MILITARY SPECIFICATION

CONTROL AND STABILIZATION SYSTEMS: AUTOMATIC, PILOTED AIRCRAFT, GENERAL SPECIFICATION FOR

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

1. SCOPE

1.1 Scope - This specification covers design. test and performance requirements for either GFE or CFE automatic control and stabilization systems for all U.S. Navy piloted aircraft. In the event of conflict between this specification and other referenced documents the requirements of this specification shall govern. The detail requirements for a particular system shall be as specified in the detailed specification, contract or purchase order for that system. (See 6.2)

2. APPLICABLE DOCUMENTS

2.1 General - The following documents, of the issue in effect on the date of invitation for bids, shall be used wherever applicable in the design installation and operation of the automatic control and stabilization system.

SPECIFICATIONS

Military	
JAN-I-225	Interference Measurements, Radio, Methods of, 150 Kilocycles to 20 Megacycles (For Components and Complete Assemblies)
JAN-T-781	Terminal; Cable, Steel (For Swaging)
MIL-F-3541	Fittings, Lubrication
MIL-S-3950	Switches, Toggle
MIL-E-4682	Electron Tubes and Transistors, Choice and Application of
MIL-W-5088	Wiring, Aircraft, Installation of
MIL-E-5272	Environmental Testing, Aeronautical and Associated Equipment, General Specification for
MIL-E-5400	Electronic Equipment, Aircraft, General Specification for
MIL-H-5440	Hydraulic System; Aircraft Type I and II Installation and Data Requirements for
MIL-I-6115	Instrument Systems, Pitot Tube and Flush Static Port Operated, Installation of
MIL-I-6181	Interference Control Requirements, Aircraft Equipment
MIL-L-6880	Lubrication of Aircraft, General Specification for
MIL-E-7080	Electrical Equipment, Piloted Aircraft Installation and Selection of, General Specification for
MIL-M-7969	Motors, Alternating Current, 400-Cycle, 115/200 Volt System, Aircraft, General Specification for
MIL-A-8064	Actuators and Actuating Systems, Aircraft, Class A and B, Electrical, Mechanical, General Requirements for

FSC N/A

MIL-M-7793	Meter, Time Totalizing
MIL-H-8501	Helicopter Flying Qualities, Requirements for
MIL-S-8512	Support Equipment Aeronautical, Special, General Specification for Design of
MIL-M-8609	Motors, Direct Current, 28-Volt System, Aircraft, General Specification for Class A and B
MIL-D-8706	Data, Design; Contract Requirement for Aircraft
MIL-F-8785	Flying Qualities of Piloted Airplanes
MIL-D-18300	Design Data Requirements for Contracts Covering Airborne Electronic Equipment
MIL-N-18307	Nomenclature and Nameplates for Aeronautical Electronic and Associated Equipment
MIL-E-19600	Electronic Modules, General Aircraft Requirements for
MIL-R-22256	Reliability Requirements for Design of Electronic Equipment or Systems
MIL-R-23094	Reliability Assurance for Production Acceptance of Avionic Equipment, General Specification for

STANDARDS

Military

MIL-STD-208	Cockpit Controls; Location and Actuation of For Fixed Wing Aircraft
MIL-STD-704	Electric Power, Aircraft, Characteristics and Utilization of
MS15001	Fittings, Lubrication (Hydraulic) Surface Check, 1/4 - 28 Taper Threads, Steel, Type I
MS15002	Fittings, Lubrication (Hydraulic) Surface Check, Straight Threads, Steel, Type II

2.2 Availability of Documents

(1) When requesting specifications, standards, drawings, and publications refer to both title and number, Copies of this specification and applicable specifications required by contractors in connection with specific procurement functions may be obtained upon application to the Commanding Officer, Naval Supply Depot, Code DCS, 5801 Tabor Avenue, Philadelphia 20, Pennsylvania.

3. REQUIREMENTS

3.1 System Design Requirements - Automatic Flight Control Systems (AFCS) shall be as simple, direct, and foolproof as possible with respect to design, operation and maintenance.

3.1.1 Automatic Flight Control Systems (AFCS)

3.1.1.1 Categories of Operation , The control function or functions to be performed by automatic flight control systems or components shall be determined from the military characteristics or the requirements of the aircraft or class of aircraft in which the equipment shall be used. By definition, the automatic control functions shall fall within the following categories:

3.1.1.1.1 Augmentation - The augmentation category shall include those control functions which are required to improve the stability and handling characteristics of the vehicle. The damping of the longitudinal or direction-lateral oscillatory mode shall be governed by the requirements specified in Specification MIL-F-8785.

3.1.1.1.2 Pilot Assist or Pilot Relief - The pilot assist or pilot relief category shall include those automatic control functions which simplify or ease the control of the flight path of the aircraft. These functions include but shall not necessarily be limited to the following:

(a) Attitude Hold (Pitch and Roll)

(b) Heading Hold

(c) Heading Select

(d) Automatic Turn Coordination

(e) Side Slip Limiting

(f) Altitude Hold

(g) Mach Hold

(h) Return to Level

(i) Control Stick Maneuvering

3.1.1.1.3 Guidance - The guidance category shall include those control functions which provide automatic fligh path control in accordance with steering signals generated by guidance and control systems external to the flight control system. The category shall include the following types of control functions:

(a) Enroute navigation

(b) Rendevous and station keeping

(c) Terminal guidance for bomb delivery

(d) Search and tracking for fire control

(e) Automatic takeoff, approach and landing

(f) Inertial Flight Path Control

(g) Automatic Terrain Avoidance

3.1.1.2 Choice of Components - Systems, subsystems and components shalt be selected from the following categories in the order listed, consistent with the applicable requirement and specifications:

(a) In operational use, or under procurement for operational use, by the same service.

(b) In operational use, or under procurement for operational use, by other branches of the service.

(c) Modification of category a.

(d) Modification of category b.

(e) Certified by a competent government agency for commercial aircraft use.

(f) Developed under contract to the services and approved in principle.

(g) Under development on concurrent programs having more stringent requirements or scheduled for earlier completion

(h) Designed and developed specifically for the requirements on hand.

Compliance with the above listed order of categories shall be a major criterion in the selection of an automatic flight control system subcontractor. The proposed use of systems, subsystems and components from a category lower than category b shall be justified and any changes made during the development phase which necessitate the use of systems, subsystems or components in a lower category must be approved by the procuring activity. Requests for approval supported by studies showing the necessity for the use of the system, subsystem or component shall be submitted prior to the appropriate design review, at which time the procuring activity shall decide upon approval or disapproval.

3.1.1.2.1 System Design - The AFCS shall be designed for minimum weight and volume consistent with the design of the aircraft for which it is intended.

3.1.1.2.1.1 Avoidance of Duplication - Automatic flight control systems, subsystems and components shall be so designed that a maximum of integration is accomplished, consistent with system reliability, operation and safety between:

(a) Those components providing the automatic conrol function and components Or parts comprising or providing any other function of a weapon system, and

(b) The components providing the different functions of the automatic flight control system itself.

Detailed requirements of each integration situation shall be as specified in the procurement document or in the system or component specification.

3.1.1.2.2 Additional Design Requirements - The AFCS shall be designed to meet the following requirements:

The electronic control amplifier shall consist of separate assemblies for each major channel.

Channels having higher reliability requirements than other channels shall be electrically isolated and have their own power supply, circuit breakers, etc.

(c) A control panel switch shall be provided so that the AFCS can be isolated before ground power is applied or removed.

3.1.1.2.3 Interchangeability - All assemblies having the same manufacturer's part number shall be directly and completely interchangeable with respect to installation and performance without adjustment.

3.1.1.2.3.1 Reordered Equipment or Second Source Procurement - Where models or drawings of components of systems are furnished by the procuring activity on a contract to facilitate interchangeable construction, or where procurement is for equipment to provide interchangeable use with equipment previously procured, and the requirements for interchangeability contradict the current requirements of one or more MIL specifications, the contract requirements for interchangeability shall govern without additional approval by the procuring activity,

3.1.1.2.4 Repairability - No assembly or subassembly shall be encapsulated or permanently sealed without written approval of the procuring activity. This requirement is established to insure access whenever necessary to repairable parts in components and/or assemblies.

3.1.1.3 Functional Design Requirements

3.1.1.3.1 Conditions for Engagement - Unless the automatic flight control system and integrated portions of other systems are properly energized and synchronized, it shall not be possible to engage the system or to switch from one functional category or mode of operation to another. It shall be possible to engage the augmentation mode independently of any other function or mode of the automatic fright control system. No control transients, which exceed the limits of 3.1.1.4.3, shall occur when switching from one functional mode of operation to another or when disengaging the system. Unless otherwise specified in the system specification, all control axes shall be engaged and disengaged simultaneously. Means shall be provided so that the pilot can visually determine the operation status of the system.

3.1.1.3.2 Warm-up - After the application of power, the warm-up time required shall be not more than 90 seconds for fighter or attack type aircraft and not more than 3 minutes for other types of aircraft,

3.1.1.3.3 Synchronization - The system design shall be such that, upon engagement, the aircraft's attitude or other comtrol mode will be maintained, or the aircraft will be displaced at a predetermined rate to a predetermined attitude as defined in the system specification covering the particular automatic flight control system. Synchronization indication, if required, shall be as specified in the system specification. The synchronization rate shall be such that no transients exceeding the limits of 3.1.1.4.3 shall occur due to system engagement or mode switching after the completion of any maneuver up to the maneuver limits of the aircraft.

3.1.1.3.4 Disengagement - Provisions shall be made for inflight disengagement and reengagement of the automatic flight control system. Disengagement shall be positive under any and all load conditions. Disengagement switches shall be normally closed and shall be located in accordance with the requirements of MIL-STD-203. A disengagement not initiated by the pilot shall be indicated by means which shall be approved by the procuring activity. In the event that servo disengagement should result from action of the structural protective means, the circuitry shall provide for immediate re-engagement at the pilot's discretion.

3.1.1.3.5 Series Actuators - The series actuators shall, after deactivating, be positively centered and capable of transmitting full control system load without creep. The rate of centering shall be such that no undesirable transients will be introduced. Unless a dual cross monitoring system, including dual separate actuators with a common output is used, series actuators having more than 40 percent primary control authority shall not be used.

3.1.1.3.6 Overpower - With the automatic flight control system engaged and operating, it shall be possible to manually overpower or countermand the control action of the system on all axes. For fixed-wing aircraft_ the maximum steady forces required to maneuver the aircraft within its design limits about all axes, subsequent to overpowering or countermanding control system action shall not exceed the values specified in Sections 3.3 and 3.4 of Specification MIL-F-8585; in addition the maximum instantaneous forces shall not exceed 120 percent of the maximum steady force.

3.1.1.3.7 Cockpit Control Motion - The control surface motion required to accomplish augmentation functions shall not be reflected aircraft's cockpit control. In addition there shall be no random spurious stick motion associated with any automatic flight control mode.

3.1.1.3.8 Automatic Trim - Means shall be provided to automatically reduce the control system trim error to essentially zero. Such a means shall operate at a rate which does not significantly affect the transient performance of the automatic flight control system. Automatic trim shall be operational during the guidance and pilot assist modes only.

3.1.1.3.9 Manual Trim - Powered manual trim shall be made inoperative when the automatic flight control system is engaged, The circuitry shall be arranged so as to minimize the effect of a failure in the automatic flight control system on the manual trim operation after the automatic flight control system is disengaged,

3.1.1.3.10 Control Stick (or Wheel) Maneuvering - Where control stick maneuvering is a system requirment, provisions shall be made so that the pilot shall have full capability to maneuver the aircraft within control forces and maneuver limits specfied in Specification MIL-F-8785 or the applicable system specification. This maneuvering capability shall be possible at any time when the automation flight control system is engaged by using the normal aircraft controls. Unless otherwise specified in the applicable system specification, design shall be such as to allow the pilot to superimpose his control stick maneuvering commands over those of external guidance system signals. Cross control between the pitch and roll force sensors shall not exceed one percent of the applied forces.

3.1.1.3.10.1 Vernier Control - When control stick steering is a requirement, means shall be provided to apply vernier attitude control unless changes commensurate with the minimum maneuver requirements can be added by control stick steering commands.

3.1.1.3.10.2 Control Stick Maneuvering Modes - Control stick steering modes shall operate as follows:

(a) Control Augmentation Mode - This mode shall provide those features as required by 3.1.1.1.1. The pilot's force on the stick or wheel shall superimpose the commanded maneuver signal onto the augmentation signal,

(b) Pilot Relief Mode - This mode shall provide the augmentation features of part (a) above and in addition those outlined by 3.1.1.1.2, parts (a) and (b).

3.1.1.3.11 Interlocks - Interlocks to prevent engagement of the automatic flight control system in the absence of proper hydraulic pressure, electrical power of the proper voltage, proper gyro rotor speed, adequate warm-up, and normal overall operation shall be provided as part of the automatic flight control system. It shall not be possible to engage incompatible functions. Interlocks shall also be provided to prevent power from being applied to the system if lack of power to the servo units prevents synchronization. In the event of failure of any one of the hydraulic or electrical power sources, the automatic flight control system shall become disengaged within 0.3 second.

3.1.1.3.12 Structural Protection - Means shall be provided to prevent automatic flight control system malfunctions from producing airplane loads in excess of the airplane limit load factor. Due to consideration shall be given to the fact that during rapid roll maneuvers the load factor of one of the wings is higher than than determined by the center of gravity acceleration. Mess proven unnecessary, the protective device for high roll performance aircraft shall respond to an appropriate combination of lift, roll velocity, and roll acceleration.

3.1.1.3.12.1 Ground Check - The structual protective means shall be such that it can be conveniently ground-checked by the pilot.

3.1.1.3.12.2 Reliability - The structural protective means shall be designed for maximum reliability and shall be self-monitoring, Electrical power applied within the limits shown in 3.2.7 shall not cause the structural protective means to become inoperative.

3.1.1.3.13 Protection Against Prohibited Maneuvers - Devices which protect against prohibited maneuvers, whether initiated by the pilot or by the automatic flight control system (i.e. command signal limiting as a function of velocity - normal load limits, pitch-up inhibitors, etc.) shall be provided as specified in the applicable system specification. The design of the protective devices shall be similar to 3.1.1.3.12.

3.1.1.3.14 Pre-Flight Check- Means shall be incorporated into the design of the AFCS to enable the pilot to determine the operational ability of the AFCS while the airplane is on the ground prior to take-off. Additional equipment needed to meet such pilot pre-flight check requirements shall be kept to a minimum, shall be integrated into the AFCS, and shall not require use of ground test equipment. The pilot shall be enabled to initiate the pre-flight tests and to observe the results from the airplane cockpit. A means of activation to be mounted in the cockpit of the airplane, shall be provided for use in initiation of the pre-flight test. Other than the means of activation, the pre-flight test shall not require the installation of additional controls in the cockpit area. It shall be possible to perform all pre-flight tests by manipulation by the pilot of the following equipment.

(a) The AFCS pre-flight test means of activation.

(b) The airplane control stick

(c) The airplane control pedals.

(d) The controls on the AFCS control console.

(e) The AFCS emergency disengage switch on the stick grip.

The results of the pre-flight tests shall indicate to the pilot the proper functioning of all electronic and electrical equipment of the AFCS which perform flight control funtions to the extent that no unsafe condition shall occur upon engagement of the AFCS. Specifically, the tests shall indicate to the pilot that inputs to the rudder, elevator and aileron channels of the AFCS shall result in corresponding displacements of the rudder, elevator and aileron control power mechanisms. Tests shall indicate whether or not any malfunctions exist in the structural protection system. Indication of functioning of gyro sensors, flight data unit, or signal sources external to the AFCS is not required, except: indicating of proper functioning of control stick force sensor and force switches is required. The AFCS pre-flight tests subsystem shall enable the pilot to complete all pre-flight tests in a time not to exceed 2 minutes after elapse of warm-up period specified herein or after satisfaction of AFCS interlocks from equipment not supplied by the vendor whichever occurs hitter. The pre-flight tests are not required to indicate the operating condition of any equipment beyond whether or not the equipment is in a functionable or non-functionable condition.

3.1.1.4 General Tie-in Requirements - Provisions shall be made for the acceptance of external guidance signals from various computers generating. the necessary commands in attitude, speed, altitude, flight path rate, acceleration, etc., to control the aircraft's flight path.

3.1.1.4.1 Reference Voltage - Unless otherwise specified in applicable specifications, the input signal to the automatic flight control system shall be based on the same voltage source as the corresponding feedback signal of the automatic flight control system. This shall prevent the voltage variations from changing the correlation between the commanded and actual value.

3.1.1.4.2 Command Signal Limiting - Means shall be provided to limit the command signals from external guidance systems, to that the automatic flight control system will not cause the aircraft to exceed maneuver limits that are inconsistent with the external guidance function and flight conditions. Such means shall be located immediately prior to the input to the amplifier.

3.1.1.4.3 Switching - Switching with zero command signal input from external guidante systems shall not cause transients greater than ± 0.05 g normal acceleration at the center of gravity in pitch or ± 1 degree in the roll attitude.

3.1.1.4.4 Noise Compatibility - The automatic flight control system shall be so designed that the noise content in the external guidance signal, as specified in the applicable system specification, shall not saturate any component of the automatic flight control system, shall not impair the response of the aircraft to the proper guidance signals, and shall not cause objectionable control surface motion or attitude variation. If the specified noise content is too great to achieve this goal, additional noise filtering shall be employed. Since additional noise filters impair the guidance performance, an optimum compromise between performance and noise filtering shall be determined by the procuring activity, the automatic flight control system contractor and the contractor responsible for the guidance computer and the overall guidance performance.

3.1.1.4.5 Data Link - If the steering information is transmitted to the automatic flight control system via a digital data link, the sampling frequency and number of bits per signal shall be compatible with the accuracy and dynamic performance requirements of the guidance loop, and the noise resulting from the sampling and digitalizing process shall not cause a total noise which will be incompatible with 3.1.1.4.4. If the steering information is transmitted to the automatic flight control system via an analog data link, the gain variation and the zero shift of the data link shall be compatible with the performance and accuracy requirements of the guidance loop and the data link noise shall not cause a total noise which will be incompatible with 3.1 1.4.4.

3.1.1.5 Performance Requirements - The aerodynamic and flight configurations, external stores configuration, and aircraft performance range through which the automatic flight control system shall be required to provide the specified performance shall be as defined in the applicable specification. The performance requirements specified herein shall apply to all fixed. wing aircraft, helicopters, and VTOL aircraft during forward flight at a speed greater than 30 knots. Deviations from the performance requirements specified herein shall be allowed only as necessary, and shall be subject to the approval of the procuring activity.

3.1.1.5.1 Augmentation - The augmentation system shall provide handling characteristics which will satisfy, as a minimum, the requirements of Specification MIL-F-8785 for all fixed-wing aircraft and VTOL aircraft in the cruise configuration and Specification MIL-H-8501 for helicopters and VTOL in the hover and transition configurations. During turn maneuvers, the augmentation system shall provide turn coordination as specified in 3.1.1.5.2.4. The control authority of the augmentation system shall be limited as far as possible to insure that a "hard-over" signal will not cause the aircraft to exceed its limit load factor. If this is not possible because of the demands of the augmentation system, additional requirements shall be specified in the applicable system specification to insure the safety of the weapons system operation.

3.1.1.5.2 Pilot Assist Function -

3.1.1.5.2.1 Attitude Hold (Pitch and Roll) - The selected pitch and roll attitudes shall be maintained within a static accuracy of ± 0.5 degree with respect to the gyro reference. Upon completion of a pilot controlled maneuver, the time attitude maintained by the automatic flight control system shall be the airplane attitude at the time the commanded forces were removed, if this attitude is within the limits of the attitude hold mode. When using a flight controller, the airplane shall return to a wings level attitude when the turn control is placed in the detent position.

3.1.1.5.2.1.1 Pitch Transient Response - The short period pitch response shall be smooth and rapid. After the automatic flight control system has been manually overpowered to change the pitch attitude by at least ± 5 degrees, the aircraft shall return to the reference attitude within one overshoot which shall not exceed 20 percent of the initial deviation. The period of overpowering shall be short enough to hold the airspeed change to within 5 percent of the trim airspeed,

3.1.1.5.2.1.2 Roll Transient Response - The short period roil response shall be smooth and rapid. After the automatic flight control system has been manually overpowered, and the overpowered controls released upon reaching a bank angle of apprximately 20 degrees, the aircraft shall return to the initial roll attitude within one overshoot which shall not exceed 20 percent of the initial deviation.

3.1.1.5.2.1.3 Residual Oscillations During Steady State Flight - Residual oscillations as measured in the cockpit during steady flight shall not produce normal accelerations, a_o, lateral accelerations, a_y, attittude amplitudes, θ(pitch), (yaw), and $\emptyset$ (roll) greater than the following:

$$a_n \leq 0.05\ g$$

$$a_y \leq 0.02\ g$$

$$\theta \leq \pm 0.25\ g$$

$$\emptyset \leq \pm 0.50\ g$$

$$\psi \leq \pm 0.25\ g$$

3.1.1.5.2.2 Heading Hold - When the beading hold is engaged, the automatic flight control system shall maintain the aircraft at its existing heading within a static accuracy of $\pm$ 0.5 degree with respect to the gyro accuracy.

3.1.1.5.2.2.1 Transient Response - The short period heading response shall be smooth and rapid. After overpowering the rudder and generating a sideslip angle corresponding to approximately 0.15 g lateral acceleration, the aircraft shall return to the reference heading within one overshoot which shall not exceed 20 percent of the initial deviation.

3.1.1.5.2.3 Heading Select - Where heading select is a system requirement, the automatic flight control system shall automatically turn the aircraft through the smallest angle (left or right) to a heading either selected or preselected by the pilot and maintain that heading as in the heading hold mode. The heading selector shall have 360 degrees control The bank angle while turning to the selected heading shall be limited to a bank angle designated by the procuring activity. The pilot shall be able to select any other bank angle by exerting the required force on the stick to command the new bank angle, then releasing the force. The aircraft shall not roll in a direction other than the direction required for the aircraft to assume its proper bank angle. In addition, the roll in and roll out shall be accomplished smoothly with no noticeable variation in roll rate.

3.1.1.5.2.3.1 Transient Response - Entry into and termination of the turn shall be smooth and rapid. The aircraft shall not overshoot the selected headings by more than 1.5 degrees.

3.1.1.5.2.4 Automatic Turn Coordination -

3.1.1.5.2.4.1 Lateral Acceleration Limits, Steady Bank - The uncoordinated sideslip angle shall be not greater than 2 degrees and the lateral acceleration shall not exceed 0.03 g, whichever is the more stringent requirement, while at steady state bank angles up to 60 degrees. Lateral acceleration in all cases shall refer to body-axis acceleration at the center of gravity.

3.1.1.5.2.4.2 Lateral Acceleration Limits, Rolling - For aircraft having a roll velocity capability up to 60 degrees per second the lateral acceleration, while the aircraft is in essentially constant altitude flight and rolling from 60 degrees on one side to 60 degrees on the other up to this roll velocity, shall be maintained within $\pm$ 0.1 g by the automatic flight control system. For aircraft having a roll velocity capability in excess of 60 degrees per second, the lateral acceleration, while the aircraft is rolling at velocities up to its rolling velocity limit, shall be maintained within 0.2 g.

3.1.1.5.2.5 Sideslip Limiting - Where sideslip limiting is a system requirement, the static accuracy while the aircraft is in straight and level flight shall be maintained within a sideslip angle of 1 degree or a sideslip angle corresponding to a lateral acceleration of O.02 g, whichever is the lower.

3.1.1.5.2.6 Altitude Hold - Engagement of the altitude hold function at rates of climb or dive less than 2000 fpm shall select the existing barometric altitude and control the air craft to this altitude as a reference.

3.1.1.5.2.6.1 Control Accuracy - After engagement and stabilization or altitude control, a constant barometric altitiude shall be maintained within ± 30 feet up to 30,000 feet. From 30,000 feet to 55,000 feet constant altitude shall be maintained within ± 0.l percent. From 55,000 feet to, 80,000 feet constant altitude shall be maintained within ± 0.1 percent at 55,000 feet varying linearity to 0.2 percent at 80,000 feet. Up to an altitude of 80,000 feet the AFCS shall hold the reference altitude to within ± 60 feet or 0.3 percent whichever is greater up to 30° bank angle and ± 90 feet or 0.4 percent whichever is greater from 30° to 60° bank angles. Within the capabilities of the aircraft, any periodic oscillation within these limits shall have a period of at least 20 seconds.

3.1.1.5.2.7 Mach Hold- After engagement and stabilization on Mach hold, the automatic flight control system shall maintain the selected Mach number without further attention. The steady state Mach number error shall not exceed ±0.01 steady state Mach number. Provisions shall be made for trimming over a range of at least ± 0.05 Mach. Any periodic oscillation within these limits shall have a period of at least 20 seconds.

3.1.1.5.2.8 Return to Level - This mode shall be operable from any flight attitude and shall return the aircraft automatically to a straight and level flight condition through the smallest angle with no overshoot. There shall be no stopping or reversal of either roll rate or pitch rate during this maneuver other than the overshoot specified in 3.1.1.5.2.1 and 3.3.1.5.2.2. When operated the return to level control shall disengage any other automatic control mode. When leveled the aircraft shall be in the attitude hold mode.

3.1.1.5.2.9 Control Stick Maneuvering - The force applied at the stick grip reference point to effect disengagement of any other operational modes shall be minimized consistent with the prevention of nuisance disconnects. When the force on the stick is released the automatic flight control system shall maintain the aircraft at the attitude prevailing at the time of stick release.

3.1.1.5.2.9.1 Stick Feel - The stick forces experienced by the pilot shall not exceed ± 25 percent of the force while maneuvering through the manual control system under similar aerodynamic conditions.

3.1.1.5.2.10 Standard Legend and Definitions for AFCS Control Panel.

NOMENCLATURE	ABBREVIATION	DEFINITION
AUTOMATIC APPROACH AND LANDING	AUTO LAND	A control mode in which the aircraft's speed and flight path are automatically controlled for approach, flareout and landing.
ALTITUDE HOLD	ALT	Barometric altitude existing at time of engagement maintained automatically.
AUTOMATIC FLIGHT CONTROL SYSTEM	AFCS	A system which automatically controls the flight of an aircraft to a path or attitude described by reference internal or external to the aircraft.
ENGAGE	ENGAGE	A system state in which aircraft control surfaces are actuated by the automatic flight control system actuators.

NOMENCLATURE	ABBREVIATION	DEFINITION
GLIDE	GLIDE	Aircraft is automatically positioned to the center of the glide slope beam.
GROUND SPEED	GND SPD	Aircraft gound speed automatically Controlled to a computed value.
HEADING SELECT	HDG SEL	A control feature permitting accurate selection or preselection of a desired heading or headings.
HEADING HOLD	HDG	Automatic control of aircraft to maintain heading existing at the instant of engagement.
INDICATED AIRSPEED	IAS	Indicated airspeed existing at time of engagement maintained automatically.
LOCALIZER	LOC	Aircraft is automatically positioned to and held at the center of the localizer beam.
AUTOMATIC LEVELING	LEVEL	A system control feature which automatically returns the aircraft to level flight attitude in roll and pitch.
MACH HOLD	MACH	Control of the aircraft to redstab the Mach number existing at the instant of engagement.
NAVIGATION	NAV	Control mode in which the aircraft heading is determined by signals from navigation equipment.
PITCH	PITCH	Pertains to control of the aircraft about its lateral area.
RADAR ALTITUDE	RAD ALT	Control of the aircraft to an altitude determined by signals from a radar/radio altimeter.
REVOLUTIONS PER MINUTE	RPM	Automatic rotor speed control referenced to a helicopter rotor tachometer.
ROLL	ROLL	Pertains to control of the aircraft about its longitudinal axis,
STABILITY AUGMENTATION	STAB AUG	A state of system control in which an automatic device operates to augment the stability characteristics of an aircraft.

NOMENCLATURE	ABBREVIATION	DEFINITION
STANDBY	STBY	The period in which all elements of the AFCS are energized and the system ready for engagement of surface actuators.
TRIM FOR TAKE OFF	TO TRIM	A control feature in which the aircraft's trim systems are automatically displaced to the best take off position.
TRACK	TRACK	Aircraft is automatically maintained on Doppler track reference existing at time of engagement.
YAW	YAW	Pertains to control of the aircraft about its vertical axis.

3.1.1.5.3 Automatic Guidance Functions - During the automatic guidance functions, the automatic flight control system - aircraft combination is an element within the overall guidance loop. The requirements which this combination has to meet depend upon the performance requirements of the guidance loop, the guidance method and the particular guidance computer. Unless specific performance data are established in the applicable system specification, the following requirements shall be met.

3.1.1.5.3.l AN/SPN-10 Tie-in - All data stated below are for wing aircraft and shall be met by the aircraft in the landing configuration and over the range of the expected weight, center of gravity, and speed variations. The guidance control system shall be incremental pitch and bank commands with respect to the trim attitude at the moment the guidance signals are inserted.

3.1.1.5.3.1.1 Pitch Control -

(a) The damping factor ζ_θ of the short period mode of the pitch oscillation shall be

$$0.5 \leq \zeta_\theta \leq 1$$

(ζ = 1 means critical damping)

(b) The natural undamped frequency ω_θ of the short period mode of the pitch oscillation shall be

$$\omega_\theta \geq 0.75 + 3.1\,\zeta_\theta \quad \text{(radians per second)}$$

These requirements shall be met for step input commands up to ± 5 degrees from trimmed conditions at constant airspeed without changing trim and in the presence of noise as indicated in 3.1.1.5.3.2.5.

(c) The static gain K of the automatic flight control system, i.e,, the ratio of elevator deflection to pitch attitude error, shall be

$$K \geq 2\left[\frac{C_{m_\alpha}}{C_{m_\delta}}\right]$$

where C_{m_α} is the pitch moment coefficient of the airplane, and C_{m_δ} is the control pitch moment coefficient.

3.1.1.5.3.1.2 Lateral Control -

(a) During the landing phase, the airplane shall perform lateral maneuvers by coordinated turns. The uncoordinated sideslip angle shall not exceed. the limits specified in 3.1.1.5.2.4. The longitudinal axis of the airplane shall not be tied to a heating reference, in order to tietiati the effect of side gusts on lateral touchdown dispersion.

(b) The transfer function from bank command to actual bank angle, when fitted by a second order lag, shall exhibit a natural frequency ω_ϕ and damping factor ζ_ϕ within the following limits:

$$0.6 \leq \zeta_\phi \leq 1.2$$

$$\omega_\phi \geq 0.46 + 1.46\ \zeta_\phi \text{ (radians per second)}$$

This requirement shall be met for step input commands up to ± 10 degrees bank angle and in presence of noise as indicated in 3.1.1.5.3.2.5.

3.1.1.5.3.1.3 Airspeed Control - The indicated airspeed shall automatically be maintained at the correct approach by controlling the forces acting on the aircraft in the flight path direction (thrust and/or drag force). he thrust control system shall include an auxiliary capability to quickly counteract any airspeed change which may result due to pitch maneuvers. The action of the auxiliary input may be checked by introducing an incremental pitch step command of 4 degrees up and 4 degrees down with respect to trim conditions. In quiet air the airspeed change which results from either pitch command shall not exceed 1.5% of the reference value in the transient and 1% in the steady state. The auxiliary signal shall not be limited below a value which will be necessary to prevent airspeed change when automatic waveoff commands are transmitted to the aircraft. The thrust control system shall have the capability to decrease the airspeed error caused by a step horizontal wind gust to 56.7% of the initial error within 4 seconds after initiation of the gust. A single overshoot shall be permitted during the correction however it shall not exceed 20% of the initial error. The airspeed shall be withtn 1% of the reference speed at steady state. For certain aircraft manual control of airspeed shall be permitted when adquately justified by the contractor

3.1.1.5.3.1.4 Backlash and Deadspots- The total width of backlash or deadspot shall not exceed 0.1 degree of pitch command in the channel from pitch command input to control surface and in the channed from the pitch gyro to the control surface. For input signals larger than this specified backlash, the system performance shall be as specified in 3.1.1.5.3.2.1 and 3.1.1.5.3.2.2. Backlash and deadspot in the channel from pitch input to control surface shall be determined on the ground by varying the pitch command input up and down while the gyro signal is kept constant. Backlash and deadspot in the channel from pitch gyro to the control surface shall be determined by tilting the pitch gyro up and down while the pitch command signal is held at zero or a constant value. The backlash and deadspot requirements shall be met under a loaded condition corresponding to 2 degrees of incremental angle of attack with respect to the trimmed condition and under the unloaded neutral condition. Neutral condition is defined as zero torque requirement from the servo. These same requirements shall be met by the roll autopilot.

3.1.1.5.3.1.5 Noise Compatibility - Noise which is superimposed on a proper input signal shall not saturate the automatic flight control system components and shall not cause objectionable motion of control stick or wheel. The performance requirements specified in 3.1.1.5.3.2.1 and 3.1.1.5.3.2.2 shall be met under the presence of this noise. The noise content in the input signal to the pitch and roll system shall be represented by white Gaussian noise which has a power spectrum density Ø and is passed through a filter with the transfer function $G(j\omega)$.

Pitch Command Input:

Ø = 0.04 (degrees of pitch command)? per radian per second; flat in the frequency range from 0 to at least 30 radians per second.

$$G(j\omega) = \frac{1 + 3\,j\omega}{\left(\frac{j\omega}{5}\right)^2 + \left(\frac{j\omega}{5}\right) + 1} \times \frac{1}{1 + \left(\frac{j\omega}{1.85}\right)^2}$$

Bank Command Input:

Ø = 0.02 (degree of bank command)^2 per radian per second; flat in the frequency range from 0 to at least 30 radians per second.

$$G(j\omega) = \frac{1 + 10\,j\omega}{\left(\frac{j\omega}{5}\right)^2 + \left(\frac{j\omega}{5}\right) + 1} \times \frac{1}{1 + \left(\frac{j\omega}{1.85}\right)^2}$$

3.1.1.5.3.1.6 Command Signal Limiting - Means shall be provided to limit the pitch and band command signals immediately before feeding them to the automatic flight control system. The pitch command shall be limited to -13.5 and +6.5 degrees and the bank commmand shall be limited to ± 30 degrees.

3.1.1.5.3.1.7 Data Link- The resolution of the data link shall be at least ±0.04 degree minimum for pitch and ±0.1 degree minimum for roll. The sampling interval in the case of a sampling data link shall be not greater than 0.1 second.

3.1.1.5.3.2 Tie-in With Ground Controlled Bombing (AN/MPQ-14, AN/TPQ-10) - The general tie-in requirements of 3.1.1.4 shall be applicable. Specific performance data for the automatic flight control system - aircraft combination shall be compatible with the performance requirements of the overall guidance loop and shall meet the requirements of the detail system specification

3.1.1.5.4 Additional Requirements for Rotary Wing Aircraft - In addition to the applicable requirements of 3.1.1, helicopter automatic flight control systems shall meet the following requirements.

3.1.1.5.4.1 Control Force Maneuvering - Where force maneuvering is a system requirement, the relationship between cyclic stick force and attitude or attitude rate in pitch and roll shall be as specified in the applicable system specification, the yawing velocity shall be proportional to the pedal force during hovering, and unless otherwise specified, the rate of climb or descent shall be proportional to the collection stick force and the helicopter shall maintain the established altitude when no force is applied. To reduce the collective servo kind, the friction lock of the collective stick may be automatically removed during this mode of operation. The pilot shall have full capability to maneuver the aircraft within control forces and maneuver limits specified in Specification MIL-H-8501.

3.1.1.5.4.1.1 Overpower - With the automatic flight control system engaged and operating, it shall be possible to manually overpower or countermand the control action of the system in all axes. The overpower requirements shall be in accordance with the requirements of Specification MIL-H-8501.

3.1.1.5.4.2 Coordinated Turn - Unless otherwise specified in the system specification, automatic turn coordination shall be operative for the airspeed range between 30 knots and the maximum airspeed.

3.1.1.5.4.3 Groundspeed Hold - Where groundspeed hold is a system requirement, provision shall be made to insert radar groundspeed signals to the cyclic pitch and roll control, After engagement of the groundspeed hold mode, the groundspeed existing at the time of engagement shall be held in calm air within ± 1 knot or ± 2 percent, whichever is greater.

3.1.1.5.4.4 Groundspeed Select - Where groundspeed select is a system requirement the transition from the airspeed existing at the moment of engagement to the selected airspeed shall be smooth, and the transient of the groundspeed shall not exhibit a first overshoot higher than 20 percent of the difference between the selected groundspeed and the groundspeed existing at the moment of engagement.

3.1.1.5.4.5 Vernier Control for Hovering - Vernier control shall be provided for accurate positioning of the aircraft during hovering, unless control commensurate with the minimum accuracy requirements can be obtained with the regular controls.

3.1.1.5.4.6 Stability Augmentation - The stability augmentation system shall provide, as a minimum, those flying qualities specified in Specification MIL-H-8501.

3.1.1.5.4.7 Attitude Hold, Pitch, Roll and Yaw - During the attitude hold mode, the attitude, in calm air, shall be kept within ±1 degree of the referernce attitude. After the automatic flight control system has been overpowered to change the attitude by 5 degrees, the helicopter shall return to the reference attitude with the first overshoot not exceeding 20 percent.

3.1.1.5.4.8 Altitude Stabilization -

3.1.1.5.4.8.1 Barometric Altitude Stabilization - The requirements of 3.1.5.2.6 shall be met within the altitude limits of the aircraft when the aircraft is outside the ground effect. In addition, the transient after, 2 displacement of approximately 100 feet shall not exhibit a first overshoot in excess of 20 percent.

3.1.1.5.4.8.2 Radar Altitude Stabilization - The operational range of the radar altitude control mode shall be as specified in the applicable system specification. Within this range, the aircraft shall be controlled to the indicated radar altitude with an accuracy, in calm air, of ± 7 feet or ± 10 percent, whichever is greater.

3.1.1.5.4.8.3 Altitude Select - Where altitude select is a system requirement, the transition from any engaged altitude within the operational range of the altitude stabilization mode to the preselected altitude shall be smooth and shall not show a first overshoot in excess of 20 percent.

3.1.1.5.4.9 Sonar Coupled Operation - Where sonar coupled operation is a system requirement, the automatic flight control system shall meet the following requirements for submerged sonar ball and calm air.

3.1.1.5.4.9.1 Altitude Hold - The preset altitude shall be held to within ± 3 feet or 10 percent of the preset altitude, whichever is greater. The transient, following a displacement in altitude of approximately 10 feet, shall not exhibit a first overshoot exceeding 20 percent of the initial displacement,

3.1.1.5.4.9.2 Transiational Stability - The cable angle shall be kept within ± 2 degrees. The first overshoot in the transient following a cable angle displacement of approximately 10 degrees from the vertical shall not exceed 30 percent of the initial displacement.

3.1.1.5.5 Additional Requirements for Convertiplane, VTOL Aircraft - The requirements of these special type aircraft are, in most cases, identical to the requirements for other conventional and rotary wing aircraft.

3.1.1.5.5.1 Hovering Flight - The automatic flight control system shall control the moment generating devices (reaction controls, thrust modulation controls, etc.) and possibly thrust to provide stability augmentation, attitude hold, altitude hold, control stick maneuvering or other modes of operation as specified in the applicable system specification, In aircraft which are unstable without stability augmentation the stability augmentation system must be dualized.

3.1.1.5.5.2 Attitude Hold, Pitch, Roll and Yaw - During the attitude hold mode, the aircraft's selected attitude in pitch, roll, and yaw shall be maintained within a static accuracy of ± 0.5 degree, with respect to the gyro reference. The attitude transients in pitch, roll, and yaw shall be well damped and shall not exhibit a damping factor of less than 0.5.

3.1.1.5.5.3 Stick Maneuvering - The steady state relationship between stick force and pitch and roll velocity or pitch and roll attitude shall be as specified in the applicable system specification. If the pitch and roll velocity of the aircraft is proportional to the stick force, the aircraft shall maintain its existing pitch and roll attitude when the stick force is released. Where proportionality between stick force and pitch and roll attitude is required, trim button command shall be provialed to obtain and hold any desired pitch or roll attitude. The rate of yaw shall be proportional to the pedal force and the aircraft shall maintain its existing heading after release of the pedal force. Unless otherwise specified in the applicable system specification, a force applied to the thrust control shall cause a proportional climb or sink rate of the aircraft and the aircraft shall maintain its existing altitude when the force is released. The transient caused by a sudden application of control forces shall be well damped.

3.1.1.5.5.4 Transition - The transition from one set of controls to another set shall be smooth and shall not cause undesirable transients.

3.1.1.5.6 Additional Requirements for Lighter-Than-Air Aircraft - The requirement of this paragraph are in addition to previous applicable requirements.

3.1.1.5.6.1 Longitudinal Control - Longitudinal control shall be by means of a wheel and column (yoke type). Forward movement of the wheel and column shall cause the aircraft to nose down and aft movement shall cause the aircraft to nose up. The range of movement of the longitudinal control shall be a maximum of 14 inches. The extreme aft position shall not be more than 9 inches from the neutral position.

3.1.1.5.6.2 Directional Control - Directional control shall be by means of the wheel on the column. Rotation of the wheel clockwise shall cause the airship to turn to the right and rotation of the wheel counterclockwise shall cause the airship to turn to the left, The rotation of the wheel shall be a maximum of 110 degrees clockwise and 110 degrees counterclockwise.

3.1.1.6 General Requirements -

3.1.1.6.1 Stability Margins - The AFCS shall be demonstrated to be stable in all modes of operation in all flight conditions as follows: All AFCS aerodynamic loops shall be flight demonstrated to be static for at least one and one-half times the production gain. At the beginning of service life and under standard conditions as specified in Specification MIL-E-5272, all AFCS non-aerodynamic servo loops shall be demonstrated to be stable at three times the production gain. All AFCS non-aerodynamic loops shall be demonstrated to be stable at one and one-half times the production gain throughout all operating service conditions. At the end of service life and under standard conditions all non-aerodynamic loops shall be demonstrated to be stable at one and one-half times the production gain. It shall also be demonstrated that an additional lag of 45 degrees, when introduced into any loop with production gains, shall not result in instability.

3.1.1.6.2 Internal Noise - There shall be no noticeable high frequency motion of the controls due to noise signals generated within the automatic flight control system. Control surface oscillations which are a necessary feature of certain self-adaptive automatic flight control systems shall not exceed the limits of the applicable specification.

3.1.1.6.3 Parameter Ground Adjustment - Controls shall be provided to facilitate ground adjustments of the automatic flight control system parameters. Such control provisions, however, shall be held to a minimum and shall not be readily accessible to flight crews, that is, they must be tamper resistant.

3.1.1.6.4 Life - Components of automatic flight control systems shall have a guaranteed service life of at least 1000 hours in naval aircraft. The operating time shall be computed by reference to data in the log book of the aircraft in which the component is installed or to a time totalizing meter supplied with the equipment.

3.1.1.6.5 Shelf Life - The equipment shall be capable of immediate service use without operational conditioning or maintenance during storage periods up to 24 months.

3.2 Installation Design Requirements

3.2.1 Accessibility and Serviceability - The automatic flight control systems and components shall be designed for easy accessability and servicing. Components shall be desiged, installed, located. and provided with access doors so that inspection, rigging, removal, repair, and lubrication can be readily accomplished without major disassembly of the aircraft. Suitable provision for rigging pins, or the equivalent, shall be made for locating and holding each control system component at some point in its travel, such as the neutral or mid-point to facilitate correct rigging of the control system, and to permit removal of components, including the control surface, without disturbing the rigging. Any AFCS component shall be replaceable in not more than one-half man hour.

3.2.2 Maintenance Provisions - Systems and components shall be designed to provide for ready accessibility and for connection of such test equipment as may be required for field maintenance. (See 6.3)

3.2.2.1 Design of equipment should include provisions for the connection of circuit, or other test facilities, by test point terminals or connections leading to selected positions in the system or components. Actual locations should be determined by the system or component design and as specified in the detailed system or component specification, Sufficient test points should be provided to facilitate location of the most probable malfunction which may be expected to be encountered in service usage.

3.2.3 Foolproofness - All automatic fright control systems shall be designed so that incorrect assembly and reversed operation of controls is impossible.

3.2.4 Fouling Prevention - All elements of the AFCS shall be suitably guided, protected, or covered in all compartments where it is possible for them to be fouled by dropping of articles, loading of cargo, changing of engines, etc.

3.2.5 Draining - Adequate provisions shall be made to drain AFCS components subject to the accumulation of moisture or fluid leakage,

3.2.6 Hydraulic Systems - Hydraulic systems shall be in accordance with the requirements of Specification MIL-H-5440, and shall comply with the design objectives of 3.1 of this specification.

3.2.6.1 Ground Checkout - The hydraulic systems shall be designed and installed in such a manner that ground checkout of automatic control systems can be made by the use of a standard dual system hydraulic test stand without the necessity of reservicing any of the systems after completion of testing.

3.2.7 Electrical Power - The AFCS shall operate satisfactorily in accordance with the performance requirements specified herein when supplied power from sources conforming to the applicable requirements of MIL-STD-704. The performance and operation requirements of this and the applicable component specifications shall be met with equipment supplied by this power, Which may be subject to steady state and transient variations within the specified tolerances of MIL-STD-704.

3.2.8 Calibration Adjustments, Controls and Knobs -

3.2.8.1 Controls and Knobs - Controls and knobs requiring manipulation in flight shall operate smoothly with negligible backlash or binding. Means shall be provided to prevent movement due to shock or vibrations encountered in service. Controls and knobs shall be readily accessible and of a size and shape for convenience and ease of operation under all service conditions. The direction of motion of the knob or control and the location within the cockpit shall be in accordance with the requirements of MIL-STD-203.

3.2.8.2 Calibration Adjustments - Calibration adjustments required for ground maintenance of the system or component shall be kept to a minimum. The system objective shall be to concentrate all required ground adjustments in one major component of the system. It is preferred that the removal of an auxiliary cover plate be necessary for access to calibration adjustment, Suitable means shall be provided to prevent a change in adjustment to occur due to shock or vibrations encountered in service. These adjustments shall be labeled, indexed, and marked in such a manner that only visual means are necessary for setting the desired adjustment.

3.2.9 Dynamic and Static Pressure and Air Data System - Whenever AFCS components require connection to pitot tubes or static ports, the required performance shall be obtainable from pitot tube and static port installations conforming to the requirements of Specification MIL-I-6115. Compensation of static or dynamic signals, which may be required to obtain desired performance, shall be accomplished within the system or components. Whenever the automatic flight control system requires outputs from a central air data system in lieu of static and pitot measurements, the characteristics of the outputs, both static and dynamic shall be submitted to the using agency by the automatic flight control system contractor at the earliest possible date in order to insure compatibility between the AFCS and air data system,

3.3 System Component Design Requirements -

3.3.1 Electrical and Electronic Components - All electrical equipment in the control systems shall be designed and installed in accordance with Specifications MIL-E-5400, MIL-E-7080, MIL-W-5088, MIL-A-8064, MIL-M-8609, MIL-E-4682, MIL-M-7969, and any other applicable specifications. Critical components shall have the best possible relatability to insure against loss of control of the aircraft. Specific consideration shall be directed toward achieving simplicity, producibility, and maintainability of equipment. The procedures outlined in Specification MIL-R-22256 shall be followed to insure that electronic equipment designs will have a high level of inherent reliability.

3.3.1.1 Electron Tubes - Electron tubes shall not be used.

3.3.1.2 Electrical Tape - No pressure-sensitive (adhesive or friction) fabric or textile tape shall be used. Nonmoisture absorbing tape may be used for mechanical purposes, with the approval of the procuring activity.

3.3.1.3 Switches - Switches shall conform to the requirements of Specifications MIL-S-3950, JAN-S-63, or MIL-S-6743 as the application may require. The operating position requirements of Specification MIL-E-5400 shall normally apply.

3.3.1.4 Electron Devices - Transistors and diodes shall be chosen and applied, and the complements reported, as outlined in Specification MIL-E-4682. The complement report must be submitted to the procuring activity for review and approval prior to design approval testing.

3.3.1.5 Saturable Reactors - Saturable reactors in automatic flight control systems and components shall comply with the environmental and performance requirements specified herein and in detail system component specifications.

3,3.1.6 Materials, parts and Processes- In the selection of electronic materials, parts, and processes, fulfillment of major design objectives shall be the prime consideration, In so doing, the following factors shall govern:

3.3.1.7 Modules - The electronic portions of the equipment shall be divided into modules conforming to Specification MIL-E-19600. At this level, modules may be repairable or nonrepairable in accordance with Specification MIL-E-5400, When possible, microelectronic processes shall be used; then these modules shall be subdivided. further into nonrepairable (expendable) modules in accordance with instructions to be obtained from the procuring activity. Each nonreps.trable module will be treated as a single part and nonstandard part approval must be obtained. The parts and materials used within the expendable module must be equal to or superior to that required by MIL specifications for similar items, MIL-STD items need not necessarily be used. The expendable module, as a whole, must pass electrical and environmental requirements. Drawings used for the purchase or construction of the module must be sufficiently complete to permit the construction of the module by other than the original manufacturer. All modules must be designed for long, reliable life.

3.3.1.7.1 Microelectronic Processes - The electronic portions of the equipment shall be constructed using microelectronic processes to the greatest extent possible. The processes used shall include the following with priority as shown: (See 6.3)

(a) The diffusion of various materials into a semiconducting base material,

(b) The evaporation or chemical deposition of thin films of various materials on an insulating base material.

3.3.1.8 Standard and Nonstandard Parts and Material - Conventional parts may be used only when the performance requirements of the equipment cannot be met by using the requirements of 3.1.1.1, or when specifically authorized by the procuring activity. To the extent possible consistent with the requirements herein, materials, parts, processes and nonstandard parts approval requirements of Specification MIL-E-5400 shall be followed.

3.3.1.9 Lubrication - Where applicable, lubrication of the components and systems shall be in accordance with Specification MIL-L-6880. Lubrication fittings shall be in accordance. with Specification MIL- F-3541, MS15001 and MSl5002-1 and -2.

3.3.1.10 Materials - The materials utilized in the components and systems shall be entirely suitable for the service and purpose intended. When Government specifications exist for the type material being used, the materials shall conform to these specifications. Nonspecification materials may be used if it is shown that they are more suitable for the purpose than specification materials.

3.3.1.11 Workmanship - Workmanship shall be sufficiently high grade throughout to insure proper operation and service life of the systems and components. The quality of the items being produced shall uniformly high and shall not depreciate from the quality of qualification test items.

3.3.1.12 Standardization - When possible, contractor designed equipment which has been approved for use in some models of aircraft shall also be used in later model airplanes if the installation and requirements are similar. This procedure will reduce supply problems, test and qualification expenses, and provide tried and proven equipment which should be more reliable.

3.3.1.13 Totalizing Time Meter - Units of the equipment shall include a time totalizing meter conforming with the applicable requirements of Specification MIL-M-7793. Control boxes, mounting bases, junction boxes, small indicators and other items not susceptible to failure, due to circuitry and moving parts, shall be exempt from this requirement.

3.4 Planning and Procedural Requirements -

3.4.1 Technical Development Plan - A technical development plan or program guide shall be established for the AFCS, and shall be submitted to the procuring activity for review and approval. This plan shall be revised and kept up to date as necessary. Revisions shall be submitted as part of the quarterly progress report to the procuring activity until it is mutually agreed that the revision usefulness has ended. The plan shall, in general, conform to the following:

3.4.1.1 Scheduling -

3.4.1.1.1 Interrelationship Between Phases - The plan shall show the interrelationship between phases anti/or items of development work to be accomplished. It shall show the logical sequence of work to be accomplished, and which items of work are to be completed before others can be initiated.

3.4.1.1.2 Bar Graph - The plan shall include a bar graph of all major items of work showing the starting and completion dates of these items of work.

3.4.1.1.3 Due Dates of Reports - The plan shall show the time for submittal of all required technical data and reports.

3.4.1.1.4 Schedule Changes - As the work outlined in the plan progresses, any changes, schedule difficulties or slippanges shall be clearly shown in the quarterly revision to the plan together with the justification and request for approval for any such changes.

3.4.1.2 Contents of the Plan - The plan shall include, but not be limited to, the planned procedure to develop and provide design information on the following items:

(a) Preliminary automatic flight control system performance specification. See 3.5.1.

(b) Initial system synthesis - A study shall be performed which will lead to the synthesis of an automatic flight control system to fulfill the requirements specified in the preliminary performance specification.

(c) Initial system analysis - The automatic flight control system contractor shall:

(1) Perform an analysis of the synthesized system wing analog or digital computer methods and/or graphical methods such as Bode plots, Nyquist plots, root locus plots, etc.

(2) Make a preliminary reliability analysis of the autocmatic flight control system.

(3) Make a preliminary failure analysis of the automatic flight control system,

(d) Preliminary automatic flight control system report. See 3.5.2.

(e) Fired automatic flight control system specification. See 3.5.1.

(f) Development of basic design - The contractor shall proceed with the development of preliminary designs and components of the automatic flight control system in rough form. An experimental model (or models) of the system may be developed to demonstrate the technical soundness of the basic idea without detailed attention to the eventual overall design or form factor and which may not contain parts of the final production design. Systems, subsystems, and components for AFCS shall be selected as specified in 3.1.1.2.

(g) Preparation of subsystems and component specifications. See 3.5.9.

(h) Design approval test specifications: See 3.5. &

(i) Simulation studies using development models. See 4.2.1.

(j) Automatic flight control system simulation report. See 3.5.5.

(k) Design approval tests.

(l) Design approval test report. See 3.5.6.

(m) Fabrication of Service Test Models -

NOTE: Approval of the procuring activity shall be obtained prior to fabrication of service test models. In order to decrease procurement lead time, approval may also be requested at this time of fabrication of prototype models.

(n) Identification of equipment. See 3.5.7.

(o) Flight test procedures. See 3.5.8.

(p) Preliminary flight tests.

(q) Preliminary flight test reports. See 3.5.9.

(r) Performance flight tests.

(s) Contractor's demonstration flight tests.

(t) Performance flight test reperk See 3.5.10.

(u) Fabrication of special maintenance and overhaul tools. See 3.5.11.

(v) Preparation of handbooks.

(w) Tooling for production.

(x) Fabrication of production models.

3.4.2 Design Approval - The procuring activity shall retain the right to disapprove any part of the design on the basis of nonconformance with the requirements of the contract or not being in the best interests of the government.

3.5 Data Requirements - The design and test data listed herein are required, If applicable design data are abailable, the contractor shall, in lieu of submitting new design data, submit these available data supplemented by sufficient information to substaniate its applicability, Design data shall be prepared and submitted as required by Specification MIL-D-18300 and shall include the following:

3.5.1 Automatic Flight Control System Specification - A performance specification shall be prepared by the contractor for the AFCS. The performance of the system and the various individual subsystems and components shall be specified. In addition, any special features or unusual requirements shall be indicated. This specification shall also define the environmental criteria and the testing required to show suitability for both the environment and the overall performance. Installation details, weights, sizes, structural limitations shall be included as required by the design, Preparation and format of this document shall be such that the areas of responsibility for the airframe, external guidance, primary flight control system and AFCS are clearly defined. The specification shall be prepared in accordance with the format outlined by Specification AV-5000.

3.5.2 Preliminary Automatic Flight Control System Report - Following the initial study and analysis of the proposed system, a preliminary automatic flight control system report shall be prepared and submitted to the procuring activity prior to manufacture of the prototype system. This report may be combined with a quarterly progress report as required by Specification MIL-D-18300,

(a) A discussion of the airframe and aerodynamic characteristics, and aircraft mission which were pertinent in the selection of the automatic flight control system.

(b) A discussion of any unusual or difficult design features and problems,

(c) A discussion of and justification for any contemplated deviations from the applicable specifications. Approval will be required from the procuring agency for such deviations.

(d) A discussion of the tie-in of the AFCS to the overall flight control system,

(e) A block diagram of the AFCS. This diagram shall clearly indicate the normal control paths, redundance, manual overrides, emergency provisions, tie-in of external elements and the control surfaces to be actuated.

(f) A general description of the AFCS and a discussion of the theory of operation. The various modes of operation should be explained in detail.

(g) A discussion of the stability of the AFCS and its relation to the overall stability of the airplane. This may be in the form of Bode, Nyquist or root locus plots, etc. for small perturbations. Data shall also be presented for large amplitudes taking into account the main nonlinearities such as limits on actuator rates and position.

(h) Data should be presented in response to commands and disturbances, speed of response, overshot, damping. accuracy, etc. These data should also take into account the main nonlinearities.

(i) A discussion of any required special functions as as Mach control, g limiting, etc.

(j) A preedicted reliability of the proposed design, sources of data, and the analytical approach used in making this prediction and a discussion of the results in comparison to requirements shall be included.

(k) A preliminary failure analysis of the AFCS.

(l) A general control system layout showing surfaces to be actuated, method of actuation system duplication, approximate hinge moments, major components, emergency provisions, etc.

(m) A layout of the hydraulic systems supplying the AFCS. This layout shall show sources of hydraulic power, pressures required, peak and average flow rates, power spectrum, etc.

(n) A schematic wiring diagram of the electrical system affecting the AFCS. This diagram shall show source(s) Of power, peak and average power requirements, voltage, current, etc.

(o) An AFCS control panel outline drawing showing the type switches used, nomenclature and functions available shall be submitted.

3.5.3 Subsystem and Component Specifications - Detailed specifications for subsystems and components shall be prepared and submitted as engineering information. Specifications shall be prepared in accordance with Specification MIL-D-18300.

3.5.4 Design Approval Test Specifications - Design approval test specifications and procedures in accordance with Specification MIL-D-18300 for U.S. Navy aircraft shall be submitted for approval. Justification shall be submitted for special maintenance and overhaul tools and test equipment required for these tests.

3.5.5 Automatic Flight Control System Simulation Reports - Reports on simulator test equipment, test procedures and test results shall be submitted.

3.5.6 Design Approval and Preproduction Test Reports - A report shall be submitted as engineering inforemation on the design approval and production tests. All test reports shall either contain or be accompanied by a copy of the applicable test specification.

3.5.7 Identification of Equipment - Assignment of AN nomenclature and approval of nameplate drawings shall be requested in accordance with Specification MIL-N-18307. AN nomenclature may not be required for the following, when approved by the procuring activity.

(a) Approved off-the-shelf equipment which bear the vendor's standard nameplate and part number,

(b) Approved equipment which when installed becomes a structural part of the aircraft (i.e. junction boxes, console mounts).

3.5.8 Flight Test Procedures - Flight test procedures for the AFCS shall be submitted for the approval of the procuring activity.

3.5.9 Preliminary Flight Test Reports - A report shall be prepared and submitted as engineering information on the preliminary flight test. This report shall discuss any differences noted between the predicted and actual flight performance.

3.5.10 Performance Flight Test Report - A report Shall be prepared and submitted for approval on the performance flight testing, This report shall indicate compliance with the performante specification.

3.5.11 Special Maintenance and Overhaul Tools - Prior to fabrication of Special maintenance and overhaul tools, the contractor shall submit a report to the procuring agency for approval. These items shall be in accordance with Specification MIL-D-8512.

3.5.12 ECP and Deviation Data - When ECP's requests for deviations, or other similar requests are submitted for evaluation, they shall contain sufficient drawings, test reports, and justification to permit a logical sound, engineering evaluation without the necessity for requesting or hunting additional data. The problem should be well defined and a description given of the other approaches to a solution which were attempted and the reason for their rejection.

3.5.13 Nonstandard Parts Data - These data shall be submitted as required by 3.3.1.8.

4. QUALITY ASSURANCE PROVISIONS

4.1 Test Requirements - Appropriate testing, as outlined herein, shall be conducted throughout the developoment and reduction of flight control systems in order to insure proper design and performance and also continuing quality throughout production. The specific tests required shall be specified in the detailed specifications for the components and systems. If the tests required by the detailed specifications are inadequate to prove that the flight control system and flight control system installation incorporate the specified requirements, the contractor shall propose amendments to the contract to include tests which will provide adequate proof. If applicable tests are available, the contractor shall, in lieu of repeating tests, propose amendments to the contract to require the submittal of these data, supplemented by sufficient information to substantiate their applicability.

4.1.1 Test Witnesses - Before conducting a required test, an authorized procurement activity representative shall be notified so that he or his representative, may witness the test and certify results and observations contained in the test reports. When the procuring activity representative is notified, he shall be informed if the test is such that interpretation of the behavior of the test article is likely to require engineering knowledge and experience. in which case he will provide a qualified engineer who will witness the test and certify the results and observations during the test.

4.2 Design Approval Tests - Design approval tests are accomplished on a sample or samples to determine compliance with the requirements of an investigation, study, research, development contract or purchase order, experimental and developmental specifications, exhibits or other requirements applicable thereto. A breadboard model, experimental model or developmental model shall be constructed and appropriate tests shall be conducted to insure that the operational and dynamic characteristics of the systems and components meet the requirements which have been established and are reliable in their performance characteristics.

4.2.1 Simulator Testing - Tests shall be made with equipment mounted on a simulator and with gains adjusted as recommended by the manufacturer. The simulator shall include all relevant control rigging, hinge moments, artifical feel devices, and tilt tables, if required. In addition, it shall include a computer to simulate aircraft response, selectable for all conditions of flight.

4.3 Preproduction Tests - Preproduction tests are those tests accomplished on a sample or samples, representative of an article or system to be proceed or delivered on a production contract or purchase order, to determine that the article meets specifcation requirements. These tests shall be conducted by the procuring activity or contractor at the location or locations as specified in the contract, purchase order or detailed specification. A test report in accordance with 3.5.6 shall be submitted to the procuring activity for approval.

4.3.1 Sampling - Usually, three systems or components shall be made available to accomplish the preproduction tests. Allocation of, and additional or different quantities required shall be as specified in the contract or purchase order.

4.3.2 Scope of Tests - Preproduction tests shall consist of at least the following series of accelerated tests to determine reliability and performance under the various conditions which may be encountered in service usage. The preproduction tests may be allocated among the three test systems or components. A suggested order of tests is as follows:

System or Component	System or Component	System or Component
(a) Individual tests	(a) Individual tests	(a) Individual tests
(b) Power supply variation	(b) High temperature	(b) Acceleration
(c) Dielectric strength	(c) Low temperature	(c) Vibration
(d) Radio interference	(d) Altitude	(d) Shock
(e) Sand and dust	(e) Composite rain-ice	(e) Humidity
(f) Miscellaneous	(f) Salt spray	
(g) Fungus resistance		

Breakdown of tests where additional or a different quantity of systems or components is allocated for preproduction test shall be as specified in the contract or detailed specification.

4.3.3 Contractor Testing - With the consent or request of the contractor and at the discretion of the procuring activity, any service condition tests conducted by the contractor and witnessed by an authorized procurement activity representative prior to submission for preproduction approval maybe acceptable as preproduction tests.

4.3.4 Test Tolerances - In conducting service condition tests, performance tolerances shall be as specified in the system or component specification.

4.3.5 Test Procedures - Appropriate environmental tests shall be conducted on all components which are subject to deterioration or malfunction due to any environmental condition. Environmental testing shall be conducted on system components in accordance with Specification MIL-T-5422 or Specification MIL-E-5272 as required by the equipment detail specification, Modification of test procedures shall be submitted for review and approval by the procuring activity prior to actual usage.

4.3.5.1 Power Supply Variation - Each component shall be tested individually or assembled, or both, into a system in a manner as specified in the component or system specification. Rated electrical, hydraulic and other required power sources, shall be applied and all calibration setting placed at maximum rated positions. After completion of the warm-up period, the power sources shall be varied and modulated, throughout their specified limits. The performance of the components shall be observed in the reamer defined in the component or system specification. No steady state nor transient modulation changes in the power source, within permissable limits, shall cause a variation or modulation in the systems performance which may result in undesirable or unsatisfactory operation. With rated power applied, the systems switches, controls and components shall be operated as in actual service. Observation of the rated power source shall note no variation nor modulation of the power source beyond permissible operational limits when the system is operated against load conditions varying from no load to full load conditions.

4.3.5.2 Dielectric Strength - Each circuit of electrical and electronic components shall be subjected to a test equivalent to the application of a root mean square test voltage of three times the maximum (but not less than 500 v) surge d.c. or maximum surge peak a.c. voltage to which the circuit will be subjected under service conditions. The test voltage shall be of commercial frequency and shall be applied between ungrounded terminals and ground, and between terminals insulated from each other, for a period of 1 minute. Test shall be accomplished at normal ground barometric pressure. No breakdown of insulation of air gap shall occur. Circuits containing capacitors or other similar electronic parts which may be subject to damage by application of above voltages shall be subjected to twice the surge peak (but no less than 100 v) operating voltage for the specified period. If the maximum peak operating voltage is greater than 700 v, the rms value of the test voltage shall be 1050 v greater than 1.5 times the maximum peak operating voltage. Electrical and electronic components shall also be tested for resistance to air gap breakdown at the maximum altitude specified in the altitude test.

4.3.5.3 Radio Interference - The automatic flight control system and components, or both, shall be assembled and arranged in a manner as specified in the system or component specification with interconnecting cables and supporting brackets representative of an actual installation. Provisions shall also be made for inverting all components with respect to the ground plane or positioning in such a manner as to permit measurements from the bottom of all components. Measurement of radiated and conducted interference limits shall be made in accordance with Specification MIL-I-6181 with the system switches, controls and components operated as in actual service. Measured values shall not exceed the limits specified in Specification MIL-I-6181.

4.4 Acceptance Tests - Acceptance tests are all the sampling and individual tests specified herein and in the system, or component specification, exhibit, or other requirements which are to be accomplished on an article or articles submitted for acceptance under contract to determine acceptablility under the requirements of the procurement document. When these tests are appropriate, they will be required by the procurement document or detailed specification. Contractors' records of all inspection work and tests giving the quantitative results of tests required to determine compliance with the requirements and tests specified herein and in the system or component specifications shall be kept complete and shall be available to the procuring activity representative at all times. The record or report of inspection and tests shall be signed or approved by a responsible person specifically assigned by the contractor. Acceptance testing shall be accomplished by the contractor on articles submitted for acceptance under the contract or purchase order. Acceptance or approval of material during the course of manufacture shall in no case be construed as a guaranty of the acceptance of the finished article.

4.4.1 Individual Tests - Each component or system shall be examined to determine conformance to this specification and the system or component specification with respect to material, workmanship, dimensions and markings, in addition to the individual tests specified by the system or component specification in the sequence specified therein.

4.4.2 Sampling Tests - One each component or system shall be selected at random by the procuring activity representative as a representative sample from each 100 systems or components. or fraction thereof delivered on the contract or purchase order and subjected to the sampling tests. When the component or system fails to meet the specified sampling tests, acceptance of all components or systems will be withheld until the extent and cause of failure is determined. Additional components may be selected and tested if required to aid in determination of extent and cause of failure. For operational reasons, individual tests may be continued pending completion of investigation of a sampling test failure, but the final acceptance of components or systems is contingent upon the procuring activity inspector's decision regarding the overall compliance of the product with specification requirements, If investigation indicates that the defect(s) may exist in items previously accepted, full particulars concerning the defect(s) found, including recommendations for correction, shall be furnished to the procuring activity.

4.4.3 Reliability Assurance - Equipment reliability shall be assured by testing production sample lots to specific test requirements. These tests do not replace preproduction tests, production sample tests, individual or special acceptance tests or life tests specified. Specification MIL-R-23094 shall be used as a guide in establishing requirements and procedures to assure compliance with mean-time-between-failures (MTBF) requirements for production avionics equipment. The test level, the duty cycle, the parameters to be measured, the MTBF, and the accept-reject criteria will be specified by the detail equipment specification.

4.5 Life Tests -

4.5.1 Component Life Testing - Components which are subject to wear, fatigue, or other deterioration due to wage, shall be life tested under realistic environmental conditions for a number of cycles representative of the desired life expectancy of the component. In most cases, life test requirements are defined in Government specifications.

4.5.2 A FCS Life Tests - One automatic flight control system or component shall normally be selected at random from those delivered on the purchase order or contract and subjected to the life test. The system shall be assembled and operated for 1,000 hours in the manner described in the system or component specification, provisions shall be made for cyclic loading of parts or components subject to such operation and for intermittent operation of parts or components subject to such operation. Provisions shall likewise be made to subject the system or component to vibration as well as to elevate and reduce temperatures during the course of the test. At the completion of the test no deterioration of performance or of the physical condition of the equipment shall be evident beyond that permitted in the system or component specification, The following test condition schedule shall be adhered to:

Time Period	Condition
First 400 hrs.	At room ambient conditions.
Next 200 hrs.	Subject system to vibration of 0.001-inch amplitude at 10 cps. Reduce ambient temperature to -29 degrees C (20.2 degrees F).
Next 100 hrs.	Subject system to vibration of & 005-inch amplitude at 10 cps, Increase ambient temperature to +60 degrees C (140 degrees F).
Next 206 hrs.	Subject system to vibration of 0.005-inch amplitude at 20 cps. Reduce ambient temperature to -40 degrees C (-40 degrees F). Increase altitude to 30,000 feet.
Next 100 hrs.	Subject system to vibration of 0.005-inch amplitude at 20 cps. Increase ambient temperature to +71 degrees C (159.8 degrees F).

4.6 Flight Tests - The AFCS shall be flight tested in the aircraft for which it was designed, the aircraft shall be suitably instrumented so that time histories of each flight can be recorded The following records are considered essential:

(a) Roll, pitch and yaw attitudes

(b) Roll, pitch and yaw rates

(c) Control surface position

(d) Altitude

(e) Airspeed and/or Mach number

The flight tests shall prove that the equipment will satisfactorily stabilize and/or automatically control the aircraft through its airspeed and altitude range. When the automatic flight control or stabilization system is integrated with other systems such as fire control, automatic navigation, ground controlled bombing, etc., the flight tests shall demonstrate the adequacy of the AFCS in performing its function as part of the integrated system.

4.7 Failures and Retests - Component failing a service condition test shall not be resubmitted for test without furnishing complete information on the corrective action taken subsequent to the failure. This information shall be furnished to the procuring activity or in the test report, depending upon location of testing. Depending upon the nature of the failure encountered and corrective action required and at the option of the procuring activity, the rework or modifications accomplished shall also be incorporated into the other test samples. Where rework or modification may be considered as sufficient to affect performance under the other service condition tests already completed, at the option of the procuring activity, these tests shall be repeated in the specified order.

4.8 Higher Category of Service Application - Components to be used under a particular category of service application, which have previously been subjected to and accepted under the requirements of a lower, or less severe, category of service application, either as an individual component or as a component of the same or a different system shall be subjected to a rerun of those service condition tests which vary with category of service application.

4.9 Instrumentation - During the conductance of dynamic performance test, sufficient instrumentation shall be provided to record all input and output quantities fundamental to the function or basic design concept of the systems or components operation. All instrumentation used shall be accurately calibrated prior to and at the completion of all tests. In addition, ambient conditions, power supplied, voltage and frequency variations shall be noted, or recorded, as the nature of the test may warrant.

4.10 Special Test Equipment - Special test equipment used shall be accurately calibrated. Calibration data or curves shall be included in the test report or shall accompany the test equipment when submitted to the procuring activity for conductance of tests.

4.11 Test Technique - Dynamic performance of systems and components shall be demonstrated by using transient response or frequency response testing techniques, or both.

4.11.1 Physical Characteristics of Transients - Applied transients shall be step or ramp functions in displacement, rate of displacement, or other suitable inputs.

4.11.2 Application of Transients - Where feasible, transients shall be applied physically to inertial sensing elements by actual displacement or rotation of the unit. Electrical inputs, such as command inputs, as well as other types of inputs shall be applied in any convenient manner, such as rotation of a signal generator, switching or use of an electronic integrator.

4.11.3 Variation of Transient Amplitudes and Rates - A sufficient number of displacement transients of different amplitudes as well as rate of displacement transients of different rates shall be applied to the system or component under test to adequately define its dynamics in the region of threshold, linear operation, saturation, and velocity limit.

4.11.4 Variation of Gain - For those systems or components in which loop gains maybe varied, either automatically or manually, the dynamic tests shall be accomplished over a sufficient number of gain settings to adequately define the systems or components dymanics throughout the obtainable range of gain variation.

5. PREPARATION FOR DELIVERY

5.1 Packaging Requirements - In the event of direct purchases by or shipments to the Government, the packaging shall be in accordance with the contract or the approved detailed specification, as applicable. Components shall be delivered complete, tested, and ready for installation. All receptacles, ports, and delicate protruding shafts or parts which may be damaged during handling shall be protected by dust-tight covers, caps, or plugs during shipping, storage, and handling.

6. NOTES

6.1 Intended Use - The requirements of this specification are general as applicable to flight control systems and are based on service experience to date. Deviations to the requirements of this specification may be granted following presentation and approval of substantiating data. This specification is intended for use to incorporate by reference in the equipment detail specification or (when no specification is available) in the equipment contractor order.

6.2 Detail Data for Equipment Specification - Since this specification covers only the general requirements for parts, materials, processes and design, the detail specification for the equipment should specify the actual requirements for that particular equipment from the multiple choices or exceptions which are available in the following items:

(a)	Type of aircraft for which AFCS equipment is to be designed and used,	
(b)	Detail each integration situation requirement,	3.1.1.2.1.1
(c)	Heading selection.	3.1.1.5.2.3
(d)	Stick maneuvering (pitch and roll attitude).	3.1.1.5.5.3
(e)	Control surface oscillations limits.	3.1.1.6.2
(f)	Adequate test requirements,	Section 4
(g)	Preparation for delivery.	5.1

6.3 Additional information on “Microeletronic Modular Assemblies” and “Aircraft Electronic Equipment Maintainability” will be available upon application to the Bureau of Naval Weapons, Washington 25, D. C. Attention: Avionics Division.

INDEX

INDEX

INDEX

INSTRUCTIONS: In a continuing effort to make our standardization documents better, the DoD provides this form for use in submitting comments and suggestions for improvements. All users of military standardization documents are invited to provide suggestions. This form may be detached, folded along the lines indicated, taped along the loose edge *(DO NOT STAPLE)*, and mailed. In block 5, be as specific as possible about particular problem areas such as wording which required interpretation, was too rigid, restrictive, loose, ambiguous, or was incompatible, and give proposed wording changes which would alleviate the problems. Enter in block 6 any remarks not related to a specific paragraph of the document. If block 7 is filled out, an acknowledgement will be mailed to you within 30 days to let you know that your comments were received and are being considered.

NOTE: This form may not be used to request copies of documents, nor to request waivers, deviations, or clarification of specification requirements on current contracts. Comments submitted on this form do not constitute or imply authorization to waive any portion of the referenced document*(s)* or to amend contractual requirements.

(Fold along this line)

(Fold along this line)

DEPARTMENT OF THE NAVY

NO POSTAGE NECESSARY IF MAILED IN THE UNITED STATES

OFFICIAL BUSINESS
PENALTY FOR PRIVATE USE $300

BUSINESS REPLY MAIL
FIRST CLASS PERMIT NO. 12503 WASHINGTON D. C.

POSTAGE WILL BE PAID BY THE DEPARTMENT OF THE NAVY

Commander
Naval Air Systems Command (AIR 51122)
Washington, DC 20361

STANDARDIZATION DOCUMENT IMPROVEMENT PROPOSAL

(See Instructions – Reverse Side)

1. DOCUMENT NUMBER	2. DOCUMENT TITLE

3a. NAME OF SUBMITTING ORGANIZATION	4. TYPE OF ORGANIZATION *(Mark one)*
	☐ VENDOR
b. ADDRESS *(Street, City, State, ZIP Code)*	☐ USER
	☐ MANUFACTURER
	☐ OTHER *(Specify)*: _____

5. PROBLEM AREAS

a. Paragraph Number and Wording:

b. Recommended Wording:

c. Reason/Rationale for Recommendation:

6. REMARKS

7a. NAME OF SUBMITTER *(Last, First, MI)* – Optional	b. WORK TELEPHONE NUMBER *(Include Area Code)* – Optional
c. MAILING ADDRESS *(Street, City, State, ZIP Code)* – Optional	8. DATE OF SUBMISSION *(YYMMDD)*

(TO DETACH THIS FORM, CUT ALONG THIS LINE.)

DD FORM 82 MAR 1426

PREVIOUS EDITION IS OBSOLETE.