapons for preliminary approval the following design data:

4.3.1.1 Schematic diagram - Schematic diagram of the system showing container sizes, valve sizes, tubing sizes and wall thicknesses, and discharge outlet sizes. When applicable, component parts shall be identified by AN or MS part numbers.

4.3.1.2 Quantity of agent - Calculations showing derivations of amounts of agent from air flow and volume figures for all zones protected, and information as to the direction and location of air flow in each zone.

4.3.1.3 Tubing sizes - Calculations showing derivation of tubing sizes and discharge outlet sizes (area).

4.3.1.4 Installation - Preliminary installation drawing showing location of agent containers, tubing, distribution pattern, and materials with respect to the area to be protected.

4.3.1.5 Compartment sealing - Information as to the effectiveness of the method of sealing compartments to be protected from the surrounding compartments.

4.3.1.6 Control panel - Layout of control panel in the cockpit.

4.3.2 Final approval - The entire fire extinguishing system shall be mocked-up or installed in the aircraft down to and including distribution tubing and outlets. The following tests shall be conducted, and reports of these tests shall be submitted to the Bureau of Naval Weapons for final approval.

4.3.2.1 Discharge duration - The system shall be discharged and the duration of discharge shall be timed by means of motion pictures taken at the rate of 32 frames per second, or by any other means suitable to the Bureau of Naval Weapons. The pictures (if used) shall be taken from a position forward of all distribution outlets and also from a position opposite the distribution outlets at right angles to the fore and aft line of the aircraft. The structure on which the system is set up shall be such that, as nearly as possible, an unobstructed view can be obtained from all the distribution outlets. The discharge duration shall be in accordance with the requirements of this specification.

4.3.2.2 Distribution test - Under actual or simulated cruise conditions, the system shall be discharged, and compliance with 3.8 shall be verified by use of an appropriate method of measuring agent concentration.

5. PREPARATION FOR DELIVERY

5.1 This section is not applicable to this specification.

6. NOTES

6.1 Intended use - This specification is intended for use in the installation of built-in fire extinguishing systems for the protection of aircraft in flight and during ground operations.

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