MILITARY SPECIFICATION

COCKPIT CANOPY SYSTEM, FIXED WING SINGLE AND MULTI-PLACE, FIGHTER, ATTACK, AND TRAINER AIRCRAFT, GENERAL SPECIFICATION FOR

This specification has been approved by the Naval Air Systems Command, Department of the Navy

1. SCOPE

1.1 This specification establishes the general requirements for the design and installation of a cockpit canopy system on fixed wing single and multi-place fighter, attack, and trainer aircraft.

1.2 Classification - Cockpit canopy systems shall be considered generally as fixed or openable types; crew escape provisions may be incorporated in either type.

2. APPLICABLE DOCUMENTS

2.1 The following specifications, standards, and publications of the issue in effect on date of invitation for bids, form a part of this specification to the extent specified herein.

SPECIFICATIONS

Military

MIL-P-5518	Pneumatic Systems; Design, Installation & Tests in Aircraft
MIL-T-5842	Transparent areas, Anti-Icing, Defrosting and Defogging Systems, General Specification for
MIL-I-8500	Interchangeability and Replaceability of Component Parts For Aircraft and Missiles
MIL-A-8860	Airplane Strength & Rigidity, General Specification for

SPECIFICATIONS (Continued)

MIL-A-8861	Airplane Strength & Rigidity, Flight Loads
MIL-A-8865	Airplane Strength and Rigidity, Miscellaneous Loads
MIL-A-8867	Airplane Strength and Rigidity, Ground Tests
MIL-E-18927	Environmental Systems, Pressurized Aircraft, General Requirements for
MIL-D-23615	Design & Evaluation of Cartridge Actuated Devices

STANDARDS

Military

MIL-STD-143	Specifications and Standards, Order of Precedence for the Selection of
MIL-STD-203	Cockpit Controls Location & Actuation of For Fixed Wing Aircraft
MIL-STD-803	Human Engineering Design Criteria for Aerospace Systems and Equipment
MIL-STD-838	Lubrication of Military Equipment
MIL-STD-846	Escape System Testing; Ground, Track, & Flight Test
MIL-STD-850	Aircrew Station Vision Requirements for Military Aircraft
MS33573	Dimensions, Clearance, Cockpit Fixed Wing Aircraft

PUBLICATIONS

SD-24	General Specification for Design and Construction of Aircraft Weapons Systems, Volume I - Fixed Wing Aircraft
AFSCM 80-1	Handbook of Instructions for Aircraft Design (HIAD)

(When requesting specifications, drawings, and publications refer to both title and number. Copies of this specification and applicable specifications and drawings may be obtained upon application to the Commanding Officer, U.S. Naval Supply Depot, 5801 Tabor Ave., Philadelphia, Pa. 19120

2.2 Other Publications - The following documents form a part of this specification to the extent specified herein. Unless otherwise indicated, the issue in effect on date of invitation for bids or request for proposal shall apply.

Report No. NADC ED-5928 dated 4 August 1959 - Canopy, Airplane, Design for Underwater Removal.

(Application for copies should be addressed to Naval Air Systems Command, Washington, D.C. 20360

3. REQUIREMENTS

3.1 Components

3.1.1 Materials - The order of precedence for the selection of materials, process specifications and standard parts to be used in the design and construction of aircraft cockpit canopies shall be as outlined in MIL-STD-143.

3.1.2 Canopy - The canopy shall enclose the cockpit area aft of the windshield. The canopy may be fixed or openable, either entirely or in parts or any combination of fixed and openable sections. The design of the canopy shall be in accordance with the requirements outlined herein.

3.1.3 Actuation, latch and control system - Openable sections of the canopy may be manual or power actuated. Means shall be provided to latch the canopy securely in the closed position. A control system shall be provided to operate latches and actuating system from inside and outside the cockpit. Means shall be provided for positive opening or jettisoning of the moveable sections of the canopy for emergency escape or access. Lubrication provisions in accordance with MIL-STD-838 shall be incorporated for all mechanisms.

3.1.4 Temperature Limits - The entire canopy system shall be designed to operate satisfactorily between -65°F (-54°C) and 160°F (71°C). If the canopy system is subjected to aerodynamic heating it shall be designed to operate satisfactorily throughout the entire temperature/duration envelope of aerodynamic heating to which it will be exposed in flight.

3.2 Aerodynamic Shape - As part of the aerodynamic shape of the airplane the cockpit enclosure design is strongly influenced by the requirements for low drag. However, the exact shape shall include an optimum combination of all design requirements.

3.3 Structural Arrangement

3.3.1 Frames - Structural frames which affect vision from the cockpit shall be arranged to avoid critical viewing areas. Frame size and shape shall be arranged for minimum vision obstruction.

3.3.2 Joints - Detail design of joints between the openable section and the surrounding fixed structure shall insure that distortions due to crash loadings will not cause mechanical interlocking and hangup which will preclude forceable opening or jettisoning for emergency escape or rescue. For example, structural designs which result in heavy members being terminated at the edge of canopy or hatch openings in such a manner that crash loads applied in random directions could cause distortion of the opening shall be avoided.

3.3.3 Provision shall be made at the fully open and fully closed positions of sliding canopies to protect the tracks and rollers from failure due to wear caused by vibration.

3.3.4 Transparent panel and frame design shall consider optical limitations of the material to be used. Cylindrical and spherical radii of nonplanar transparent panels shall be as large as possible to minimize optical distortion.

3.4 Structural Design

3.4.1 All parts within 24 inches of the magnetic compass shall be of nonmagnetic material.

3.4.2 All canopy transparencies shall be constructed of glass or approved nonflammable transparent plastic. Acrylic plastics employed in pressurized cockpits and cabins shall be of hot-stretched material for maximum toughness.

3.4.3 Transparent enclosure elements may incorporate edge attachments of the laminated-type based on glass fabric or other suitable textile to reinforce the edges and restrain crack initiation.

3.4.4 The transparent materials shall be securely anchored within the supports, but, where feasible, shall be free to expand and contract with changes in temperature and aging without distorting the structure, impairing the efficiency of the joints, impairing the optical qualities of the panel, or unduly affecting actuating, locking, and unlocking forces.

3.4.5 The combination of transparent materials and support frames shall be sufficiently rigid to withstand all probable loads imposed in flight, landing, and handling without either elastic deflections or permanent deformations of magnitudes which will adversely affect the proper functioning of the canopy assembly or its actuating components.

3.4.6 Consideration shall be given to the interaction between transparent components and frame caused by thermal effects under extreme temperature conditions to insure that stress concentration in the transparent components and frame is kept to a minimum.

3.4.7 Accessories or equipment shall not be attached to the transparent element of the cockpit canopy.

3.4.8 Airtightness - Pressurized cockpits shall be airtight within the limits of SPEC MIL-P-18927 when the airplane is in flight or with engine(s) running. Seals at the interface between the canopy and basic structure shall be designed to minimize leakage, excessive closing forces, and sliding friction. Self-pressurizing seals shall be a consideration. The seal material shall be resistant to adverse changes in properties when exposed to the flight and ground environment. To prevent damage when entering and leaving the cockpit, the seals shall be installed on the canopy rather than the structure.

3.4.9 Redundant Load Paths - To avoid catastrophic failures, the canopy design shall provide multiple load paths whenever practical. Each load path shall be capable of carrying the anticipated applied load such that failure or malfunction of one component will not be likely to cause a more serious failure. It may be necessary to permit elastic deflection in excess of that normally desired in the event the applied load is carried by a structural system in which one or more of the redundant load paths is inactive. The maximum amount of deflection occurring under these conditions shall not cause further failure or malfunction.

3.4.10 Failure Control - Consideration shall be given to probable modes of failure and designs shall provide for controlled failure paths to avoid catastrophic failures. For example, in the event of a cabin pressure regulator failure resulting in over-pressurization, elastic deflection of the canopy may permit leakage and venting, thus avoiding catastrophic rupture of the cabin or canopy.

3.5 Strength Requirements

3.5.1 Load Sources - The entire canopy system design shall be based on the most critical combinations and/or separate applications of the following loading patterns.

3.5.1.1 Air Loads - Magnitude and distribution of air loads over a cockpit enclosure body should be determined by wind tunnel tests. Design loads shall be based on reliable aerodynamic data.

3.5.1.2 Internal Pressure - Loads based on internal cabin pressure shall be derived from the cabin pressurization schedule, including maximum regulator tolerance.

3.5.1.3 Openable canopies and hatches which have aerodynamic breakaway capabilities shall be designed, when fully open, to break away free of the airplane if a headwind of 120 knots relative velocity is encountered. Such aerodynamic jettisoning shall not cause damage to the rest of the airplane which will render the airplane uncontrollable.

3.5.1.4 Openable canopies and hatches and their supporting hardware shall be designed to withstand, without damage, the loads imposed by a minimum headwind of 60 knot relative velocity and minimum crosswinds of 45 knots from 45° left or right with the canopy full open.

3.5.1.5 The canopy and its supporting structure shall be designed to withstand, without damage, the loads imposed by taxiing over rough ground with the canopy full open. For design purposes a load factor of 2.0 in any direction, except 4.0 vertically down, times the weight of the canopy shall be applied separately at the centroid of the moveable section, as a design ultimate load assuming zero wind effects.

3.5.1.6 Jettisoning - Jettisonable canopies or hatches shall be designed so as not to endanger the crew, hinder escape, or damage the aircraft during jettisoning to such an extent that continued flight to a safe landing is not practical. The canopy, when jettisoned under any conditions, shall clear the cockpits and shall not endanger rescue personnel operating the external canopy jettison handle.

3.5.1.6.1 - Aerodynamic loads experienced during in-flight jettisoning, which may cause the canopy to break up after it leaves the aircraft need not be considered.

3.5.1.6.2 - Application of maximum remover loads to the canopy or fuselage attach points shall not cause failure at these points throughout the entire range of canopy remover travel.

3.5.1.6.3 - Canopy hinges, supports, or fairings which are intended to break away during canopy jettison shall be designed to break in a specific manner providing a clean break path without absorption of excessive amounts of energy in unnecessary deformations and gross damage to adjacent areas. Designs shall utilize high mechanical advantage to insure adequate break away forces.

3.5.1.7 Crash and Ditching

3.5.1.7.1 - Mode of canopy or hatch actuation (i.e. sliding, hinged, etc.) and detail structural arrangement of openable sections shall be carefully evaluated for crash survivability. The long parallel tracks for sliding canopies shall be rugged and adequately supported to minimize the possibility of distortion or breakage which could prevent canopy opening. The use of break away rollers or alternate jettison modes might be considered.

3.5.1.7.2 - Consideration shall be given to the routing of canopy controls,

electrical wiring, hydraulic lines, etc., to minimize the likelihood of damage which could prevent functioning of the system for escape or rescue after a crash.

3.5.1.7.3 - Adequate restraining latches shall be provided for a sliding canopy or hatch to prevent re-closing if opened before impact. Latches shall prevent canopy or hatch from closing when exposed to crash landing loads of MIL-A-8865.

3.5.1.8 - Underwater canopy or hatch actuation - The canopy system shall be designed to permit escape when the airplane is submerged in water. Unless provisions can be made to insure canopy removal upon impact, the following design conditions shall be met to the depth specified by the detail specification.

3.5.1.8.1 - Openable canopies or hatches and actuator supporting structure shall be capable of withstanding the actuator loads required for underwater opening or removal without failure.

3.5.1.8.2 - A cockpit flooding orifice or other means of cockpit pressure neutralization shall be provided to limit cockpit pressure differential to a value which will permit canopy jettison.

3.5.1.8.3 - The components of the emergency canopy actuator system shall be water proof such that they are capable of operation in accordance with this specification when submerged in water at a pressure of 50 psig. for 10 minutes.

3.5.1.8.4 - Sufficient opening force shall be provided by the emergency actuation system to overcome all restraining water loads on the outside of the submerged canopy and open or remove the canopy within 3 seconds after initial canopy movement occurs. Canopy-seat interlock should prevent seat firing until the canopy is out of the path of the seat.

3.5.1.8.5 - The emergency canopy actuation system shall be capable of maintaining its design output load for a period of 3 seconds, once initiated.

3.5.1.8.6 - Emergency canopy opening or jettisoning shall be possible with the airplane in any attitude, at any rate of sink up to 12 feet per second, and in any condition of cockpit flooding. The rate of sink may be decreased if the methods of NAVAIRDEVCEN Report ED-592B of 4 Aug 59 indicate lower sink rates to be justifiable.

3.5.1.8.7 - Once opened beyond its normal open position during emergency opening, a canopy or hatch shall not be permitted to reclose.

3.5.2 - All structural designs shall be in accordance with the applicable portions of MIL-A-8860, MIL-A-8861, MIL-A-8865, and the detail specification of the airplane. Transparent windows and associated structure shall be given special consideration to insure structural continuity and compatibility between window and surrounding structure.

Design safety factors shall be in accordance with MIL-A-8860, paragraph 3.1.3. Deflections which may cause glass breakage or stress crazing in plastic panels must be avoided.

3.6 - Latches & Control System

3.6.1 - Latches and Restraining Devices

3.6.1.1 - All latches and restraining devices shall be designed for positive engagement and safe locking under all design conditions. Provisions shall be made such that unsafe engagement or incomplete or unsafe locking is not possible. For example, latches may be designed to interfere and prevent latching and locking if the moveable section is not fully closed. It shall be possible to verify from the pilot's seat that all latches are properly engaged.

3.6.1.2 - Synchronization and positive linking of all latches must be assured. For example, a latch and control system may be designed such that the system cannot be operated unless all latches are properly installed and adjusted.

3.6.1.3 - Restraining devices, such as deflection supports or overload latches, shall be designed with adequate adjustment to insure desired load distribution.

3.6.1.4 - For designs which require that normal restraining latches be actuated for emergency release, sufficient actuating power shall be provided to insure complete release of all latches under the most adverse design loading conditions. Consideration shall be given to such items as maximum friction coefficients, system inertia, and mechanical binding. Method of application of emergency actuating power shall be such that the entire latch system can be loaded against a hangup at the farthest most latch without excessive deflection, local buckling, or failure of any part of the system.

3.6.1.5 - Latch systems intended for use only in emergency conditions, shall be designed to permit actuation without damage for inspections and functional checks.

3.6.1.6 - Break away restraints and other frangible type devices shall be designed to avoid the need for close control of strength or dimensional tolerances.

3.6.1.6.1 - Avoid the use of the break away section as part of the normal operating load path. For example, a latch bolt should not also be the shear pin for emergency release.

3.6.1.6.2 - Breakaway devices, designed for emergency release, must have adequate margin between normal operating loads and emergency actuation forces to insure safety under both conditions.

3.6.2 - Actuation & Latching Control Systems

3.6.2.1 - The normal canopy and hatch control systems shall be designed such that a single control will open or close the moveable section as well as latch and lock all restraining devices. The control shall be in accordance with MIL-STD-203.

3.6.2.2 - Provision shall be made to prevent inadvertent actuation of internal canopy control handles while entering or leaving the cockpit, performing routine flight duties, and performing maintenance on the airplane.

3.6.2.3 - All external canopy control handles and doors shall be suitable for operation by personnel wearing asbestos gloves.

3.6.2.4 - Additional controls shall be provided, as required, to permit actuation of the canopy from all crew stations enclosed by the canopy, and from outside the cockpit.

3.6.2.5 - Canopy and hatch control systems shall be designed to permit sequenced operation of latches and actuators, and shall incorporate such detents and indicators as required to clearly identify function performed or latch condition of the system.

3.6.2.6 - Canopy and hatch control systems shall be designed such that handle travel is smooth throughout its entire range. There shall be no abrupt change in loads. Detent action may be used to permit "feel" of latch condition and to insure positive positioning. Designs which permit a handle load increase just before the "locked" condition is achieved should be avoided. The control should be self-seeking into the locked position to avoid partially locked or unsafe situations. Means shall be provided for positive control retention to withstand all applicable ground and flight loads within the performance envelope of the airplane.

3.6.2.7 - Canopy and hatch control systems shall be designed to provide operating control loads, commensurate with the function performed. Operating handle design with respect to size, location, and operating loads shall be in accordance with MIL-STD-803. In mechanical systems the operating handle load shall be 35 ± 15 pounds in each direction. Loads shall be measured at the center of the grip area in the plane of motion of the control and in the direction of motion.

3.6.2.8 - The canopy and hatch control system shall be designed for sufficient strength and rigidity to withstand an ultimate design load of 225 pounds applied to any one handle and also for 150 pounds each applied to all handles in the system simultaneously. Ultimate design loads shall be applied at the extreme end of the handle and in all directions of anticipated load application.

3.6.3 - Canopy Jettisoning Control System - The canopy jettisoning control system shall not require electrical power in any portion of the system for initiation or actuation.

3.6.3.1 - Means, independent of other emergency systems, shall be provided both inside and outside the cockpit for readily jettisoning the canopy from the airplane to facilitate crew exit and rescue operations in the event of a crash. These controls shall be adequately identified, guarded, and located to prevent inadvertant actuation. Alternate emergency canopy jettison systems shall not be interconnected with the seat ejection system.

3.6.3.2 - External emergency canopy releases shall be provided on both left and right sides of the airplane. Controls shall be located to be accessable from the ground with the airplane in normal static position as well as after a gear up crash landing.

3.7 Actuator & Remover Systems

3.7.1 - Openable sections of the cockpit enclosure, which may be used for normal entrance or access, shall be designed for easy actuation. Either manual or powered actuation may be used.

3.7.2 - Manual actuation is generally not practical for canopies which weigh over 80 pounds. Counter-balance devices should be employed such that no more than 20 pounds applied force is required to move the canopy. Designs employing manual canopy actuation shall consider that the canopy can be actuated throughout its full range of normal travel by any crewman served by that hatch while he is secured in his normal flight position. Inertia reels and other emergency devices may be considered "unlocked" as they are for normal flight, but all straps, belts, etc. must be properly installed and secured.

3.7.3 - Power actuated canopies shall be designed to be actuated throughout their full range of normal travel by the same handle used for locking and unlocking the canopy restraining devices. Warning or safety stop provisions shall be incorporated to preclude full closing and injury to personnel who might be trapped between the canopy and its mating structure. Means shall be provided to actuate the canopy when the aircraft engines are not in operation. For stored energy systems, sufficient storage capacity must be provided to permit at least 5 full cycles of canopy actuation, for each canopy without recharge.

3.7.4 - Canopy actuators shall be designed to prevent very rapid canopy motion which might result in high impact stopping loads and possible injury to personnel who might be in the path of the canopy. Designs which permit full canopy travel in less than 5 seconds shall be avoided.

3.8 - Canopy actuating devices (bungees, canopy actuating cylinders, etc.) shall be mounted in such a fashion that failure of any one of the mounts will not leave the device unrestrained. Alternatively, if after failure of any one support, the remaining support permits uncontrolled motion of the device, there shall be nothing in the possible field of motion which, if struck, could adversely affect the aircraft or its occupants. When the canopy is jettisoned, the portions of the actuating device which leave with the canopy, and the portions of the device which remain with the aircraft, shall be so restrained as not to inhibit function of any other system, cause damage to the aircraft or injury to its occupants.

3.9 - Power to the system shall not be required to maintain the canopy or hatch in locked condition, especially in flight.

3.10 Human Factors

3.10.1 Cockpit Space - When the canopy is open, there shall be sufficient clearance between the openable section and the surrounding fixed structure to permit reasonably convenient ingress and egress by aircrew attired with flight apparel and survival equipment peculiar to the aircraft. When the canopy is closed, there shall be sufficient clearance for head and torso movement to perform crew duties, as specified in MS 33573.

3.10.2 Vision

3.10.2.1 - The cockpit enclosure shall be designed to provide vision from the cockpit as required by MIL-STD-850, as a minimum.

3.10.2.2 - For aircraft utilizing a tandem cockpit arrangement in which the pilot may occupy the rear cockpit, the vision requirements of paragraph 3.10.2.1 shall apply. If forward vision is limited by the man and seat in the front cockpit, the effect of such obstruction must be kept to an absolute minimum and must be demonstrated by a mockup.

3.10.3 - Optics - Optical requirements of all transparent areas shall be as defined by the detail specification of the airplane.

3.10.4 - Cockpit Reflections - Windshield and canopy configurations shall be coordinated with locations of internal light sources, light baffles, and orientation of reflective surfaces for an optimum configuration. Proposed cockpit enclosure configurations shall be verified by a lighting mockup. Point source and distributed illumination effects shall be demonstrated.

3.10.5 - The use of heat sources to keep transparent areas free of fog and ice shall be carefully evaluated for uncomfortable temperature rise on the crewmen. Surface temperature shall be controlled to maintain the minimum required to provide clear vision. Designs shall conform to the requirements of MIL-T-5842.

3.10.6 - The physical forces generated in canopy opening or jettisoning shall cause no effects on the crewmen which may inhibit escape from the aircraft either in-flight, on the surface, or when submerged.

3.10.7 - Windblast protection shall be provided for rear seat occupants of aircraft utilizing a tandem cockpit arrangement to permit operation of seat ejection controls or flight and landing from the rear seat subsequent to canopy jettison.

3.11 - Maintainability

3.11.1 - Designs which require special tools for handling, installation, or rigging should be avoided. Appropriate attach points shall be provided and labeled for sling attachment to hoist canopy or hatch from aircraft.

3.11.2 - Designs which require lengthy and complicated rigging shall be avoided. Not more than 8 man hours should be required to rig a canopy system after complete disassembly. Removal and reinstallation time of the same canopy on an airplane shall not exceed 30 minutes, utilizing the efforts of two men, or one man hour, after it had been previously rigged. Rigging to precise dimensions and close tolerances is usually difficult to accomplish and frequently results in misrigged or unsafe conditions due to human error.

3.11.3 - Major components which are subject to frequent removal shall be designed to permit removal and re-installation without affecting the rigging of the entire system.

3.11.4 - Components which require frequent inspection, adjustment or maintenance shall be designed and located so as to provide easy access for servicing. For example, installations which can be serviced only by removal of other equipment, or which cannot be reached or readily seen shall be avoided. Provision shall be made for preflight inspection of rigging of locks and release to insure proper engagement.

3.11.5 - Items which require frequent replacement such as transparent panels shall be designed to have interchangeable fit and attach hole patterns per MIL-I-8500 to permit replacement with minimum danger of damage during installation of the new part. Replaceable or removable items shall be designed to preclude improper reinstallation. All adjustments shall be protected to avoid tampering. Devices permitting control adjustments shall be lockwired. Friction type locking devices are not acceptable.

3.11.6 - Consideration shall be given to the strains and abuses which might be imposed on the canopy during ground handling, maintenance, removal, servicing, etc. Exposed skin edges of the removable sections shall not be so thin as to be bent and damaged if canopy is stowed by resting on its edges while removed from the airplane. Areas which are convenient for sitting and stepping by maintenance personnel shall be designed to withstand such loads.

3. 11. 7 - Designs shall provide for simple replacement of items subject to deterioration or frequent damage, such as rain and pressure seals.

3. 11. 8 - Canopies and hatches shall be designed to seal against entry of water into the cockpit under any ground or flight condition. Water shed type overlaps shall be used on joints where practical. Drainage paths or gutters shall be considered. Provision shall be made to protect weather seals and cockpit pressurization system seals from damage as a result of normal maintenance activities and from normal ingress and egress by the crew.

3. 11. 9 - Parts which, when not installed, are subject to warpage or distortion, shall be suitably protected. If applicable, they shall be marked to forbid nesting.

3. 11. 10 - Installation of ballistic and other sensitive devices shall guard against accumlation of moisture due to condensation or other causes. The installation shall permit natural drain out of moisture.

3. 11. 11 - Provisions shall be made to adequately safety ballistic and other dangerous devices. Ground safety pins shall be designed to preclude improper installation. All areas to be safetied shall be readily visible. Designs which may be unsafe if an undersize safety pin is used shall be avoided.

4. QUALITY ASSURANCE PROVISIONS

4. 1 Responsiblility for Inspection - Unless otherwise specified in the contract or purchase order, the supplier is responsible for the performance of all inspection requirements as specified herein. Except as otherwise specified, the supplier may utilize his own facilities or any other facilities suitable for the performance of the inspection requirements specified herein, unless disapproved by the Government. The Government reserves the right to perform any of the inspections set forth in the specification where such inspections are deemed necessary to assure suppliers and services conform to prescribed requirements.

4. 2 Classification of Tests - The inspection and testing of the canopy system and its components shall be classified as follows:

(a) Preproduction Tests
(b) Quality Conformance Tests

4. 3 Preproduction Tests - Preproduction tests shall consist of the quality conformance tests herein and the following additional tests.

4. 3. 1 Strength Testing - Tests shall be conducted to prove that adequate strength exists in all parts of the canopy system to meet the minimum

strength and rigidity requirements imposed on the airplane. Airplanes designed in conformance with AFSCM-80-1 for USAF and SD-24 for Navy shall be tested for compliance with applicable specifications with the canopy installed.

4.3.1.1 Test Load Factors - Load factors required by MIL-A-8860, the detail specification of the airplane, and as outlined in paragraph 3.5.2 shall be used.

4.3.1.2 Test Setup - The canopy shall be tested as part of a complete airplane or on a test fixture, representative of at least the cockpit portion of the airplane complete with the enclosure installation.

4.3.1.3 Test Procedure - The enclosure shall be tested in accordance with MIL-A-8867. Internal cabin pressure and external air loads shall be applied simultaneously where applicable. Loads shall be applied and increased in increments and deflection readings taken at points forming a representative survey pattern of the entire enclosure. Deflection measurements shall be recorded for each 10% incremental load. Areas of excessive deflection and local failures shall also be noted.

4.3.2 Functional Testing

4.3.2.1 Normal Canopy Actuation - The normal canopy latching and actuating system shall be operated thru at least 1000 complete cycles of unlocking, full opening, closing and locking. The canopy shall be loaded to simulate aerodynamic loads and maximum operating cabin pressure each time the canopy is locked. Each of the control handles in the system used to lock and unlock the latches shall be utilized to perform approximately an equal number of the total cycles. Operating handle loads shall be noted at the beginning and end of the test and at any time a change in the handle "feel" is noted. Handle loads shall remain within the design specification limits at all times. Any change in system operation shall be noted and investigated for possible failures. After completion of this test series, the entire system shall be disassembled and inspected for wear or distortion.

4.3.2.2 Emergency Canopy Actuation - The emergency actuation system shall be tested to prove proper functioning. Reduced loading and simulated load application methods may be employed to avoid structural damage. Breakaway portions of the emergency actuation system may be deleted and simulated to facilitate system functioning. Breakaway items, if deleted in actuation test, shall be tested separately in special test setups in sufficient quantity to prove reliability in its break-away function. The actuator or remover unit shall be qualified separately in accordance with the governing specification, i.e. MIL-D-23615 for cartridge actuated devices, or MIL-P-5518 for pneumatic actuated devices.

4.3.2.3 - Canopy Jettisoning - Canopy jettisoning shall be demonstrated as part of the airplane escape system testing per MIL-STD-846, if applicable,

otherwise the following tests shall be performed as a minimum.

4.3.2.3.1 Static - Satisfactory canopy jettison capability shall be demonstrated by jettisoning a canopy from an airplane or complete cockpit mounted in a suitable jig. The complete canopy jettison system, and its control system shall be utilized in conducting this test.

4.3.2.3.2 Simulated Flight - Satisfactory inflight canopy jettison capability shall be demonstrated for all modes of canopy actuation which might be used in flight. Flight performance may be simulated by mounting the cockpit on a test sled operated at the prescribed air speed. Jettison tests shall be conducted at minimum and maximum limits of the flight escape envelope.

4.3.2.4 Underwater Opening or Jettison - Satisfactory underwater canopy operation to permit escape shall be demonstrated. Compliance with the requirements of this specification and the detail specification of the airplane shall be demonstrated.

4.4 Quality Conformance Tests - The quality conformance tests for acceptance shall consist of those tests required by applicable specifications listed in 2.1 and the following:

(a) Examination
(b) Functional Operation

4.4.1 Examination - The canopy system shall be inspected to determine compliance with the requirements specified herein with respect to materials, workmanship, and all other requirements not covered by tests.

4.4.2 Functional Operation - The entire canopy system shall be tested for proper functioning and reliable operation of all moving parts.

5. PREPARATION FOR DELIVERY. NOT APPLICABLE

6. NOTES

6.1 Intended Use

6.1.1 This specification establishes design practices and methods for aircraft canopy design for fixed wing fighter, attack, and trainer aircraft.

Preparing Activity:

Navy - AS

SPECIFICATION ANALYSIS SHEET

Form Approved
Budget Bureau No. 119-R004

INSTRUCTIONS

This sheet is to be filled out by personnel either Government or contractor, involved in the use of the specification in procurement of products for ultimate use by the Department of Defense. This sheet is provided for obtaining information on the use of this specification which will insure that suitable products can be procured with a minimum amount of delay and at the least cost. Comments and the return of this form will be appreciated. Fold on lines on reverse side, staple in corner, and send to preparing activity *(as indicated on reverse hereof)*.

SPECIFICATION
MIL-C-81590(AS) COCKPIT CANOPY SYSTEM, FIXED WING SINGLE AND MULTI-PLACE, FIGHTER, ~~ATTACK, AND TRAINER AIRCRAFT, GEN SPEC FOR~~

ORGANIZATION *(Of submitter)* | CITY AND STATE

CONTRACT NO. | QUANTITY OF ITEMS PROCURED | DOLLAR AMOUNT
$

MATERIAL PROCURED UNDER A

☐ DIRECT GOVERNMENT CONTRACT ☐ SUBCONTRACT

1. HAS ANY PART OF THE SPECIFICATION CREATED PROBLEMS OR REQUIRED INTERPRETATION IN PROCUREMENT USE?
   A. GIVE PARAGRAPH NUMBER AND WORDING.

   B. RECOMMENDATIONS FOR CORRECTING THE DEFICIENCIES.

2. COMMENTS ON ANY SPECIFICATION REQUIREMENT CONSIDERED TOO RIGID

3. IS THE SPECIFICATION RESTRICTIVE?

   ☐ YES ☐ NO IF "YES", IN WHAT WAY?

4. REMARKS *(Attach any pertinent data which may be of use in improving this specification. If there are additional papers, attach to form and place both in an envelope addressed to preparing activity)*

SUBMITTED BY *(Printed or typed name and activity)* | DATE

DD FORM 1 APR 63 1426

C-8870