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MILITARY SPECIFICATION

INSTALLATION OF FIXED GUNS AND ASSOCIATED EQUIPMENT IN NAVAL AIRCRAFT

This specification is approved for use by the Naval Air Systems Command, Department of the Navy, and Is available for use by all Departments and Agencies of the Department of Defense.

1. SCOPE

1.1 Scope. This specification establishes the minimum requirements for the installation of all types of fixed guns and associated equipment including ammunition feed and ejection systems in naval aircraft. Installation details such as mounting arrangements and fastening devices for the separate component equipments of the gun Installations are contained on drawings or in other publications specifically applicable to the various equipments. In addition to installation reaquirements. certain functional requirements for components of the installations are contained herein. Also contained herin are certain inspection and test procedures applicable to the installations covered by this specification. This specification does not contain requirements for gun fire control equipment or gun boresight alignment.

1.2 Classification. Fixed gun installation are classified into the following two general types (see 6.2b):

a. Wing Installations: Guns mounted in or on the wings.

b. Fuselage Installations: Guns mounted in the fuselage.

Beneficial comments (recommendations, additions, deletions) and any pertinent data which may be of use in improving this document should be addressed to: Commanding Officer, Naval Air Warfare Center Aircraft Division Lakehurst, Systems Requirements Department, Code SR3, Lakehurst, NJ 08733-5100, by using the self-addressed Standardization Document Improvement Proposal (DD Form 1426) appearing at the end of this document or by letter.

AMSC N/A FSC 1005

2. APPLICABLE DOCUMENTS

2.1 Government documents.

* 2.1.1 Specifications, standards, and handbooks. The following specifications, standards, and handbooks form a part of this document to the extent specified herin. Unless otherwise specified, the Issues of these documents are those listed in the issue of the Department of Defense Index of Specifications and Standards (DODISS) and supplement thereto, cited in the solicitation (see 6.2c).

SPECIFICATIONS

FEDERAL

QQ-A-250/5	Aluminum Alloy Alclad 2024, Plate and Sheet
QQ-A-250/8	Aluminum Alloy 5052, Plate and Sheet

MILITARY

MIL-S-5059	Steel, Corrosion-Resistant (18-8) Plate, Sheet and Strip
MIL-I-8671	Installation of Droppable Stores and Associated Release Systems
MIL-D-8708	Demonstration: Aircraft Weapon Systems, General Specifications for

(Unless otherwise indicated, copies of federal and military specifications, standards, and handbooks are available from the DODSSP - Customer Service, Standardization Documents Order Desk, 700 Robbins Avenue, Building 40, Philadelphia, PA 19111-5094.)

* 2.1.2 Other Government documents, drawings, and publications. The following other Government documents, drawings, and publications form a part of this document to the extent specified herein. Unless otherwise specified, the issues are those cited in the solicitation.

PUBLICATIONS

SD-24	General Specification for Design and Construction of Aircraft Weapons Systems

(Application for copies should be addressed to the Commander, Naval Air Systems Command, Standardization Section, Code AIR-51122E, Arlington, VA 22243-5110 or DODSSP - Customer Service, Standardization Documents Order Desk, 700 Robbins Avenue, Building 4D, Philadelphia, PA 19111-5094.)

* NAVAL AIR SYSTEMS COMMAND TECHNICAL MANUALS

NA-11-95M89-1	M89 Declutching Feeder
NA-11-95M197-1	M197 20MM Automatic Gun

(Copies are available from the Naval Aviation Supply Office, Naval Publications and Forms Directory, Code 03443, 5801 labor Road, Philadelphia, PA 19120.)

* 2.2 Non Government publication. The following document forms a part of this document to the extent specified herein. Unless otherwise specified, the issues of the document which are DoD adopted are those listed in the issue of the DODISS cited in the solicitation. Unless otherwise specified, the issues of the document not listed in the DODISS are the issues of the document cited in the solicitation (see 6.2c).

AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

ASTM B 168	Standard Specification for Nickel-Chromium-Iron Alloys.

(Application for copies should be addressed to the American Society for Testing and Materials, 1916 Race Street, Philadelphia, PA 19103-1137.)

(Non-Government standards and other publications are normally available from the organizations that prepare or distribute the documents. These documents also may be available in or through libraries or other Informational services.)

* 2.3 Order of precedence. In the event of a conflict between the test of this specification and the 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.

3. REQUIREMENTS

3.1 Materials. Materials used in fixed gun Installations shall be of the highest quality suitable for the purpose. The materials shall be in accordance with applicable government specifications. Selection and substution of materials shall be made in accordance with requirements of SD-24, or the applicable aircraft detail specification.

3.1.1 Materials for ammunition boxes and chutes. Materials used in the construction of ammunition boxes, feed chutes and ejeciton chutes shall be in accordance with the following specifications, listed in order of preference:

QQ-A-250/5:	For boxes only
ASTM B 168:	For boxes and ejection chutes only
MIL-S-5059:	For boxes; feed and ejection chutes
QQ-A-250/8:	For boxes and ejection chutes only

3.1.2 Materials for blast tubes. Materials used in the contruction of blast tubes shall be resistant to corrosion caused by hot gun gases (see 3.13.3).

3.2 Required guns and ammunition feed and ejection systems. The number and type of guns and Government-furnished or contractor-furnished equipment to be installed In any particular model aircraft shall be as specified in the applicable aircraft detail specification.

3.2.1 Contractor-furnished equipment. All parts and equipment necessary for the proper operation of the gun and ammunition feed and ejection system(s), which are not specified in the aircraft detail specification as Government-furnished, shall be furnished and Installed by the contractor as required. Installation of contractor-furnished parts and equipment shall be subject to Naval Air Systems Command approval. Use of new-type equipment proposed by the contractor will be considered by the Naval Air Systems Command, but shall not be installed in lieu of specified Government-furnished or approved-type contractor-furnished equipment, unless specifically approved by the Naval Air Systems Command.

3.3 Required ammunition loads. The gun installations in the aircraft shall provide for accommodation of the full ammunition load for each gun. Unless otherwise specified in the applicable aircraft detail specification, a full load shall consist of a sufficient number of rounds to permit a total of 9.0 seconds minimum firing time at the normal rate of fire of the gun. The ammunition load shall be contained in as few boxes, or drums, as necessary. Although one container for each gun is preferable, the type and number of containers Installed for each gun shall-be in accordance-with the aircraft detail specification. The capacity of the ammuniton feed chutes may be utilized for containing a portion of the full load, but, if so used, the feed chutes must be designed with separate convenient access for loading the ammunition which is in excess of the box capacity.

3.4 Location of guns. Guns shall be so locatd that the distance between the guns and the Hne-of-sight shall be a minimum consistent with aircraft design, with location requirements for other adjacent equipments and with satisfactory operation of the guns and gun firing control equipment in the aircraft. The location of the guns shall be such that the recoil and blast forces produced by firing will cause no damage to the aircraft structure, instruments, and equipment in the aircraft and will cause no impairment to the operation of the power plant or other aircraft components. Special attention shall be given to the location of the guns with respect to electronic equipment; maximum separation shall be maintained between gun supporting structure and electronic equipment supporting structure to prevent malfunction of the electronic equipment due to gun firing vibration. When more than one gun is installed at a station, each gun shall be located as close as practicable to the adjacent gun; the distance between guns to be a minimum consistent with accessibility requirements (see 3.17). Guns shall be so loacted with respect to the center of gravity of the aircraft such that the yawing and pitching moments caused by firing a 4 second burst from all guns do not reduce more than 2 mils deflection of the mean point of contact (MPI) at 800 yards. The gun firing electrical controls such as relays, power, and supplies shall be located sufficiently remote from the guns to prevent accidental tripping or malfunction resulting from gun firing vibration. For alignment, see 3.8.

3.4.1 Location with respect to propeller disks. Guns shall be located so that in any of the required positions of boresight alignment (see 3.8) clearance as required in 3.16.1 is allowed between the line-of-fire of each gun and the propeller disk(s).

3.4.2 Muzzle location. The location of gun muzzles in the fuselage or wings shall be in accordance with the aircraft detail specification. The muzzles of the guns shall be displaced a sufficient distance from adjacent radomes or antenna to prevent fatigue failure of the radome or antenna from gun blast. This will require consideration of gun blast pressure patterns under static and dynamic firing conditions up to the maximum Mach number of the airplane. Available gun blast information will be furnished by the Naval Air Systems Command upon request. The gun muzzles shall be adequately loacated with respect to jet engine air intakes to prevent, to the maximum extent possible, the entrance of gun muzzle gas into the engine air Intake. In meeting this requirement, consideration must be given to the air flow around the engine air intake and the gun muzzles during firing under dynamic flight conditions up to the maximum Mach number and maximum altitude of the aircraft.

3.4.2.1 Location of muzzles in wi ngs. In wing gun installations, the muzzles shall emerge at points on the wing on the forward extremity of the leading edge of the wing or as near to it on the underside of the leading edge as is compatible with satisfactory aircraft and gun performance.

3.4.2.2 Location of muzzles in fuselage. Fixed guns installed in the fuselage shall be properly located so that the adverse effect of gun flash and gun smoke on the pilot’s vision is minimized. The muzzle shall emerge at a point below the horizontal plane which passes through the foremost point of the nose of the aircraft with the aircraft in level flight attitude.

3.4.2.3 Location of guns with respect to other weapons. The guns shall be so located that there will be no mutual interference between the trajectories of the gun projectiles and rockets or other weapons fired or released from the aircraft within the minimum target range determined by the armament control system.

3.4.2.4 Location of guns in jet aircraft. In jet aircraft the guns shall be so located as not to cause engine flame out or-compressibility stall during or immediately after firing. Should this not be practicable, othe means shall be provided to prevent the above engine malfunction.

3.5 Location of ammunition containers and feed chutes. Ammnunition boxes, drums, and their respective feed chutes shall be so located and Installed as to provide a rapid, uninterrupted movement of ammununition to the gun feed mechanism. Installation shall be such that maximum “g” loads in the vertical plane do not interfere with the passage of the ammunition to the feed mechanism (see 3.14).

3.6 Strength requirements for gun installations. Adequate strength shall be provided in the gun mounts, attaching fittings, brackets, supporting members and-carry-through structures consistent with the strength of the aircraft structure for all combinations of translational and rotational velocities and accelerations for which the aircraft detail specification requires that the aircraft be designed. The design-ultimate and design-yield factors of safety shall be as specified in the aircraft detail specification. The strength of the

gun mounts and supporting structure shall be adequate to withstand all loads Imposed upon them by the reaction forces which occur when the guns are fired singly and simultaneously during under "g" loads specified in 3.14. The design loads must be carried from the trunnion and distributed into the primary aircraft structure in a manner which will prevent local distortion and fatigue failures. The installation shall be constructed to withstand firing, (without defects resulting) of 30,000 rounds (minimum) from each gun in bursts of 100 rounds minimum per gun from all guns fired simultaneously with cooling periods of minimum duration between bursts as required to prevent overheating of guns.

3.6.1 Gun reaction forces. Fore and aft reaction forces shall be considered to act along the barrel centerline of the guns. The value of the average reaction forces considered shall be in accordance with the applicable gun drawings and gun manuals (see 6.3). The natural period of vibration of the gun mounts and supporting structure shall be sufficiently different from the fundamental and harmonic periods of vibration of the guns to avoid resultant detrimental effects to the mounts, the guns or to the aircraft equipment during firing (see 3.4).

3.6.2 Fabrication of gun mounts and supporting structure. The gun mounts shall have no loosely fitted parts or linkages which will cause impact as the. mount or parts thereof change position in response to the forces applied by the gun during firing. Forged fittings and riveted, bolted or welded assemblies may be used in the fabrication of gun mounts and supports. Welded assemblies shall be subjected to 100 percent inspection. Clamps shall not be used for attaching the gun mount to the aircraft structure.

3.7 Adjustment provisions for gun mounts. The design of the mounts shall facilitate adjustment of the guns as follows: (a) a minimum of 3° (total excursion) of-adjustability with 2 1/2° downward in elevation and 1/2° upward from the mean position plus or minus 1° in azimuth shall be provided in the mounts, (b) adjustment within the specified limits shall be possible without relocation of the mounts on their supporting structure, and (c) the gun mounts, when adjusted to any required position, shall be sufficiently rigid to prevent firing dispersion or malfunction of the guns due to slippage of the-mounts during firing as required in 3.6. Allowance shall be made in the adjustment provisions for correction of alignment errors resulting from manufacturing tolerances and distortion caused by gun firing.

3.7.1 Adjustment in wing Installations. The mounts in wing gun Installations shall provide for an adjustment of the guns in the horizontal plane from convergence at 800 yards to convergence at 250 yards and 3" in the vertical plane as required in 3.8.

3.7.2 Adjustment in fuselage Installations. The mounts in fuselage gun Installations shall provide for a 1° adjustment of the guns in the horizontal and 3° in the vertical planes so that the gun barrel centerlines extended can be aligned as required in 3.8.

3.8 Boresight alignment of guns. The alignment of the fixed guns shall be in accordance with the gun alignment criteria and requirements.

3.8.1 Boresight retention.Each single-barrel fixed gun shall retain its boresight, within a circle about the original boresight of two mils radius while firing 1000 rounds of ammunition. During the firing period, the aircraft shall have engaged in normal flight and the guns shall have been removed and reinstalled at least once. Retention of boresight and requirements for multi-barrel guns shall be in accordance with the applicable aircraft detail specification.

3.9 Gun removal. In Installations containing six guns or less, fixed guns shall be installed in a manner which will enable a ground crew of two men to remove all guns in a maximum time of fifteen minutes and reinstall all guns in a maximum time of twenty-five minutes. If the above time limits exceed the time required for refueling the aircraft (see 3.15.2), the refueling time shall apply In lieu of the above maximum time limits for removal and reinstallation of guns. Removal of the guns for servicing and reinstallation shall be possible without disturbing the boresight adjustment of the gun mounts. Arrangement of pneumatic lines, electrical connections, hydraulic lines, and chuting shall prevent Incorrect connections and accidental interchange of lines between guns. Shafts and pins used to secure the gun to the mounting arrangement shall have lead in centering chamfers to facilitate ease of assembly and shall be equipped with an approved locking arrangement. Safety wiring shall not be required for retaining these shafts and pins in place.

3.10 Gun charging, clearing, and safing. A suitable hydraulic, pneumatic, or electrical charging/clearing/safing system as specified in the aircraft detail specification shall be installed for all guns (single barrel, multi-barrel, revolver, rotary, self or externally powered). For self powered single barrel guns, provisions shall be included in the Installation whereby the gun bolts or rounds are securely held in the rear “out of battery” safe position automatically by means of the charging/clearing/safing system when not firing. For multi-barrel externally powered rotary guns that eject the spent cartridge cases overboard, a solenoid actuated declutching feeder or similar arrangement should be used which prevents ammunition from entering the gun until firing is initiated. This safes the gun by stopping the flow of ammunition to the gun and ensures that all rounds left in the gun are fired before rotation ceases. For rotary gun systems that retain the spent cartridge cases and unfired rounds, a clearing/safing arrangement employing a solenoid actuated mechanism or similar arrangement shall be used to keep the gun bolts in the rear/safe position and for clearing live ammunition from the gun after each burst and at the end of firing. To prevent chambering of live ammunition by the gun bolts when the gun/aircraft is on the ground, a suitable safing tool shall be installed on the gun to mechanically hold the gun bolts in the rear/safe position. Selective gun charging/clearing/safing shall be provided for multiple installations to enable separate charging of each gun, each group, such as inboard guns, or upper and lower, or the right hand and left hand guns. Provisions, also must be provided for charging all guns simultaneously. Pneumatic, hydraulic, or electrical systems used to control charging shall be separated from or fused off from other aircraft systems operating from the same power source.

3.11 Gun firing controls. All necessary wiring, fuses, connectors, switches, other electrical system components, and teh electric trigger control (except Government-furnished equipment) shall be furnished and Installed by the aircraft contractor as required to select and fire the guns. Selectivity shall

be provided for firing each gun separately, or each group separately (such as Inboard or outboard, upper and lower, and right hand and left hand guns), and all guns simultaneously. Wiring circuits shall conform to drawing numbers listed in the applicable aircraft detail specification. The voltage of the system will be specified in the aircraft detail specification. The contractor shall Install the necessary equipment for providing the specified power to the gun installation components.

3.12 Gun and ammunition heating. If required, gun heating and cooling provisions shall be as specified in the applicable aircraft detail specification.

3.13 Blast tubes and blast suppression devices. If the guns are installed so that the muzzles are recessed withln the fuselage or wings, suitable blast tubes shall be Installed to convey the blast pressure and gun muzzle gas outside the fuselage or wing surfaces. The size and design of the tubes shall permit adjustment of the guns as specified in 3.7 and 3.8. Blast tubes shall be installed concentric with the gun barrel centerline within ±0.15 inch with the gun barrel in its mean boresight alignment. The tubes shall be of adequate size and shape to prevent adverse effects on the trajectory of the projectile and to prevent damage to the tubes in any position of gun adjustment required by 3.7 and 3.8. Blast tubes shall be removable for replacement. Blast deflection and muffling devices shall be installed to prevent gun blast damage on adjacent structures and equipment and to prevent adverse effect on engine performance. Design criteria for blast suppression devices will be furnished on request by the Naval Air Systems Command.

3.13.1 Strength requirements for blast tubes. Strength of blast tubes shall be sufficient to withstand the forces resulting from the blast pressures encountered at the gun muzzles. Any part of the aircraft which is exposed to blast pressure shall be reinforced sufficiently to withstand the maximum loads resulting from the blast pressures. For certain installation conditions, the magnitude of the blast pressures shall be obtained from the Naval Air Systems Command. If these are unavailable, the contractor may be required to determine these pressures empirically or analytically.

3.13.2 Gas tightness in blast tubes. The balst tubes shall be gas tight and shall be Installed in the aircraft in a manner which will prevent gun gas in the tubes from entering into the aircraft.

3.13.3 Blast tube temperatures. The gun blast tubes shall be installed in a manner which will prevent excessive heating of adjacent structure. Blast tube temperatures of 1000°F shall be considered in conjunction with the muzzle pressures discussed in 3.13.1.

3.13.4 Gun blast strength requirements for adjacent structures. Suitable reinforcement shall be provided to prevent gun blast damage to adjacent structure of the aircraft. Gun blast pressures for various aircraft guns can be obtained from the Naval Air Systems Command upon request.

3.13.5 Ventilation of gun compartments. A suitable means shall be provided for preventing the accumulation of gun gases in the gun compartments. Gun gas collection or gun compartment ventilation shall be employed. Ventilation or gun gas collection shall be adequate to prevent gun gas

concentrations exceeding 90 percent of the lower explosive limit after firing a minimum of 100 rounds (or SIX seconds of fire, whichever is greater) per gun from all guns in a single burst. The gun installation shall be adequate to prevent the gun gases and gases from the case and link stowage compartments and unventilated portion of the aircraft. a positive means for preventiong gun gas explosions in any part of the aircraft shall be provided. Measurements of gun gas concentration shall be made by government approved gas measurement equipment.

3.14 Ammunition handling-feed and ejection systems. The ammunition feed system Installed for each gun shall include one (or more, if necessary) a-munition boxes or storage containers and suitable feed chutes for supplying the required full load of ammunition to each gun. The ammunition feed system should be designed to function adequately and to ensure the uninterrupted operation of the guns under acceleration and "g" loads without the use of ammunition boosters. However. if tests show that iperation of the system is not satisfactory without boosters, suitable feed assist mechanism, energized by a source other than the gun, itself, shall be Installed. Systems utilizing ammunition storage drums, containers which are not removed from the aircraft for loading, shall be equipped with a suitable manual and powered arrangement to upload and download linked and linkless ammunition as required. Ejection chutes shall be provided to carry the expended cartridge cases and links from the gun to suitable storage compartments or outside the aircraft. The ammunition handling feed and case and link ejection arrangement shall be designed and installed in accordance with the access and clearance requirements of 3.15 and 3.17. The gun's ammunition handling-feed and ejection systems shall operate satisfactorily at all altitudes, flight speeds, and "g" loads specified in the gun demonstration requirements of MIL-D-8708.

3.14.1 Adjustment provisions for feed chutes, ejection chutes and accessories. A suitable means shall be provided for adjusting the postion of feed chutes, ejection chutes and related accessories as necessary to ensure their proper.functioning for any of the boresight positions of the guns required in 3.8. A minimum length (compressed state) of four and a maximum not to exceed sixteen Inches of flexible feed chute shall be Installed at the gun end of the chute to facilitate adjustment of feed chutes for single barrel fixed guns. The remainder of the chute shall be rigid to prevent de-linking of ammunition which occurs when moving ammunition whips in the flexible chuting. The length of flexible feed and ejection chutes for multi-barrel fixed guns shall be in accordance with the applicable aircraft detail specification.

3.14.2 Friction reduction in ammunition feed and ejection systems. The inside surfaces of ammunition boxes shall be smooth and entirely free of any obstruction of the ammunition as it is removed from the box during the operation of the gun. The inner surfaces of the feed and ejection chutes shall be smooth and highly polished to a minimum of 16 microinches to reduce friction and shall be free of sharp corners and edges or other protrusions which might obstruct the continuous passage of the ammunition. All screw and rivet heads shall be flush with the inside surfaces. No belt-retaining springs shall be placed in the feed chutes. Sharp twists or turns in the feed chutes that will cause friction shall not be acceptable. Overlaps of the structure material used in feed and ejection chutes shall be in the direction of the flow of ammunition in order to avoid obstructions to ammunition, links, and expended cases.

3.14.2.1 Feed rollers. Anti-frlctlon rollers or other suitable means may be installed in the ammunition boxes to reduce ammununition belt drag if excessive belt drag is encountered. The rollers shall be of the proper diameters and spacing, as required by the size and contour of the rounds, to ensure level feed of the rounds.

3.14.3 Ammunition boxes or drums. Ammunition boxes or drums shall be provided in accordance with the applicable aircraft specification. The boxes shall be easily and conveniently removed by hand without the use of tools. The shape of the boxes shall conform closely to the space in which the Installation must be contained to avoid shifting during flight. The maximum gross weight of each loaded box shall not exceed one hundred and fifty pounds. The maximum Internal width of the box shall not exceed the length of the round plus 1/16 inch clearance between each end of the round and the box sides. A drawer-pull and a suitable handle(s) arrangement shall be provided to serve as a locklng device to secure the box in Position and to facilitate handling. Anti-friction rollers or buttons shall be installed on the box or on the tracks, if necessary, to facilitate the loading and removal of the box. The bottom of the box shall be adequately shaped and reinforced to prevent damage to the box, when the loaded box is slid across rough decks or floors. A drain hole adequate to eliminate moisture accumulation shall be placed in each bottom corner of the ammunition box. Provisions shall be made-in boxes to prevent jamming of the belt at the entrance of the feed chute or fouling of the ammunition belt within the box during maneuvers under conditions Indicated in 3.14. Belt layer separators shall be provided in layer-type ammunition boxes in order to ensure a smooth flow of ammunition from the box. The separators shall prevent link to link contact between the layers of the belt. Figure I illustrates a typical belt layer separator Installation. Ammunition channels may be used in lieu of boxes. The internal dimension of channels shall conform to those of ammunition feed chutes. Ammunition drums may be provided if multi-barrel fixed guns are installed in the fuselage of the aircraft. Easy access for removal and servicing of the drum shall be provided. The drum shall have sufficient strength-and stiffness to prevent deformation during operation and handling. Hand hold or hoist attachment points shall be provided to the drum to facilitate handling during rearming and maintenance.

3.14.3.1 Mounting provisions for ammunition boxes. The ammunition box(es) shall be mounted so that the lowermost layer of the belt is either at or above the gun feed level and at right angle to the centerline of the gun; i.e., with rounds parallel to the gun barrel centerline, in its average boresight position, (or as close to right angle as design space and weight considerations will permit)(see 3.8). The supporting structure for the ammunition box or drum shall be constructed with sufficient strength and rigidity to withstand the stress loads to which it will be subjected with the box fully loaded and the aircraft operating under flight conditions imposing the maximum design acceleration for the aircraft (see 3.14). The mounting shall be arranged so that two men may conveniently mount the required ammunition load without use of special tools or handling equipment unless otherwise specified by the applicable aircraft detail specification. The total capacity of the ammunition boxes and feed chutes shall be in accordance with 3.3. Ammunition channels, if used in lieu of boxes, shall be removable for repair and replacement. Access doors or panels shall be provided for removing ammunition jams from the channels. The drum capacity for multi-barrel guns shall be in accordance with the applicable aircraft detail specification.

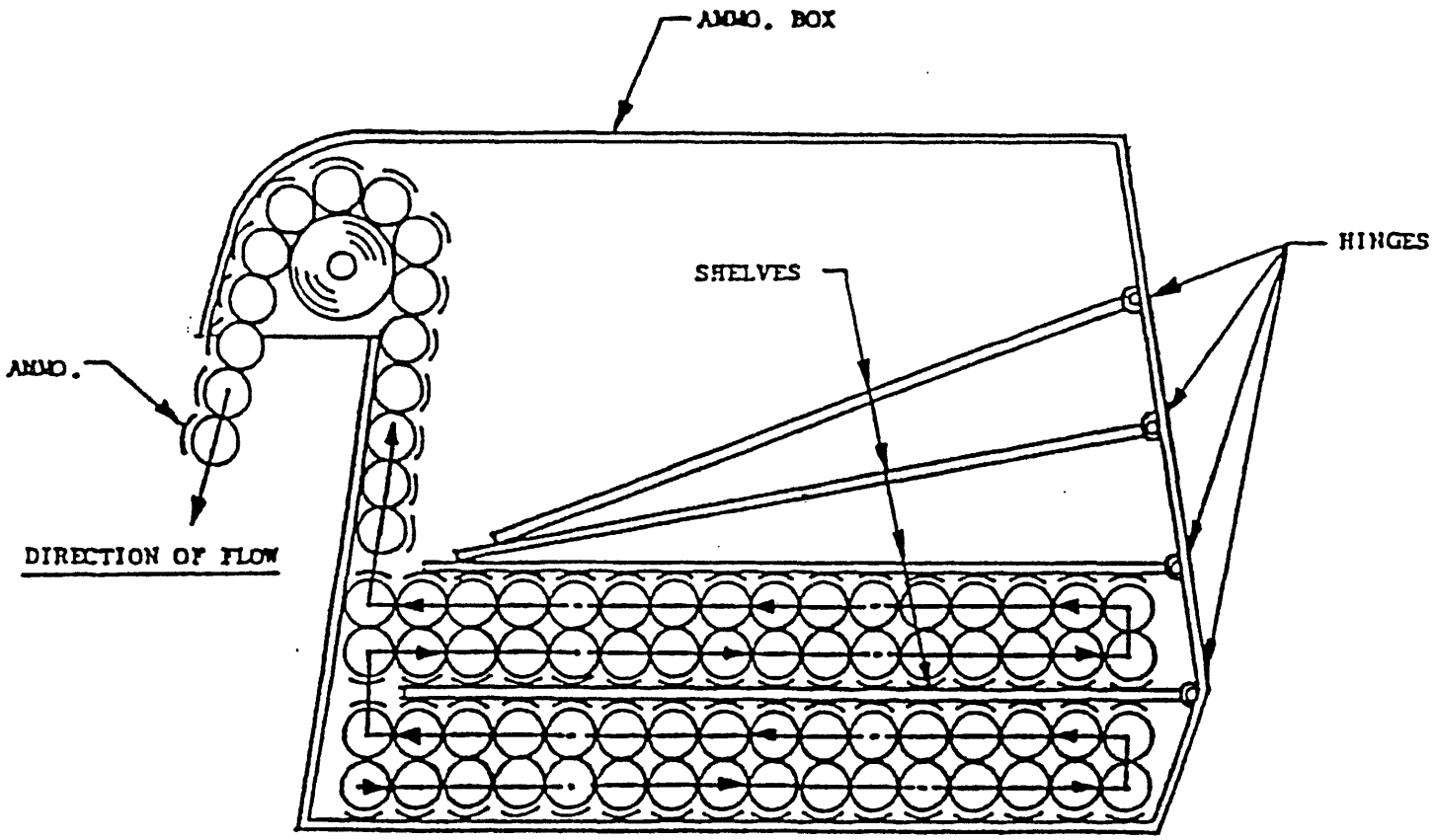

FIGURE 1. Typical layer-type ammunition box.

3.14.3.2 Multiple boxes. If space or weight limitations make it necessary, more than one box may be provided for each gun to meet the requirements of 3.3 and 3.14.3. If two or more boxes are to be Installed in close proximity, it shall be possible to replace the boxes for each gun without disturbing the box(es) for the other guns. Each box in the gun Installation shall be provided with a positive locking device (see 3.14.3) which will hold the box securely In its proper postion and in proper adjustment (see 3.14.1). In multiple box installations, provisions shall be included which will ensure unobstructed continuous feeding of the ammunition from all boxes in accordance with requirements of 3.14. Self-adjusting false box bottoms or other satisfactory devices may be provided for this purpose If necessary. See 3.1.1 bor box material requirements. Where aircraft design makes multiple boxes necessary, consideration shall be given to use of integral compartments for the ammunition.

3.14.4 Ejected case and link discharge provisions. Adequate provisions shall be installed as part of the gun installation in the aircraft for conveying the ejected cases and links from all guns. The cases and links shall be discharged either free of the aircraft or into a suitable compartment as required by the aircraft detail specification. Where the links and cases are retained, adequate space and distribution methods shall be provided so that no jamming will occur due to pile up of links and cases. Where the links and cases are discharged free of the aircraft, it should be done in such a manner and at sufficient velocity that no hits due to links and cases are sustained by the aircraft.

3.14.4.1 Case ejection chutes. Case ejection chutes shall be of minimum length compatible with the aircraft design and shall be constructed with the minimum number of bends and twists. Separate chutes shall be provided for each gun. The case ejection chutes should be designed to follow the normal path of the expended cases as ejected from the gun. For guns which eject cases perpendicular to the centerline of the bore of the gun, the cross sectional size of the case ejection chute shall permit unobstructed passage of a complete cartridge; this will require that the minimum inside longitudinal dimension of the chute cross section shall be equal to the maximum inside width of the ammunition box as specified in 3.14.3. Case ejection chutes which bend to the right or left of the centerline of the bore shall have sufficient width so that a complete round of ammunition can pass through the chute endwise. For guns which eject expended cases fore or aft, a cylindrical chuting shall be used. The radii of bends in these chutes shall be as large as practicable and shall be adequate to prevent obstruction to the passage of a complete round of ammunition. Where case chute exits are adjacent to one another or combined, the cross sectional area of the combined chute exits shall be equivalent to the sum of the areas of the several chutes. Detailed characteristics of ejected case chuting for guns which eject for and aft will be furnished by the Naval Air Systems Command upon request. Walls of all ejection chutes which receive the initial impact of the ejected cases shall be reinforced to prevent failure of the chutes within these areas. For ejected case chute material requirements, see 3.1.1. At the gun end the chutes shall be adjustable to permit the gun adjustments required in 3.7. The exit ends of the chutes shall guide the cases in a direction which will ensure positive discharge of the case from the aircraft (see 3.16).

3.14.4.2 Link ejection chutes. Link ejection chutes may be of the rigid or flexible type. The chutes shall be of minimum length compatible with the aircraft design and shall be constructed with a minimum number of bends and twists. A separate link chute shall be provided for each gun. A cross sectional size of the link ejection chutes shall be no larger than is necessary to permit unobstructed passage of the links. The cross sectional shape of the chutes shall conform generally to the shape of links. The radii of bends, turns and twists in the chutes shall be as large as practicable and, in every-case, shall prevent obstruction to the passage of the links. The inner surfaces of the link ejection chutes shall be in accordance with 3.14.2. The exit ends of the chutes shall guide the links in a direction which will induce separation of the link belt and positive discharge from the aircraft (see 3.16).

3.14.4.3 Mounting requirements for case and link ejection chutes. The case and link ejection chutes shall be mounted sufficiently rigid to withstand the stress loads to which they will be subjected when the guns are fired under flight conditions indicated in 3.14 and under firing conditions specified in 3.6. The arrangement of the chutes shall enable satisfactory operation of the guns in any of the required boresight positions. The chutes shall be designed for quick and easy attachment and removal and, where necessary, to provide means for easy boresight adjustment. Removal and Installation of the chutes shall be possible without removal of other major components or large equipments in the airplane.

3.14.4.4 Ejected case and link stowage compartment. The case and link stowage compartment shall be provided, if required by the aircraft detail specification. Unless it is incompatible with the aircraft design, the compartment shall be undivided. The compartment shall be as close to the guns as is compatible with the aircraft design. The total space provided in the compartment shall be adequate to hold all ejected cases and links discharged from the full required load of ammunition fired (see 3.3). Provisions shall be included to facilitate removal of the cases and links by ground crew during re-arming of the aircraft. The case and link chute entrances into th compartment shall be located and constructed to prevent the ejected cases from rebounding into the gun mechanism and to prevent the cases and links in the compartment from obstructing the entrances during all aircraft maneuvers indicated in 3.14 Including inverted flight. The construction of the compartment shall prevent gases from escaping from the compartment into any inhibited or unventilated portions of the aircraft. Provisions shall be included to prevent explosions due to accumulation of gun gases or oil fumes in the case and link compartment (see 3.13.5).

3.14.4.5 Ejected case and link discharge outlet. If the aircraft detail specification requires the ejected cases and links to be discharged from the aircraft during flight, the discharge outlet shall be located in accordance with clearance requirements of 3.16. Suitable streamline baffles, chutes or reinforcement shall be provided to prevent the ejected cases and links from jamming and from damaging the aircraft as they are discharged or from being sucked into the jet engine air intake. The cases and links shall discharge properly under all required flight attitudes and speeds (see 3.14).

3.15 Ease of rearming. Arrangement of gun installation shall facilitate efficient and safe rearming of all guns under all loading and operating conditions expected to be encountered by the applicable aircraft In service ashore and afloat. Rearming procedure shall not require ground crews to stand or walk on fuselage or wing surfaces outside of the designated areas provided for this purpose. Special equipment shall not be required for rearming the guns unless required by the applicable aircraft detail specification.

3.15.1 Rearming Instructions. Determination of the most efficient procedure for rearming the aircraft shall be made in accordance with 4.4.3 and included in the applicable Handbook of Maintenance Instructions, Aircraft Gun Operation and Maintenance Manual and Weapons Loading Procedure Instructions/Check List. This determination shall be made in conjunction with the related requirements as specified in MIL-I-8671. Use of a maximum number of two men for the fixed guns and ammunition portion of the rearming procedure is desirable.

3.15.2 Rearming time. A procedure shall be determined for rearming carrier based aircraft (including servicing the guns and loading the full required ammunition load for all guns and loading other required weapons and stores) in the time required for refueling the aircraft. The time required for rearming the aircraft in accordance with the Instructions required in 3.15.1 shall correspond to the time required for refueling the aircraft.

3.16 Coearance. The following minimum clearance requirements shall be provided for in the gun installation in the aircraft.

3.16.1 Propeller disk clearance. In all of th ereuired positions of boresight alignment (see 3.8) a minimum clearance of six inches shall be provided between the line-of-fire of each gun and all propeller disks.

3.16.2 Clearance for ejected cases and links. If the Installation provides for the discharge of ejected cases and links from the aircraft, the location and construction of the discharge outlet shall, throughout the serviceable flight envelope, positively ensure adequate clearance between the discharged cases and links and all surfaces of the aircraft which might be damaged by the impact of the discharged cases and links.

3.17 Accessibility. Satisfactory access shall be provided in fixed gun installations to enable safe and efficient adjustment and maintenance of the complete gun system. Hand holes or quickly securable doors shall be provided in the aircraft if necessary for this purpose; such doors, if used shall be kept to a minimum required size and shall be so hinged that the slip stream will tend to hod them in a closed position. Removal of any gun shall be possible without disturbing adjacent guns.

3.17.1 Maintenance access. Convenient access shall be provided for inspecting, cleaning, and lubricating all guns, ammunition feeding, and ejection systems and associated equipment, such as mounts, gun pneumatic, hydraulic and electrical systems. Space shall be provided to permit ready removal of the gun and accessory components without the use of special tools. Special tooling is authorized, however, for removal of guns, ammunition, storage drums and the like, weighing in excess of 150 pounds if necessitated by their location, but must have the prior approval of the Naval Air Systems Command.

3.17.2 Access for gun system adjustment. Access shall be provided to enable operation of the necessary hand tools gages, checking, fixtures, and boresight equipment required to make proper boresight adjustment of the guns and to adjust the feed and ejection chutes as required.

3.17.3 Reamring access. Access shall be provided in all aircraft which will enable crews to reload each gun and ammunition box or drum combination and to remove ejected cases and links in accordance with rearming requirements of 3.14.1, 3.14.2, and 3.15.

3.17.4 Gun removal access. Access shall be provided to permit each gun to be removed in accordance with requirements of 3.9 and 3.15.2 without removal of adjacent guns and accessories.

3.18 Provisions for environmental conditions. The gun installations shall operate satisfactorily within the ambient temperature ranges from -65°F to +160°F and the humidity ranges encountered within this temperature range. Suitable protection shall be provided in the aircraft to prevent malfunction of guns and ammunition systems due to fungi, shock, vibration, salt water spray, dust, and rain storms. The gunnery systems shall operate satisfactorily within the altitude and speed ranges specified for the aircraft in the applicable aircraft detail specification.

3.19 Height. The total weight of the fixed gun Installations shall be a minimum consistent with strength and material requirements and ammunition load requirements. In the design and construction of feed and ejection systems, the contractor shall endeavor to reduce weight wherever possible by using shorter chutes and lighter materials.

3.20 Dispersion. The average dispersion pattern obtained at a recommended range of 1000 inches from the muzzle during ground firing of the 25 round bursts for each fuselage mounted single barrel gun and three 100 round bursts for a multi-barrel gun shall be such that 80 percent of the projectiles lie within a 4 mil radius about the MPI. For wing mounted guns, the dispersion radius shall be 4.5 mils when fired under the above conditions.

3.21 Systematic error (displacement of the MPI from the boresight point). The average radial systematic error obtained during ground firing specified in 3.20 shall not exceed 2.25 mils for single barrel fuselage or wing mounted guns and 2.5 rolls elevation or depression and 4.75 mils azimuth for multi-barrel guns.

* 3.22 Pre-instalation treatment. To ensure proper and safe handling and operation of the guns during tests and demonstrations conducted by the contractor, the guns shall be degreased, cleaned, lubricated, and adjucted in accordance with istructions contained in the publications listed in 3.23.

* 3.23 Publication for 20mm guns. Listed below are publications pertaining to operation and maintenance of several 20mm guns. These publications shall be obtained and read by personnel before attempting to handle, maintain, install, or fire these guns. The operation, maintenance, and firing of other guns (7.62mm to 40mm) shall be obtained from the Naval Air Systems Command.

NAVAIR Technical Manual 11-95M197-1 (M197 Gun)

NAVAIR Technical Manual 11-95M89-1 (M89 Feeder)

* 3.24 Pre-firing treatment. Following the treatment specified in 3.22 and previous to firing the first round from each Installed gun, the guns and ammunition feed systems shall be Inspected, adjusted, and lubricated as required in applicable publications listed in 3.23. The guns shall be forsighted prior to firing (see 3.9).

l 3.25 Workmanship. The workmanship throughout the fixed gun installations shall be in accordance with high-grade aircraft and ordnance construction practice. In all respects, the workmanship shall be acceptable to the Naval Air Systems Command.

4. QUALITY ASSURANCE PROVISIONS

* 4.1 Responsibility for inspection. Unless otherwise specified in the contract or purchase order, the contractor is responsible for the performance of all Inspection requirements (examinations and tests) as specified herein. Except as otherwise specified in the contract or purchase order, the contractor may use his own or any other facilities suitable for the performance of the inspection requirements specified herein, unless disapproved by the Gocernment. The Government reserves the right to perform any of the Inspections set forth in this specification where such Inspections are deemed necessary to ensure supplies and services conform to prescribed requirements.

* 4.1.1 Responsibility for compliance. All items shall meet all requirements of section 3. The inspection set forth in this specification shall become a part of the contractor's overall Inspection system or quality program. The absence of any inspection requirements in the specification shall not relieve the contractor of the responsibility of ensuring that all products or supplies submitted to the Government for acceptance comply with all requirements of the contract. Sampling inspection, as part of manufacturing operations, is an acceptable practice to ascertain conformance to requirements, however, this does not authorize submission of known defective material, either indicated or actual, not does it commit the Government to accept defective material.

* 4.2 Classification of Inspection. The inspection requirements specified herein are classified as follows:

a. Quality conmormance inspection. Quality conformance inspection (see 4.3).

* 4.3 Quality conformance Inspection. All the examinations and tests of this specification shall be conducted as specified herein.

4.4 Inspection methods.

* 4.4.1 Visual examination. The fixed guns and associated equipment sha be examined visually to determine conformance to this specification and applicable drawings with respect to all the requirements not covered by tests.

4.4.2 Naval Air Systems Command inspection. Authorized Naval Air Systems Command personnel will inspect the gun Installation during construction and installation in the aircraft. Approval of the installation in process of construction will in no way constitute approval of the final delivered Installation prior to completion of Navy acceptance test.

4.4.3 Rearming procedure test. The contractor shall conduct a time and motion study of the rearming procedure for the aircraft. This study shall Include the loading and adjusting procedures for all guns, other weapons, and droppable stores. The study shall provide information from which the most efficient rearming procedure may be determined (see 3.15.2 and 6.3). For the fixed guns, the study shall begin with (1) the removing of empty and partially empty ammunition boxes and removing case and links from the stowage compartment(s) or drums. (2) servicing the guns and the gun charging system, and (3) reloading. The reloading shall begin with the required ammunition load (equivalent dummy ammunition may be used in the ammunition boxes) on ground-handling equipment outside the circular area which encompasses the extrmities of the aircraft. The ammunition load shall be moved into position and loaded properly in the aircraft. The ammunition is to be supplied in the arrangement selected for the particular aircraft involved (bulk in boxes, pre-belted in boxes, and stored in bulk loader). The ammunition shall be fed through to the normal safe-take off position in the gun, feed chute, feed mechanism, or loader, as required, and the gun made ready for firing time and motion study for rearming the gun shall end when the guns are ready for firing.

4.4.4 Gun installation check-out. Operation checks on each aircraft prior to or after firing as required shall be conducted to ensure satisfactoriness of the following items in the fixed gun installations prior to delivery of the aircraft. The aircraft shall remain on the ground during these checks. For the purpose of these checks, guns shall be fired as specified in 4.4.5. This check-out does not supplant any other test(s) and demonstrations which may be required by the Naval Air Systems Command.

a. Adequacy of all mechanical fastenings and all hydraulic, pneumatic, and electrical connections in the gun firing, charging, clearing, feeding, purging, control, and heating circuits.

b. Continuity of the gunnery system electrical, hydraulic, and pneumatic circuits.

c. Functioning of gun charging and clearing arrangement.

d. Functioning of temperature control in ammunition compartment and gun bay.

e. Functioning of all switches and guards in the gun circuits.

f. Functioning of all safety devices.

g. Functioning of ammunition feed mechanisms, loaders, round, counters, and boosters.

h. Adjustment-positioning, security of all ammunition chuting, cartridge case, and link ejection chutes.

i. Accuracy of boresight alignment of guns.

j. Adequacy of clearance and accessibility (see 3.16 and 3.17).

k. Gas tightness of blast tubes, gun compartments, and ejected case and link compartments (visual Inspection).

l. Adequacy of blast reinforcement.

m. Adequacy and condition of ejected link and case stowage compartment entrance.

n. Adequacy of the gun mount Installation; i.e., no apparent looseness, shifting.

4.4.5 Gun firing. The guns in each aircraft shall be ground fired as specified herein except as noted in 4.4.5.1. Immediately before firing, all prescribed safety and operational check-out procedures must be performed to ensure satisfactory operation of the gun system. Dummy reounds may be used to check-out the system prior to firing. A clean patch (cloth) shall be passed through the bore of each gun barrel to remove excess oil and to ensure that the barrel is free of obstructions. The gun system shall be fulled to stated capacity. Fire a one second burst from all fixed guns in the aircraft. All guns shall be fired simultaneously. If a stappage of any gun occurs during the firing of the one second burst, the gun must again be fired (one second burst) after the cause of the stoppage has been determined and eliminated. This firing test shall be accomplished prior to the delivery of the aircraft.

4.4.5.1 Gun firing in first five aircraft. The first two production airplanes of any one production model (model designation being such as F/A-18) shall have the full required load of ammunition (see 3.3) fired in flight from the guns unless deviation from this requirement is granted by the Naval Air Systems Command. All guns shall be fired simultaneously. The full load of ammunition shall be fired in interrupted 100 round bursts. Adequate cooling time between bursts must be allowed to prevent cook-off of the ammunition. The Naval Air Systems Command shall be contacted to obtain the “between bursts” time specified for a particular gun. If stoppage of the gun or failure of any component of the gun installation occurs, the cause shall be determined and eliminated and the test repeated for the affected gun(s).

4.4.6 Care after firing. The installations shall be checked as specified in 4.4.4 after firing. The guns and feed mechanisms shall be cleaned and inspected immediately after firing; cleaning and Inspection shall be as specified In publications listed in 3.23.

5. PACKAGING

This section is not applicable to this specification.

6. NOTES

(This section contains Information of a general or explanatory nature that may be helpful, but is not mandatory.)

6.1 Intended use. The requirements in this specification are pertinent to the Installation of fixed guns and associated equipments in all types of naval aircraft and shall be applicable to any particular model in aircraft if conformance to this specification is required by the applicable aircraft detail specification.

6.2 Acquisition requirements. Acquisition documents must specify the following:

a, Title, number, and date of the specification.

b. Applicable type of Installation (see 1.2).

c. Issue of DODISS to be cited in the solicitation, and if required, the specific issue of individual documents referenced (see 2.1.1 and 2.2).

* 6.3 Consideration of data requirements. The following data requirements. should be considered when this specification is applied on a contract. The applicable Data Item Description (DID's) should be reviewed in conjunction with the specific acquisition to ensure that only essential data are requested/provided and that the DID's are tailored to reflect the requirements of the specific acquisition. To ensure correct contractual application of the data requirements, a Contract Data Requirements List (DD Form 1423) must be prepared to obtain the data, except where DOD FAR Supplement 227.405-70 wxempts the requirement for a DD Form 1423.

Reference Paragraph '	DID Number	DID Title	Suggested Tailoring
3.6.1	DI-DRPR-81000	Product drawings and associated listing	---
3.6.1	DI-DRPR-81001	Conceptual design drawings and associated lists	---
3.6.1	DI-DRPR-81002	Development design drawings and associated lists	---
4.1.1 ,	DI-NDTI-80809A	Test/inspection reports	10.2.7, only
4.4.3	DI-NDTI-80566	Test plan	---

The above DID's were those cleared as of the date of this specification. The current issue of DOD 5010.12-L, Acquisition Management Systems and Data Requirements Control List (AMSDL), must be researched to ensure that only current, cleared DID's are cited on the DO Form 1423.

6.4 Modification. Modification or amplification of the requirements of this specification, as applicable to a particular model aircraft will be Incorporated in the aircraft detail specification at the time of its preparation. Modification or amplification of these requirements becoming necessary subsequent to the effective date of the applicable aircraft contract shall be accomplished in accordance with established Naval Air Systems Command change procedure. Requests for modification should be submitted in writing and should include complete description, supporting data and reasons for modification.

6.5 Waivers. Requirements of this specification may be waived for specific applications upon presentation of substantiating data to and with approval from the Naval Air Systems Command.

6.6 Furnished data. Technical and other data required for the installation of Govermnent-furnished equipment will be supplied to the contractor by the Naval Air Systems Command upon request. Requests for information on gun reaction and blast forces should be forwarded to the Naval Air Systems Command; the Naval Air Systems Command will provide all available information. Use of technical data furnished by the Naval Air Systems Command will not relieve the contractor of responsibility for adequate design and construction of the gun Installations.

* 6.7 Subject term (key word) listing.

Ammunition
Feed and ejection systems
Fuselage Installation
Wing installation

* 6.8 Changes from previous Issue. The margins of this specification are marked with asterisks to Indicate where changes (additions, modicications, corrections, deletions) from the previous issue were made. This was done as a convenience only and the Government assumes no liability whatsoever for any inaccuracies in these notations. Bidders and contractors are cautioned to evaluate the requirements of this document based on the entire content irrespective of the marginal notations and relationship to the last previous issue.

Preparing activity:
Navy - AS

(Project 1005-N815)

STANDARDIZATION DOCUMENT IMPROVEMENT PROPOSAL

INSTRUCTIONS

1. The preparing activity must complete blocks 1, 2, 3, and 8. In block 1, both the document number and revision letter should be given.
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I RECOMMEND A CHANGE:	1. DOCUMENT NUMBER	2. DOCUMENT DATE (YYMMDD)
	MIL-I-8670B(AS)	93/9/16

DOCUMENT TITLE: INSTALLATION OF FIXED GUNS AND ASSOCIATED EQUIPMENT IN NAVAL AIRCRAFT

NATURE OF CHANGE (*Identify paragraph number and include proposed rewrite, if possible. Attach extra sheets as needed.*)

REASON FOR RECOMMENDATION

SUBMITTER		
NAME (*Last, First, Middle Initial*)	b. ORGANIZATION	
ADDRESS (*Include Zip Code*)	d. TELEPHONE (*Include Area Code*) (1) Commercial (2) AUTOVON (*If applicable*)	7. DATE SUBMITTED (YYMMDD)

PREPARING ACTIVITY		
a. NAME COMMANDING OFFICER, NAVAL AIR WARFARE CENTER AIRCRAFT DIVISION LAKEHURST SYSTEMS REQUIREMENTS DEPARTMENT	b. TELEPHONE (*Include Area Code*) (1) Commercial: (908) 323-7488	(2) AUTOVON: 624-7488
ADDRESS (*Include Zip Code*) CODE SR3 LAKEHURST, NJ 08733-5100	IF YOU DO NOT RECEIVE A REPLY WITHIN 45 DAYS, CONTACT: Defense Quality and Standardization Office 5203 Leesburg Pike, Suite 1403, Falls Church, VA 22041-3466 Telephone (703) 756-2340 AUTOVON 289-2340	