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MILITARY SPECIFICATION

GUIDANCE AND CONTROL SYSTEMS, MISSLEBORNE, REMOTE CONTROL (COMMAND) GUIDED MISSILES, GENERAL SPECIFICATION FOR

This specification is mandatory for use by all Department and Agencies of the Department of Defense.

1. SCOPE

1.1 Scope. - This specification covers the general requirements for the design, construction, and testing of missileborne guidance and control systems (GCS) of remote control (command) guided missiles.

2. APPLICABLE DOCUMENTS.

* 2.1 The following documents of the issue in effect on date of invitation for bids or request for proposal, form a part of this specification to the extent specified herein.

SPECIFICATIONS

Military

	MIL-P-116	Preservation, Methods of
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	MIL-E-19600	Electronic Modules, Aircraft, General Requirements for
*	MIL-M-38510	Microcircuits, General Specification for
*		
	MIL-G-46857	Gyroscopes, Remote Control (Command) Guidance Systems, General Specifications for

STANDARDS

Military

	MIL-STD-105	Sampling Procedures and Tables for Inspection by Attributes
	MIL-STD-108	Definitions of and Basic Requirements for Enclosures for Electric and Electronic Equipment
	MIL-STD-129	Marking for Shipment and Storage
	MIL-STD-130	Identification Marking of U.S. Military Property
	MIL-STD-202	Test Methods for Electronic and Electrical Component Parts
	MIL-STD-210	Climatic Extremes for Military Equipment
	MIL-STD-442	Telemetry Standards for Missiles and Aircraft
*	MIL-STD-446	Environmental Requirements for Electronic Parts
	MIL-STD-454	Standard General Requirements for Electronic Equipment
*	MIL-STD-461	Electromagnetic Interference Characteristics Requirements for Equipment
*	MIL-STD-810	Environmental Test Methods
	MIL-STD-831	Test Reports, Preparation of

(Copies of specifications, standards, drawings, and publications required by suppliers in connection with specific procurement functions should be obtained from the procuring activity or as directed by the contracting officer).

3. REQUIREMENTS

* 3.1 Preproduction. - Unless otherwise specified (see 6.2), a preproduction sample of the system equipment to be furnished under the terms of the contract or purchase order, shall meet all the requirements of this specification and shall be delivered to the testing activity designated in the contract or purchase order for preproduction testing.

* 3.2 Detail specification. - The individual system requirements shall be as specified herein and in accordance with the applicable detail specifications. In the event of conflict between this general specification and the detail specification, the latter shall govern.

3.3 Selection of parts and materials. -

* 3.3.1 Standard parts and materials. - Unless otherwise specified in the detail specification, selection of standard parts and materials shall be made in accordance with the applicable general equipment specification. (See Appendix herein.)

3.3.2 Approval of nonstandard parts. - Approval for use of nonstandard parts and materials shall be as specified in MIL-STD-454, Requirement 22.

3.3.3 Elastomeric materials. - Elastomeric components shall be fabricated from materials having maximum practicable ozone and aging resistance consistent with performance requirements and applicable specifications.

3.3.4 Critical and strategic materials. - Materials shall also be selected on the basis of suitability and relative availability, taking into account the additional restrictions created during time of national emergency. Subject to satisfactory operation of the particular equipment, the design shall incorporate the least critical and strategic materials.

* 3.4 Design and construction. - The detailed mechanical and electrical design of the equipment shall meet the requirements of this specification and any specification referenced herein. The requirements in this specification are detailed only to the extent considered necessary to obtain the desired mechanical and electrical characteristics, performance and permanence of the same. The design layout and assembly of the units and their component parts shall be such as to facilitate quantity production and to result in minimum size and weight, balance and moment inertia requirements of the detail specification.

* 3.4.1 Electronic equipment. - Unless otherwise specified in the applicable general equipment specification, electronic equipment shall be designed in accordance with the requirements of MIL-STD-454 as set forth in the Appendix. Requirements not covered by MIL-STD-454 shall be in accordance with the applicable general equipment specification (see 6.2) set forth in the Appendix. Additional requirements are as follows:

* 3.4.1.1 Microcircuits. - Microcircuits shall be chosen in accordance with MIL-M-38510.

3.4.1.2 Telemetry equipment. - When telemetry equipment is used in command guidance systems, the equipment shall meet requirements in accordance with MIL-STD-442 unless otherwise specified by procuring activity. (See 6.2).

* 3.4.1.3 Soldering. - Soldering used in the construction of the guidance and control systems shall be in accordance with the soldering provisions of the applicable general equipment specification. (See 6.2 and Appendix herein).

3.4.2 Electromechanical equipment. - The design of electromechanical equipment shall be in accordance with the detail specification.

3.4.3 Fluidic equipment. - The design and construction of fluidic equipment shall conform to the detail specification.

3.4.4 Compatibility. - The equipment shall be designed to be physically and electrically compatible with the applicable missile and launcher system as defined by the detail specification and correlation drawings.

3.4.4.1 Space limitations. - The maximum envelope dimensions of equipment shall conform to the applicable detail specification.

3.4.4.2 Mounting. - The equipment shall be mounted to the missile airframe as shown in the applicable drawing.

* 3.4.4.3 Weight. - The total weight of the equipment and the weight of each weight-critical subassembly shall be within the limits established by the detailed specification or drawing.

3.4.4.4 Electric power requirements. - Where applicable, the voltage, frequency, real power, and reactive power required by the system from missileborne and external electrical power sources shall be within the limits established by MIL-STD-454, Requirement 25, unless otherwise specified in the detail specification.

3.4.4.5 Hydraulic supply requirements. - Where applicable, the pressures and flow rates required by the system from missileborne and external hydraulic sources shall be within the limits established by the detailed specifications.

3.4.4.6 Pneumatic supply requirements. - Where applicable, the pressures and volume required by the system from missileborne and external pneumatic sources shall be within the limits established by the detailed specification.

3.4.5 Special equipment. - Unless very important advantages are obtained, the use of "special" test equipment (instead of standard existing types) shall not be required for tests or adjustments performed in depots and areas not associated with the launching site. Prior approval shall be obtained from the procuring activity before accomplishing design or construction of special test equipment.

* 3.4.5.1 Special tools. - the design and use of special tools shall be in accordance with Requirement 63 of MIL-STD-454.

3.4.6 Operating temperature of parts. - A part shall not be used in an ambient temperature or at an operating temperature exceeding that for which the part is designed.

3.4.7 Service conditions (electrical). - The detail equipment specification shall specify the power source(s) to be used and the maximum permissible power to be drawn from each.

3.4.8 Service conditions (mechanical). - The equipment shall be so constructed that no fixed part shall become loose, no movable part or control be shifted in setting, position, or adjustment, and no degradation be caused in the performance below that specified in the individual equipment specification for the particular equipment after operation, transportation, or storage under the specified environmental conditions.

3.4.9 Modularization. - To the greatest extent practicable, the equipment design shall incorporate the modularization concept commensurate with the state-of-the-art. The general requirements for the design of modules shall be in accordance with MIL-E-19600.

* 3.4.10 Producibility. - In the design of equipment, the designer shall choose tolerances and fabrication techniques which lend themselves to mass production in order that a minimum of redesign is necessary in the transition from design acceptance to production. The potential quantity involved will be specified by the procuring activity. In addition, the design shall be suitable for manufacture by other comparable contractors without comprehensive production engineering changes.

3.4.11 Simplicity. - The equipment shall represent the simplest design consistent with functional requirements and expected environmental conditions. To the maximum extent possible, it shall be capable of operation, maintenance, and repair by semi-skilled personnel.

* 3.4.12 Maintainability and reliability. - Maintainability and reliability shall be in accordance with Requirement 54 and 35, respectively, of MIL-STD-454, the detail specification or as otherwise specified by the procuring activity.

3.4.13 Watertightness. - Missileborne guidance and control equipment containing operating systems and mechanisms, when assembled, shall have the degree of enclosure specified in the individual missile specification and as defined in MIL-STD-108.

* 3.4.14 Grounding. - Grounding of electrical and electronic equipment shall be in accordance with the applicable requirements of MIL-STD-454, Requirement 1, in addition to the following:

a. When radio interference filters are used in the power input, filters shall contain only capacitors between each side of the line and chassis which are sufficiently low in value to allow less than 5 milliamperes of current to flow to the chassis under the most adverse conditions of maximum power, frequency and maximum voltage permitted by the individual equipment specification. The design of the equipment shall be such that it will operate safely and in accordance with the applicable specifications, with a ground on either side of the power source line. The primary line shall be protected or fused, except that the ground or neutral line shall not be protected or fused.

b. All cables, input power and interconnecting cables to other equipment (with the exception of radio frequency cables), shall be provided with a grounding wire. The grounding wire shall be connected through a terminal in the connector to the chassis or frame and shall be solely for the purpose of providing a ground potential. Power return wires are not to be used as grounding wires.

3.4.15 Life. - Equipment shall be capable of operating reliably for its specified life, without servicing for any combination of environmental conditions set forth herein and in the detail specification. The equipment shall also demonstrate specified performance after undergoing a life test as specified by the procuring activity (see 6.2).

3.4.16 Environment. - The equipment shall be capable of withstanding the following environmental conditions specified for storage, stowage, transit, standby, operational check, and flight.

3.4.16.1 Storage and transit. - Unless otherwise specified (see 6.2), the equipment shall be capable of safe storage and transportation without impairment of its required capabilities from the effects of the climatic extremes specified for Short-term Storage and Transit in MIL-STD-210.

3.4.16.2 Ground operation. - Unless otherwise specified (see 6.2), the equipment shall be capable of meeting specified performance requirements during and after exposure to the following climatic extremes specified for Operation, Ground, World-wide in MIL-STD-210:

a. Thermal - hot/cold

b. Humidity - high/low

c. Precipitation - rain

d. Penetration and abrasion - blowing sand/dust

e. Atmospheric pressure - minimum altitude

3.4.16.3 Airborne operation. - The equipment shall be capable of meeting specified performance requirements during and after exposure to the environmental extremes encountered while mounted in their respective locations within the missile during operational flight. These environmental conditions shall conform to the requirements of the detailed specification.

3.4.16.4 Acceleration, shock, noise and vibration. - The equipment shall be capable of meeting specified performance requirements during and after exposure to the acceleration, shock, noise and vibration conditions which occur in normal handling, transit, launching,

operational check, and flight. The levels of these conditions shall conform to the requirements of the detailed specification.

3.4.16.5 Fungus. - The equipment shall not be affected by the fungus encountered during standby, normal storage, and transit.

3.4.16.6 Salt spray. - The equipment shall be capable of meeting specified performance requirements during and after exposure to salt spray as encountered in standby, normal storage, and transit.

3.4.16.7 Nuclear radiation. - Unless otherwise specified (see 6.2), the equipment shall be capable of meeting required performance after exposure to nuclear radiation as specified in MIL-STD-446 for group IV equipment.

3.4.16.8 Water-recoverable missiles.

3.4.16.8.1 Immersion. - The equipment for water-recoverable missiles shall not be affected by immersion in water as encountered during the recovery phase.

3.4.16.8.2 Salt spray. - The equipment for water-recoverable missiles shall not be affected by exposure to salt spray as encountered during the recovery phase.

3.5 Performance requirements.

* 3.5.1 System performance. - The system shall be capable of performance specified by the detail specification when operating in conjunction with the remote control station and support equipment during the prelaunch phase. The guidance and control detail specification will identify the interface between these equipments via interface control documents, as appropriate. Furthermore, the systems shall be capable of accurately executing the flight maneuvers specified by the detail specification when operating with the remote control station during all flight phases.

3.5.2 Command guidance subsystem performance. - The command guidance subsystem shall be capable of the following:

a. The accurate reception of command intelligence from the remote control station via the command data transmission link

b. The conversion of this received command intelligence to a format compatible with the input requirements of the flight control subsystem utilizing an interface transformation unit or other similar devices compatible with the interface documents.

c. The transmission, if required, of signals back to the remote control station for use in missile tracking or feedback of missile attitude/position/velocity intelligence.

3.5.2.1 Receivers. - The command guidance subsystem shall include a receiver for the reception of command signals from a remote control station via a specified transmission link. The receiver shall have a suitable number of proportional and discrete output channels to satisfy the input channel requirements of the decoder (where applicable, see 3.5.2.2) and the flight control subsystem.

3.5.2.1.1 Warm-up time. - The warm-up time required by the receiver, under any combination of environmental conditions specified herein, shall not exceed the time period specified in the detail specification.

3.5.2.1.2 Sensitivity. - The receiver shall be capable of delivering specified output performance when operating at a minimum input signal level as set forth in the detailed specification.

3.5.2.1.3 Maximum noise output. - The maximum noise level at the receiver output shall not reach a magnitude sufficient to interfere with the accurate processing or transmission of the demodulated information signal(s).

3.5.2.1.4 Noise figure. - The receiver shall be designed so as to achieve a noise figure of minimum value compatible with other system requirements.

* 3.5.2.1.5 Susceptibility. - The receiver shall be designed to minimize susceptibility to interference from other sources in accordance with the requirements of MIL-STD-461.

* 3.5.2.1.6 Spurious radiation. - The receiver shall be designed to minimize the emission of spurious radiation in accordance with the requirements of MIL-STD-461.

3.5.2.1.7 Transmission link. - Characteristics of the transmission link between the remote control station and the receiving equipment shall be as specified in the detail specification.

3.5.2.1.8 Frequency range. - The operating frequency range of the receiving equipment shall be as specified in the detail specification.

3.5.2.1.9 Video/Audio output. - The video/audio output signal(s) shall be sufficient to perform the function(s) specified in the detail specification.

3.5.2.1.10 Video/Audio distortion. - Distortion of the video/audio output signal(s) shall be kept to a minimum compatible with specified system performance.

3.5.2.1.11 Automatic gain control. - Using the video/audio output resulting from a certain range of input signals, modulated at reference conditions, the video/audio output shall not differ from the reference level by more than a specified number of decibels (db) in specified ranges of voltage. There shall be no overloading or blocking.

3.5.2.1.12 Radar and radio command receivers. - The requirements of 3.5.2.1.12 shall apply only to radar and radio command receivers.

3.5.2.1.12.1 Carrier frequency. - The receiver shall be designed to operate at the specified carrier frequency(ies). If multiple frequency channels are required, the appropriate coding for channel selection shall be as specified in the detail specification.

3.5.2.1.12.2 Frequency stability. - The design of the receiving equipment shall be such that the center frequency drift will be within specified limits and under any service conditions shall not impair the operating performance.

3.5.2.1.12.3 Spurious response. - Modern techniques shall be utilized to reduce images and spurious responses outside of the required bandwidth.

3.5.2.1.12.4 Radio frequency (RF) input impedance. - The receiver input circuits at the operating frequency shall not produce a voltage standing wave ratio greater than that specified in the detail specification.

3.5.2.1.12.5 Tuning. - In the case where tuning shall be changed by command, the time required for such changes in tuning shall be kept at a minimum compatible with system operation.

3.5.2.1.12.6 Selectivity. - The intermediate frequency (IF) section of the receiver shall have a 6 db bandwidth of no less than a specified value and 60 db bandwidth of not more than a specified value.

3.5.2.1.12.7 IF gain. - The IF amplification shall be sufficient to assure signal detection.

3.5.2.2 Decoders. - If the command signals are in a coded format, then the command guidance subsystem shall have a decoder to convert these coded command signals from the output of the receiver into a format usable by the flight control subsystem. The decoder design shall be compatible with both the receiver and the flight control subsystem and shall be in accordance with the detail specification.

3.5.2.2.1 Inputs. - The decoder inputs shall be either pulse trains, coded pulses, individual tones or bursts of tones as established in the detailed specification. They shall be of magnitude and form such that accurate derivation of commands is achieved.

3.5.2.2.2 Audio channels and relays. - For systems in which audio tones are used for relay actuation, the magnitude of these tones shall be sufficient to assure reliable relay operation.

3.5.2.2.3 Resettability. - The electrical and mechanical characteristics of the decoder shall be such that substantially the same power output is obtained each time any particular channel is selected. Any change or recycling shall not cause the power output from the decoder to deviate by more than a specified percent from that obtained originally.

3.5.2.3 Transmitters. - When specified (see 6.2), the command guidance subsystem shall use transmitters for the purpose of providing a signal source for use by the remote control station in missile tracking (beacon transmitter) or for the transmission of missile attitude/position/condition intelligence to the remote control station for guidance and control purposes (monitor transmitter).

3.5.2.3.1 Beacon transmitters. - Beacon transmitters used in the command guidance subsystem shall be capable of modulation by a signal specified by the detail specification for purposes of missile identification.

3.5.2.3.2 Monitor transmitters. - Monitor transmitters used in the command guidance subsystem shall be capable of modulation by measurement units that monitor signals from one or more missile attitude/position/condition test points as specified in the detail specification. This information may by multiplexed or coded as specified in the detail specification. Furthermore, the impedance levels of these measurement units shall not impair the performance of the guidance and control system.

* 3.5.2.3.3 Continuous wave transmitter. - When a continuous wave transmitter is employed in the system to carry out the functions for either a beacon or monitor transmitter, the requirements of 3.5.2.3.3.1 through 3.5.2.3.3.6 shall apply.

3.5.2.3.3.1 Frequency range. - The transmitter shall be capable of operating in a frequency range specified in the detail specification.

3.5.2.3.3.2 Frequency stability. - The radio frequency (RF) carrier shall be stable to within a specified percent of the assigned frequency under any combination of environmental conditions as specified herein.

3.5.2.3.3.3 Frequency modulation (FM) sensitivity. - The modulation sensitivity shall be no greater than a specified root-mean-square voltage for a specified frequency deviation.

3.5.2.3.3.4 Frequency modulation linearity. - The deviation shall not vary more than a specified frequency from the predicted value as the amplitude of the modulating signal is increased from zero to the value required to produce a specified frequency deviation.

3.5.2.3.3.5 Modulation frequency response. - The modulation frequency shall be flat within plus or minus a specified number of decibels as the modulating signal frequency is varied over a specified range of frequencies.

3.5.2.3.3.6 Output power. - The requirements of the minimum output power shall be in accordance with those specified in the detail specification.

* 3.5.2.3.4 Pulse transmitter. - When a pulse transmitter is employed in the system to carry out the functions of either a beacon or monitor transmitter, the requirements of 3.5.2.3.4.1 through 3.5.2.3.4.7 shall apply.

3.5.2.3.4.1 Transmitter power tube conditions. - The transmitter power tube shall be either a mechanically tunable magnetron or other power tube approved by the procuring activity. The power tube shall be capable of operation throughout the specified frequency range and with the following parameters specified in the detail specification: Pulse length, pulse shape, average power and peak power.

3.5.2.3.4.2 RF output pulse shape. - The envelope of the RF output pulse shall have a specified width measured at the one-half power points. The pulse rise and fall times (0 to 90 percent) shall be less than a specified percent of the pulse width at the one-half power points.

3.5.2.3.4.3 RF frequency stability. - The construction of the transmitting equipment shall be such that the center frequency drift will be within certain limits from the selected frequency and under any service conditions shall not impair the operating performance (i.e. distortion, phase and linearity).

3.5.2.3.4.4 Pulse transformer. - If a magnetron is used, it shall be driven by a pulse transformer designed as a companion piece to the magnetron. The pulse transformer shall be capable of delivering the necessary voltage to the magnetron.

3.5.2.3.4.5 Radar modulator repetition rate. - The radar modulator shall be capable of being triggered by a synchronizing pulse from the radar receiver at a specified rate.

3.5.2.3.4.6 Pulse stability. - The jitter between the trigger pulse and modulator output pulse shall not exceed a specified time (usually given in microseconds).

3.5.2.3.4.7 Voltage standing wave ratio (VSWR). - The voltage standing wave ratio looking into the sum channel of the antenna shall be less than a prescribed value over the entire frequency band specified in the detail specification. The overall VSWR looking into the radar transmission line at the magnetron output flange shall not exceed a specified value over the same frequency range.

* 3.5.2.3.5 Spurious radiation. - The transmitting equipment shall be designed to minimize the emission of spurious radiation in accordance with the requirements of MIL-STD-461.

3.5.3 Alternate missileborne guidance subsystems. - Unless otherwise specified (see 6.2), the use of alternate missileborne guidance subsystems shall not be required. If one is required, the command intelligence generated by such systems shall be compatible with the input requirements of the flight control subsystem.

3.5.4 Flight control subsystem performance. - The flight control subsystem shall be capable of converting command intelligence from the guidance subsystems into appropriate control device operations for executing the flight maneuvers specified in the detail specification.

3.5.4.1 Compatibility with missile airframe and control devices. - The flight control subsystem shall be capable of executing specified flight maneuvers over the entire range of mission requirements utilizing only the missile control devices specified in the detail specification. The execution of these maneuvers by the flight control subsystem shall not exceed any structural limit of the missile airframe nor exceed the missile's aerodynamic capability. Mission requirements shall include, but not be limited to, the following:

a. Missile operating altitude

b. Missile airspeed

c. Missile flight time

3.5.4.2 Stability. - The flight control subsystem shall be capable of maneuvering the missile onto a directed change in flight path such that the transient conditions resulting from this maneuver will decay as rapidly as possible. Furthermore, the flight control subsystem shall be capable of maintaining the missile on a directed flight path to the greatest degree practicable while it is subjected to external disturbances.

3.5.4.3 Accuracy. - The flight control subsystem shall be designed and constructed such that it is capable of maneuvering the missile to follow a directed flight path or to intercept a terminal target within the limits specified.

3.5.4.4 Adaptive flight control subsystems. - When conventional linear control techniques fail to meet the flight control subsystem requirements specified herein over the ranges of mission requirements specified in 3.5.4.1, adaptive techniques may be employed. These techniques may include changing processing unit parameters or mode switching as a function of missile altitude, airspeed, or other parameters. Such adaptive flight control subsystems shall be in accordance with the detail specification.

3.5.4.5 Nonlinear subsystems and equipment. - When the flight control subsystem utilizes nonlinear techniques and equipment in its design for the purposes of performance improvement over a wider range of control conditions, such nonlinear designs shall be approved by the procuring activity.

3.5.4.6 Processing units. - The flight control subsystem shall have processing units which will correctly operate the missile's control device actuators to execute specified maneuvers in accordance with related input signals. These input signals will consist of command signals from the missileborne guidance subsystem and feedback signals relating to the missile's attitude, position, and condition from missileborne sensors. These processing units shall be compatible with related processing units and with other missileborne equipment. Their

characteristics may be modified or selected by preprogramming units or other processing units to make the flight control system adaptive to changing missile conditions. Processing unit characteristics shall conform to the requirements of the detailed specification.

3.5.4.7 Missileborne sensors. - Missileborne sensors shall be used in the flight control subsystem to provide feedback signals of missile attitude, position, or condition to processing units. When accessory units are incorporated with or external to these sensors in order to support the sensors' operation or to provide for the performance specified herein, such units shall be approved by the procuring activity.

3.5.4.7.1 Accelerometers. - When the flight control subsystem employs accelerometers as missileborne sensors to measure or indicate translational accelerations, translational velocities, or angular accelerations, these accelerometers shall consider the design values and tolerances of related parameters established in the detailed specification. These parameters shall include but not be limited to the following:

a. Input range

b. Sensor gain

c. Natural frequency

d. Damping ratio

e. Composite error

3.5.4.7.2 Airspeed sensors. - When the flight control subsystem employs airspeed sensors to measure indicated or true missile airspeed, these sensors shall comply with the design values and tolerances of the related parameters established in the detailed specification. These parameters shall include but not be limited to the following:

a. Input range

b. Sensor gain

c. Characteristic time

d. Accuracy

e. Drift rate

3.5.4.7.3 Altitude Sensors. - When the flight control subsystem employs altitude sensors for measuring indicated or true missile altitude, these sensors shall comply with the design values and tolerances of the related parameters established in the detailed specification. These parameters shall include but not be limited to the following:

a. Input range

b. Sensor gain

c. Characteristic time

d. Accuracy

e. Drift rate

* 3.5.4.7.4 Gyroscopes. - When the flight control subsystem employs free, rate, vertical, directional, or rate integrating gyroscopes for measuring angular displacements or angular rates of the missile airframe or of any servo stabilized equipment, these gyroscopes shall comply with requirements of MIL-G-46857 deemed applicable by the procuring activity. Further compliance is required with regard to the design values and tolerances of the applicable parameters listed in Table I and established in the detailed specification.

3.5.4.7.5 Platforms. - When the flight control subsystem employs stabilized platforms for measuring angular displacements of the missile airframe or to provide a stable reference plane for any guidance and control equipment, the characteristics of such platforms shall conform to the requirements of the detail specification.

TABLE I - A

GYRO PARAMETERS FOR PLATFORM MOUNTED - SHORT TIME, SEVERE ENVIRONMENT APPLICATIONS /1

Parameter / Gyro Type	Input Ranges	Sensor Gain	Switch Operating Point	Natural Frequency	Damping Ratio	Characteristic Time	Vehicle Induced Acceleration Effects	Slaving Rate	Composite Error	Drift Rate	Random Drift Rate	Acceleration-Sensitive Drift Rate	Acceleration-Insensitive Drift Rate	Slaving Error
Directional Gyro /2														
Free Gyro	X	X								N	X	S	S	
Rate Gyro /2														
Rate Integrating Gyro	X	X			X	X					X	S	S	
Vertical Gyro /2														

NOTES:

N - Parameter specified when no torquer is used; S - Parameter stability specified in addition to its absolute value; X - Parameter specified

/1 - Defined as gyros mounted in a servo-stabilized, external gimbal system used in high performance missile flight environments, i.e., times generally less than 15 minutes and accelerations greater than 3 g's.

/2 - Generally not applicable.

TABLE I - B

GYRO PARAMETERS FOR PLATFORM MOUNTED - LONG TIME, MILD ENVIRONMENT APPLICATIONS /1

Parameter / Gyro Type	Input Ranges	Sensor Gain	Switch Operating Point	Natural Frequency	Damping Ratio	Characteristic Time	Vehicle Induced Acceleration Effects	Slaving Rate	Composite Error	Drift Rate	Random Drift Rate	Acceleration-Sensitive Drift Rate	Acceleration-Insensitive Drift Rate	Slaving Error
Directional Gyro /2														
Free Gyro	X	X							X	N	X	S	S	
Rate Gyro /2														
Rate Integrating Gyro	X	X			X	X			X		X	S	S	
Vertical Gyro /2														

NOTES:

N - Parameter specified when no torquer is used; S - Parameter stability specified in addition to its absolute value; X - Parameter specified

/1 - Defined as gyros mounted in a servo-stabilized, external gimbal system used in cruising missile flight environments, i.e., times generally longer than 15 minutes and accelerations greater than 3 g's.

/2 - Generally not applicable.

TABLE I - C

GYRO PARAMETERS FOR BODY MOUNTED - SHORT TIME, SEVERE ENVIRONMENT APPLICATIONS /1

Parameter / Gyro Type	Input Ranges	Sensor Gain	Switch Operating Point/2	Natural Frequency	Damping Ratio	Characteristic Time	Vehicle Induced Acceleration Effects	Slaving Rate	Composite Error	Drift Rate	Random Drift Rate	Acceleration-Sensitive Drift Rate	Acceleration-Insensitive Drift Rate	Slaving Error
Directional Gyro	X	X					X	X				X		X
Free Gyro	X	X	X						X			S	S	
Rate Gyro	X	X	X	X	X				X					
Rate Integrating Gyro	X	T			X	X			X			S	S	
Vertical Gyro	X	X					X	X				X		X

NOTES:

S - Parameter stability specified in addition to its absolute value; T - Where applicable, torquer linearity also specified; X - Parameter specified

/1 - Defined as gyros affixed to missile airframe during high performance flight environments, i.e., times generally less than 15 minutes and accelerations greater than 3 g's.

/2 - Parameter applicable for gyro switches only.

TABLE I - D

GYRO PARAMETERS FOR BODY MOUNTED - LONG TIME, MILD ENVIRONMENT APPLICATIONS /1

Parameter / Gyro Type	Input Ranges	Sensor Gain	Switch Operating Point/2	Natural Frequency	Damping Ratio	Characteristic Time	Vehicle Induced Acceleration Effects	Slaving Rate	Composite Error	Drift Rate	Random Drift Rate	Acceleration-Sensitive Drift Rate	Acceleration-Insensitive Drift Rate	Slaving Error
Directional Gyro	X	X					X	X				X		X
Free Gyro	X	T							X	N	X	S	S	
Rate Gyro	X	X		X	X				X					
Rate Integrating Gyro	X	T							X		X	S	S	
Vertical Gyro	X	X					X	X				X		X

NOTES:

N - Parameter specified when no torquer is used; S - Parameter Stability specified in addition to its absolute value; T - Where applicable, torquer linearity also specified; X - Parameter specified

/1 - Defined as gyros affixed to missile airframe during high performance flight environments, i.e., times generally greater than 15 minutes and accelerations less than 3 g's.

/2 - Parameter applicable for gyro switches only.

3.5.4.8 Pre-programming units. - When the flight control subsystem employs pre-programming units to provide sequential, programmed control over the missile's operation or flight path, these units shall accomplish this in one or more of the following ways:

a. Generating command signals

b. Modifying command signals

c. Mode selection of processing units

d. Modifying processing unit characteristics.

The characteristics of pre-programming units shall conform to the requirements of the detailed specification.

3.5.4.9 Actuators. - The flight control subsystem shall have actuators which, when functioning in conjunction with suitable linkages, shall be capable of correctly operating the missile's control devices in response to signals from the flight control subsystem processing units. When accessory units are employed to aid in the operation of the actuators, the actuator input and any actuator feedback output must be compatible with the processing units. The actuator output may be either rotary or translational depending on which method is best suited to operate the control devices in conjunction with suitable linkages. Furthermore, the actuator output shall meet specified requirements for limits of travel and available output force or torque so as to adequately operate control devices during the execution of specified maneuvers. Actuators, linkages, and actuator accessory units, when required, shall be approved by the procuring activity.

3.5.4.9.1 Electric Actuators. - When the flight control subsystem employs electric actuators to operate missile control devices, they shall not exceed the electrical power limitations established in the detailed specification for actuator operation. Furthermore, the actuator response shall comply with the design values and tolerances of the related parameters established in the detailed specification. These parameters shall include but not be limited to the following:

a. Actuator gain

b. Characteristic time

3.5.4.9.2 Pneumatic and hydraulic actuators. - When the flight control subsystem employs pneumatic or hydraulic actuators to operate missile control devices, they shall not exceed the pneumatic or hydraulic source limitations established in the detailed specification for actuator operation. Furthermore, the actuator response shall comply with the design values and tolerances of the related parameters established in the

detailed specification. These parameters shall include but not be limited to the following:

a. Actuator gain

b. Characteristic time

c. Time delay

3.6 Interchangeability. - Unless otherwise specified by the procuring activity (see 6.2), the interchangeability of the missileborne guidance and control system, its subsystems, and components shall be in accordance with MIL-STD-454, Requirement 7.

* 3.7 Marking. - Identification of product shall be in accordance with Requirement 67 of MIL-STD-454, MIL-STD-130 and the detail specification.

3.7.1 Marking requirements to prevent damage. - Equipment which may be damaged by operation in excess of the duty cycle shall be so marked.

3.8 Workmanship. - Workmanship shall be in accordance with MIL-STD-454, Requirement 9, for electronic equipment and in accordance with the detail specification for mechanical equipment.

4. QUALITY ASSURANCE PROVISIONS.

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

4.2 Classification of tests. - The inspection and testing of the system equipment shall be classified as follows:

a. Preproduction tests..... (see 4.4)

b. Acceptance tests ..... (see 4.5)

4.3 Test conditions. - Unless otherwise specified by the procuring activity (see 6.2), the following general test conditions shall apply to all tests of this specification.

* 4.3.1 Standard atmospheric conditions. - Whenever the pressure and temperature of the system equipment existing at the time of the test are not specified, it is understood that the test will be made at atmospheric pressure (approximately 28.5 + 2.0 or - 4.5 inches Hg) and at room temperature (approximately 23 ± 10 degrees C.). When tests are made with the pressure or temperature differing materially from the above values, proper allowance shall be made for the difference from the specified conditions.

* 4.3.2 Test equipment accuracy. - Accuracy of the test equipment selected to measure the specified equipment performance requirements shall be based on the applicable National Bureau of Standards and equipment design limits. The test equipment shall be selected for technical compatibility with the equipment during test to assure specified accuracy of test readout.

4.3.3 Electric power input conditions. - The system equipment shall be tested with the nominal excitation voltages, at the nominal frequencies, applied at the appropriate inputs.

4.3.4 Output load impedance. - All system equipment under test shall have connected to each output an electrical load simulating the input impedance and loading effect of the equipment to be connected to these outputs during service. When practicable, the actual equipment may be used.

4.4 Preproduction tests. - Unless otherwise specified (see 6.2), all major units of the missileborne guidance and control system shall be subjected to preproduction tests as set forth herein. The preproduction tests shall consist off all tests specified in 4.6.

* 4.4.1 Preproduction test samples. - The preproduction test samples shall consist of one or more units manufactured and assembled using the same methods and procedures proposed for the production. The number of preproduction test samples submitted shall be specified in the contract or purchase order (see 6.2). Approval of the preproduction sample by the procuring activity shall be based upon satisfactory completion of all tests. Further production of the equipment by the contractor, prior to the approval of the preproduction sample, shall be at the risk of the contractor.

4.4.2 Preproduction test report. - When preproduction tests are conducted at a location other than the laboratory of the procuring activity, the following shall be furnished to that activity upon completion of the tests:

a. Test report - three copies of a test report prepared in accordance with MIL-STD-831.

b. The samples which were tested

c. Two sets of assembly drawings

d. Brief operating instructions

* 4.5 Acceptance tests. - All major units of the missileborne guidance and control system shall be subjected to the following tests as described in 4.6:

a. Mechanical inspection tests .....(see 4.6.1)

b. Electrical tests.....(see 4.6.2)

c. Performance tests.....(see 4.6.3)

4.5.1 Sampling for acceptance tests. - Lot size, sampling schedules, and rejection limits for acceptance testing shall be in accordance with MIL-STD-105 as specified in the detail specification.

4.6 Test methods.

* 4.6.1 Mechanical inspection tests. - All units of the missileborne guidance and control system shall be given a thorough mechanical and visual inspection and test to determine that the quality of all materials and workmanship is in compliance with the requirements of this specification. (see Table II.)

* 4.6.2 Electrical tests. - Units of the missileborne guidance and control system shall be given all electrical tests necessary to confirm that all circuits are inherently sound and in compliance with the requirements of this specification. The electrical tests shall include, but not necessarily be limited to those listed in 4.6.2.1 and 4.6.2.2.

* 4.6.2.1 Continuity. - Each electrical component and each wire and cable shall be given a continuity test to ascertain if it is wired and connected correctly and that good electrical contact is obtained.

4.6.2.2 Operating voltages. - The operating voltage at all important points shall be checked for conformance to those shown on the circuit label and schematic drawing. This shall be done with all controls set for normal equipment operation.

4.6.3 Performance tests. - The units of the guidance and control system shall be given all performance tests necessary to confirm that the equipment meets the performance requirements specified herein and in the applicable detail specifications.

4.7 Environmental tests. - Unless otherwise specified but the procuring activity (see 6.2), environmental tests of the system shall be performed in accordance with the test methods of MIL-STD-810 and other applicable standards listed in Table III. The tests shall be performed with all equipment properly interconnected. The parameters to be checked, the methods of parameter measurement, and the test schedule shall conform to the requirements of the detail specification.

4.8 Flight tests. - When specified (see 6.2), flight performance tests of the system shall be performed with the equipment properly interconnected and mounted within the missile. The conditions of the tests, the schedule of missile maneuver, and the methods of parameter measurement shall conform to the requirements of the detail specification.

TABLE II

MECHANICAL INSPECTION TESTS

TEST	REQUIREMENT PARAGRAPHS
1. Completeness and workmanship	3.8
2. Nameplates, identification markings, and labels	3.7, 3.7.1
3. Safety features and interlocks	3.4.1
4. Ease of operation of gears, adjustable and sliding parts, thumb screws, controls, switches, and other moving parts	3.4.1, 3.4.2
5. Structural welds	3.4.1
*6. Soldering	3.4.1, 3.4.1.3
7. Corrosion prevention	3.4.1
8. Fasteners	3.4.1
9. Electrical connectors	3.4.1
10 Electrical overload protection	3.4.1
11. Component accessability	3.4.12
12. Grounding	3.4.14
13. Interchangeability	3.6
14. Dimensions	3.4.4.1
15. Mounting	3.4.4.2
16. Weight	3.4.4.3

TABLE III

ENVIRONMENT TEST METHODS

TEST	MIL-STD-810 TEST METHOD	PROCEDURE
Acceleration	513	I, II
Acoustical Noise	515	I
Fungus	508	I
High Temperature	501	I
Humidity (Cycling)	507	I
Immersion /1, /4	---	---
*Altitude	500	II
Low Temperature	502	I
Nuclear Radiation /1, /5	---	---
Salt Fog /1, /2	509	I
* Dust	510	I
Shock	516	I, III, IV
Temperature Shock /1	503	I
Temperature-Altitude Cycling /3	504	I
Vibration	514	I
Explosive Atmosphere	511	I

NOTE:

/1 - Where applicable
/2 - Test not generally applicable to airborne or ground launched missiles
/3 - Test not generally applicable to ground launched missiles
/4 - Method 104A of MIL-STD-202 shall be used
/5 - The applicable test methods of MIL-STD-446 shall be used.

5. PREPARATION FOR DELIVERY

5.1 Preservation and packaging. - Unless otherwise specified by the procuring activity (see 6.2), preservation and packaging shall be in accordance with MIL-P-116.

5.2 Marking. - Marking of the system and its components for shipment shall be in accordance with MIL-STD-129, as applicable, and as specified in the detail specification.

6. NOTES.

6.1 Intended use. - Guidance and control systems of the type specified herein are intended for use as major sections of remote control (command) guided missiles. These systems are designed to receive and decode guidance signals form a remote control station, and to utilize these signals in controlling the flight of a missile.

6.2 Ordering data. - Procurement documents should specify the following:

a. Title, number, and date of this specification

b. When preproduction tests are not required (see 3.1 and 4.4)

* c. Which general equipment specification should be implemented (see 3.4.1)

d. Number of preproduction samples required (see 4.4.1)

e. Special requirements for telemetry equipment (see 3.4.1.2)

f. Conditions and procudeures for life testing (see 3.4.15)

g. Deviations in specified environmental conditions for storage and transit (see 3.4.16.1)

h. Alternatives to non-applicable ground operation requirements (see 3.4.16.2)

i. Alternative requirements for nuclear radiation resistance (see 3.4.16.7)

j. When transmitter is required (see 3.5.2.3)

k. When alternate missileborne guidance subsystem is required (see 3.5.3)

l. Special requirements for interchangeability (see 3.6)

m. Whether the testing will be conducted by the procuring activity or by the contractor (see 4.1)

n. Deviations from specified test conditions (see 4.3)

o. Deviations from specified environmental testing procedures (see 4.7)

p. When flight tests are required (see 4.8)

q. Applicable level of preservation, packaging and packing required

6.3 Definitions.

6.3.1 Acceleration-insensitive drift rate. - The acceleration-insensitive drift rate of a gyroscope consists of those components of systematic drift rate that have no correlation with acceleration.

* 6.3.2 Acceleration-sensitive drift rate. - The accleration-sensitive drift rate of gyroscope consists of those components of systematic drift rate that are correlated with translational acceleration applied to the gyro case.

6.3.3 Accessory unit. - A part, subassembly or assembly designed for use in conjunction with or to supplement another assembly, or a unit or set, contributing to the effectiveness thereof without extending or varying the basic function of the assembly or set. An accessory unit may be used for testing, adjusting or calibrating purposes.

6.3.4 Accuracy. - Accuracy for a missileborne sensor defines the range about the actual value of an input parameter which the output of the sensor is likely to indicate.

6.3.5 Actuator gain. - Actuator gain is the ratio of the output force or torque of the actuator to the level of the corresponding control signal.

* 6.3.6 Characteristic time. - Characteristic time is the time required for the output of a device to reach 63.2 percent of its final steady state value in response to a step input.

6.3.7 Command guidance equipment types. - The command guidance systems and equipment covered by this specification can be classified in terms of the applicable transmission link (see 6.3.29), under the following types:

a. Radar Command - Command guidance equipment utilizing radar sets for the reception of incoming command signals and for the transimssion of any corresponding reply.

b. Radio Command - Command guidance equipment utilizing a radio receiver for the reception of incoming command signals.

c. Wire Command - Command guidance equipment used for the reception of command signals transmitted through wires connecting the missile with a remote control station.

d. Infrared Command - Command guidance equipment used in systems wherin infrared rays are employed as the carrier for the transmission of command signals.

6.3.8 Composite error. - Composite error is the maximum deviation of the output data of a missileborne sensor from the least squares regression line of the output characteristics.

6.3.9 Control device. - The control device of a missile is any device which afffects the flight path of a misile either aerodynamically (with ailerons, rudders, elevators, canards, etc.) or by thrust vector means (with jetavators, gimbaled engines, secondary injection, etc.).

6.3.10 Damping ratio. - Damping ratio is the ratio of actual damping to critical damping.

6.3.11 Drift rate. - Drift rate is the time rate of deviation of the steady state value of output of a missileborne sensor for a constant input.

6.3.12 Equipment. - Equipment refers to one or more units capable of performing a specified function.

6.3.13 Frequency stability. - The control of the variation in the center frequency so that it differs from that of a reference source by not more than a prescribed amount.

6.3.14 Interference. - Interference is defined as any electrical or electromagnetic distrubance, phenomenon, signal or emission, man-made or natural, which causes or can cause undesired response, malfucntioning or degradation of performance of elelctrical and electroinic equipment, or prematrue and undesired location, detection or discovery by enemy forces. This definition is meant to exclude deliberately generated interfeence (jamming interference/ electronic countermeasures).

6.3.15 Input range. - Input range is the absolute value of the difference between zero input and the extreme measureable input for a missileborne sensor.

6.3.16 Modulation linearity. - The manner in which the devation varies as the amplitude of the modulating voltage changes.

6.3.17 Natural frequency. - Natural frequency is that frequency at which the output of a missileborne sensor lags the input by ninety degrees.

6.3.18 Random drift rate. - Random drift rate is the non-systematic, time varying component of drift rate for gyroscopes.

6.3.19 Remote control station. - The remote control station is the ground or aircraft based station which determines and transmits command signals to remote controlled guided missiles for directing their operation and flight.

6.3.20 Selectivity. - Selectivity is the degree to which the receiver is capable of differentiating between the desired signal and signals of other carrier frequencies.

6.3.21 Sensor gain. - The sensor gain for a missileborne sensor is the ratio of the output of the sensor with its accessory units (if any) to the corresponding input.

6.3.22 Sensitivity. - Sensitivity is that a characteristic which determines the minimum signal strength to which the receiver will respond.

* 6.3.22.1 Gyro sensitivity. - Gyro sensitivity is the ratio of a change of output to a change in an undesirable or secondary input. For example, the drift rate temperature sensitivity of a gyro is the ratio of the change in drift rate to a change in temperature.

6.3.23 Slaving error. - The slaving error for a gyroscope is the deviation of its spin axis from the desired spin axis orientation when slaved to this orientation.

6.3.24 Slaving rate. - The slaving rate of a gyroscope is the angular rate that the spin axis can be precessed to a reference psition, i.e., slaved.

6.3.25 Spurious response. - Specified the minimum ratio of (1) the field strength at the image frequency to (2) the field strength at the desired frequency, each field being applied in turn, under specified conditions, to produce equal outputs.

6.3.26 Susceptibility. - Susceptibility is defined as that characteristic which causes an equipment to malfunction or exhibit an undesirable response when its case or any external lead or circuit, excepting antennas, is subjected to a specified radio or audio frequency voltage or field.

6.3.27 Switch operating point. - The switch operating point of a gyroscope is the angular deviation from a reference or the angular rate at which a gyro switch will produce a discrete output.

6.3.28 Time delay. - The time delay for hydraulic and pneumatic actuators is the time interval between the time the control signal is received by the actuator and the time the actuator responds to that signal.

6.3.29 Transmission link. - The transmission link over which the remote control station and the guidance system transmits data defines the method in which such data

is conveyed. The following transmission links are used with remote controlled guided missiles:

a. Radar

b. Radio

c. Wire

d. Infrared

6.3.30 Vehicle induce acceleration effects. - Vehicle induced acceleration effects are the radial and translational accelerations resulting from the flight maneuvers of the missile which affect the gravity reference system of a gyroscope.

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

Custodians:
Army - MI
Navy - AS
Air Force - 19

Review Activities:
Air Force - 70

User Activities:
Navy - MC, OS
Air Force - 15

Preparing Activity:
Army - MI

Project Number:
1420-0058

APPENDIX

10. SCOPE

10.1 Scope of Appendix. - The scope of this Appendix is to list requirements for electronic equipment used in command guidance and control systems through reference rather than by inclusion in the specification.

20. APPLICABLE DOCUMENTS

20.1 List of applicable documents. - The following documents of the issue in effect on the date of invitations for bids or request for proposal, form a part of this document to the extent specified herein.

SPECIFICATIONS

Military

	MIL-E-5400	Electronic Equipment, Aircraft, General Specification for
*	MIL-E-8189	Electronic Equipment, Missiles, Boosters and Allied vehicles, General Specification for
*	MIL-P-11268	Part, Materials, and Processes used in Electronic Equipment
	MIL-E-11991	Electronic Electrical and Electro-Mechanical Equipment, Guided Missile Weapons Systems, General Specification for
	MIL-E-16400	Electronic Equipment, Naval Ship and Shore: General Specification
	MIL-T-17296	Test, Checkout and Evaluation Equipment, Guided Missiles (Fixed Installations): General Specification
	MIL-F-18870	Fire Control Equipment, Naval Ship and Shore: General Specification
*	MIL-T-21200	Test Equipment for use with Electronic and Electrical Equipment, General Specification for

30. REQUIREMENTS.

* 30.1 Standard general requirements. - Electronic equipment shall conform to the requirements of MIL-STD-454 and any additional requirements imposed by the applicable general equipment specification. See listing in Table I of this Appendix.

* 30.2 Equipment specification requirements. - Requirements not covered by MIL-STD-454 shall conform to the requirements of the applicable general military specifications as listed in Table II of this Appendix, unless specified otherwise by the procuring activity.

TABLE I

STANDARD REQUIREMENTS

SPECIFICATION REQUIREMENTS	REQUIREMENT OF MIL-STD-454
Safety (personnel hazard)	1
*Capacitors	2
Flammable Materials	3
Fungus - Inert Materials	4
Soldering	5
Bearings	6
Interchangeability	7
Electrical Overload Protection	8
Workmanship	9
Electrical Connectors	10
Insulating Materials, Electrical	11
Fastener Hardware	12
Structural Welding	13
Transformers, Inductors and Coils	14
Ferrous Alloys, Corrosion Resistance	15
Dissimilar Metals	16
Printed Wiring	17
Derating of Electronic Parts and Materials	18

TABLE I

STANDARD REQUIREMENTS

SPECIFICATION REQUIREMENTS	REQUIREMENT OF MIL-STD-454
Terminals (Terminals, Boards and Strips)	19
*Hookup Wire, Internal	20
Castings	21
Approval of Nonstandard Parts	22
Adhesives	23
Welds, Resistance, Electrical Interconnections	24
Electrical Power Source	25
Arc-Resistant Materials	26
Batteries	27
Controls	28
Electron Tubes	29
Semiconductor Devices	30
Moisture Pockets	31
*Test Provisions	32
Resistors	33
Nomenclature (Item Name and Type Designation)	34
Reliability	35
Accessibility	36

TABLE I

STANDARD REQUIREMENTS

SPECIFICATION REQUIREMENTS	REQUIREMENT OF MIL-STD-454
Circuit Breakers	37
Quartz Crystal Units	38
Fuses and Fuse Holders	39
Shunts	40
Springs	41
Tuning Dial Mechanisms	42
*Lubricants	43
Fibrous Material, Organic	44
*Corona and Electrical Breakdown Prevention	45
Motors, Dynamotors, Rotary Power Converters and Motor -Generators	46
*Encapsulation and Embedment (Potting)	47
Gears and Cams	48
Hydraulics	49
Indicator Lights	50
*Meters, Electrical Indicating and Accessories	51
Thermal Design	52
Waveguides and Related Equipment.	53

TABLE I

STANDARD REQUIREMENTS

SPECIFICATION REQUIREMENTS	REQUIREMENT OF MIL-STD-454
*Maintainability	54
*Enclosures	55
*Rotary Servo Devices	56
*Relays	57
*Switches	58
*Brazing	59
*Sockets, Shields, and Clamps	60
*Electromagnetic Interference Control	61
*Human Engineering	62
*Special Tools	63
*Microelectronic Devices	64
*Cable, Coaxial (RF)	65
*Cable, Multiconductor	66
*Identification Marking	67
*Readouts	68

TABLE II

GENERAL REQUIREMENTS

REQUIREMENTS	MIL-E-5400	MIL-E-8189	MIL-P-11268	MIL-E-11991	MIL-E-16400	MIL-T-17296	MIL-F-18870	MIL-T-21200
*								
*								
*								
*								
*								
Filters (Electrical)			X		X		X	
Vibrators			X	X	X		X	
*								
Cabling and Wiring (External)	X	X	X	X		X	X	X
*Wiring (Internal)	X		X	X				X
*								
*								
Microphonics	X	X			X		X	
Miniturization (Miniature Parts)					X	X	X	
Pressurization	X	X		X				
Shock and Vibration Isolators (Resiliant Mounts)	X	X	X	X	X	X	X	X
Finishes	X		X	X	X		X	X
Wood			X					
Fiberboard, Paper and Vulcanized Paper			X	X				
Rubber								

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