MILITARY SPECIFICATION

# DESIGN AND EVALUATION OF SIGNAL TRANSMISSION SUBSYSTEMS: GENERAL SPECIFICATION FOR

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

## 1. SCOPE

1.1 This specification covers the general requirements for design and establishes uniform methods for testing signal transmission subsystems. For purposes of this specification, a signal transmission subsystem (STS) includes the energy source(s) and output control function devices, and is composed of the following components: cartridges, electric initiators, cartridge actuated devices (CAD's), transmission lines, and other associated equipment (see 6.3.2). The transmission lines (hose/tubing, detonating cord, electrical, deflagrating cord, optical, etc.) provide the means for routing a signal(s) between STS components. STS examples and system applications are ejection seat/interseat sequencing subsystems, canopy removal subsystems, etc., for aircrew automated escape systems, guillotine severance subsystems for air-to-air refueling systems, sequencing subsystems for missile and target drone systems, etc. The purpose of the STS testing program is to determine performance, safety, soundness of design, and resistance to environments encountered during service use.

## 2. APPLICABLE DOCUMENTS

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

SPECIFICATIONS

Military

MIL-P-116 . Preservation-Packaging, Methods of

| | |
|---|---|
| MIL-P-514 | Plate, Identification, Instruction and Marking, Blank |
| MIL-D-1000 | Drawings, Engineering and Associated List |
| MIL-S-5002 | Surface Treatments and Inorganic Coatings for Metal Surfaces of Weapons Systems |
| MIL-C-5501 | Caps and Plugs, Protective, Dust and Moisture Seal |
| MIL-C-5541 | Chemical Conversion Coatings of Aluminum and Aluminum Alloys |
| MIL-I-6870 | Inspection Requirements, Nondestructive, for Aircraft Materials and Parts |
| MIL-A-8625 | Anodic Coatings, for Aluminum and Aluminum Alloys |
| MIL-E-9426 | Escape Systems, Requirements Conformance Demonstrations and Performance Tests for, General Specification for |
| MIL-N-18307 | Nomenclature and Identification for Electronic, Aeronautical, and Aeronautical Support Equipment Including Ground Support Equipment |
| MIL-S-18471 | System, Aircrew Automated Escape, Ejection Seat Type : General Specification for |
| MIL-P-19834 | Plates, Identification or Instruction, Metal Foil, Adhesive Backed, General Specification for |
| MIL-D-21625 | Design and Evaluation of Cartridges for Cartridge Actuated Devices |
| MIL-A-23121 | Aircrew Environmental, Escape and Survival Cockpit Capsule, General Specification for |
| MIL-I-23659 | Initiators, Electric, Design and Evaluation of |
| MIL-D-23615 | Design and Evaluation of Cartridge Actuated Devices |

STANDARDS

Military

| | |
|---|---|
| MIL-STD-129 | Marking for Shipment and Storage |
| MIL-STD-130 | Identification Marking of U. S. Military Property |
| MIL-STD-143 | Standards and Specifications, Order of Precedence for the Selection of |
| MIL-STD-794 | Part and Equipment, Procedures for Packaging and Packing of |
| MIL-STD-810 | Environmental Test Methods |
| MIL-STD-831 | Test Reports, Preparation of |
| MIL-STD-875 | Type Designation System for Aeronautical and Aeronautical Support Equipment |
| MIL-STD-889 | Dissimilar Metals |

Navy Department

| | |
|---|---|
| WR-43 | Preparation of Quality Assurance Provisions |

PUBLICATIONS

Department of Defense

| | |
|---|---|
| DSM 4120.3-M | Standardization Policies, Procedures and Instructions |

National Bureau of Standards

| | |
|---|---|
| Handbook H-28 | Screw-Thread Standards for Federal Service |

Code of Federal Regulations

| | |
|---|---|
| 49CFR 171-178 | Transportation |

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

## 3. REQUIREMENTS

3.1 **Selection of specifications and standards.** Specifications and standards for necessary commodities and services not specified herein shall be selected in accordance with MIL-STD-143.

3.2 **Special requirements.** Special requirements for specific applications shall take precedence over those listed herein, provided such special requirements are more stringent. Other conflicting requirements are subject to the approval of the cognizant design agency for the specific application involved.

3.3 **Materials.** Materials for the individual STS components, shall be compatible with all other STS components/parts, i.e., explosive, propellant, delay composition, pyrotechnic, combustion products, buffering fluid (if used), etc.; and shall withstand environmental, functional, service, and storage conditions to which the STS will be exposed. Acceptance or approval of materials for design or use during the course of manufacture shall in no case be construed as a guarantee of acceptance of the finished item. Materials which are nutrients for fungi shall not be used.

3.3.1 **Metals.** Exposed metals shall be of the corrosion-resisting type or suitably treated to resist the corrosive effects of fuels, salt spray, or atmospheric conditions to which the STS may be subjected in storage or normal service use.

3.3.1.1 **Dissimilar metals.** Dissimilar metals shall not be used in intimate contact with each other unless suitably protected against electrolytic corrosion. Dissimilar metals are defined in MIL-STD-889.

3.3.2 **Plastic parts.** The use of plastic parts shall be subject to the approval of the cognizant design agency for the specific application involved.

3.4 **Finishes.** Protective coatings and finishes shall be used which will not crack, chip, or scale during normal service life or when subjected to environmental conditions specified herein. Surface treatments, coatings, and finishes shall conform to MIL-S-5002 except that aluminum and aluminum alloy parts shall be anodized in accordance with 3.4.1.

3.4.1 **Anodizing.** Aluminum and aluminum alloy parts subject to wear, abrasion, and erosion or exposed to corrosive environmental elements shall be anodized in accordance with MIL-A-8625, types II or III. Chemical conversion coatings conforming to MIL-C-5541

may be used to repair mechanically damaged areas from which the anodic coating has been removed, or to retain electrical conductive properties.

3.5 **Color coding.** Color coding of the STS transmission lines and associated equipment for identification purposes shall be subject to the approval of the cognizant design agency.

3.6 **Design and construction.** The STS shall ensure reliable, repeatable transmission, without loss of subsystem/component integrity, and sufficient signal propagation from the energy source(s) to ensure reliable actuation of all STS components, as applicable. The design shall ensure minimum size and weight, resistance to deleterious environments, maintainability (see 3.6.9), and safety of operation. All STS components, i.e., cartridges, electric initiators, CAD's, transmission lines, and other associated equipment, submitted for or subjected to the requirements of 3.18 shall be of final design configuration, identical in design, manufactured by the same process, and shall be from the same lot.

3.6.1 **Cartridges and cartridge actuated devices.** Prior to commencing STS acceptance/inspection, environmental, and functional testing specified herein, cartridges and CAD's shall have successfully met all the requirements and completed all tests required by MIL-D-21625 and MIL-D-23615, respectively, and shall be from an acceptable lot which has been tested in accordance with the applicable production acceptance specification. Unless otherwise specified by the cognizant design agency, cartridges and CAD's shall be government furnished equipment (GFE).

3.6.2 **Electric initiators.** Prior to commencing STS acceptance/inspection, environmental, and functional testing specified herein, electric initiators shall have successfully met all the requirements and completed all tests required by MIL-I-23659, and shall be from an acceptable lot which has been tested in accordance with the applicable production acceptance specification. Unless otherwise specified by the cognizant design agency, electric initiators shall be GFE.

3.6.3 **Associated equipment.** The contractor shall submit to the cognizant design agency, for approval, detailed specifications (see 3.9.3.4) for all other STS components (see 6.3.2) including follow-on production acceptance testing and nondestructive testing in accordance with MIL-I-6870. Prior to commencing STS acceptance/inspection, environmental, and functional testing specified herein, each component shall have successfully met all the requirements and completed all tests required by the approved detailed design specification and shall be from an acceptable lot which has been tested in accordance with the applicable production acceptance specification.

3.6.4 **Redundancy.**. As a minimum, STS design redundancy shall be compatible with system performance and reliability requirements. The design shall consider, but not limited to, such factors as weight, complexity, proven reliability of components, and criticality of component operation. STS redundancy shall be achieved by providing multiple transmission lines so as to function/operate associated STS components.

3.6.5 **Fail-safe operation.** STS critical functional components which have several modes of operation shall be designed to ensure that any failure of the component will result in the component functioning in the mode providing maximum safety.

3.6.6 **Structural integrity.** The STS/subassemblies/components shall be designed with a minimum safety factor of 1.5 at the most critical temperature extreme based on the maximum calculated operating pressure limit in the most severe operating condition. The STS/subassemblies/components shall also be designed to withstand locked shut conditions (see 6.3.4) without evidence of mechanical failure or rupture.

3.6.6.1 **Signal transmission subsystem, ballistic gas.** A Ballistic Signal Transmission Subsystem (BSTS) shall be designed to withstand the internal ballistic gas pressure developed during functional testing (see 4.8) and during locked shut conditions (see 6.3.4) over the temperature range -65° F to 200° F. There shall be no mechanical failure or rupture.

3.6.6.2 **Ballistic signal transmission subsystem subassemblies.** Each BSTS subassembly (see 6.3.3) shall be designed to withstand the internal ballistic gas pressure developed during a locked shut condition (see 6.3.4) over the temperature range -65° F to 200° F. There shall be no mechanical failure or rupture.

3.6.6.3 **Associated equipment.** The detailed design specification for each STS component defined as associated equipment (see 6.3.2) shall include a structural integrity/"locked-shut" testing program.

3.6.7 **Signal transmission subsystem actuation, ballistic gas.** The ballistic input delivered by the BSTS to each individual CAD at the final point of actuation i.e. firing mechanism, piston, guillotine blade, etc., shall provide a minimum safety factor of 1.5 based on the maximum required CAD actuation pressure under worse case condition. For gas actuated firing mechanisms, no-fire/all-fire pressures are defined in MIL-D-23615. For previously released items, actual "no fire/all fire" pressures shall be verified from the appropriate item specification.

3.6.8 **Screw threads.** All screw threads shall be specified in accordance with National Bureau of Standards Handbook H-28.

3.6.9 **Disassembly and reassembly.** Unless otherwise approved by the cognizant design agency, the STS shall be designed in such a manner that it can be disassembled for inspection or installation of cartridges, CAD's, and associated equipment as applicable and reassembled. Disassembly and reassembly of the STS shall be accomplished by the use of standard tools. (See 3.6.11).

3.6.10 **Installation.** The STS components i.e. cartridges, CAD's, transmission lines, and other associated equipment shall be selected, designed, routed, and mounted, as applicable, to withstand system operational loads, relative motion between STS components, other subsystem(s) interfaces, etc., without degradation sufficient to cause loss of STS/component integrity during operation. Other considerations shall be ease of accessibility to maintenance personnel for periodic replacement of age limited components, resistance to deleterious environments, and maintenance personnel safety during removal/installation operations.

3.6.10.1 **Routing.** The STS component location and routing and/or shielding shall be selected to provide maximum protection against (1) injury/damage resulting in STS failure during operation and (2) damage encountered during service and/or maintenance operations.

3.6.10.2 **Mounting connections.** Installation provisions, e.g., mounting holes, flanges, and brackets, for STS components shall be so arranged that the possibility of incorrect installation or connection of fittings is minimized. Utilization of female end fittings for transmission lines is preferred. Use of transmission line end fittings of different thread diameters is mandatory. End fittings, tightened to torques required by the system, shall withstand system operational loads and contain internal gas pressures produced by the STS.

3.6.11 **Locking of components/parts.** All STS components/parts not required to have relative motion prior to or during STS initiation/operation shall be securely locked by a method that will not damage components or interfere with ease of assembly/disassembly. Safety wiring is the preferred method. (See 3.6.9).

3.6.12 **Service life.** STS components excluding cartridges, CAD's, and electric initiators when packaged in containers shall have a service life of not less than 5 years from the date of manufacture and shall be capable of being rendered serviceable after this period. Cartridge, CAD, and electric initiator service life requirements are defined in MIL-D-21625, MIL-D-23615, and MIL-I-23659 respectively. Service life assignments must be approved by the Naval Air Systems Command prio pplication in service.

3.6.13 **Signal transmission subsystems for capsules and ejection seat types.** A STS for escape and survival cockpit capsules or ejection seat types shall meet all additional requirements specified in MIL-A-23121 or MIL-S-18471, respectively, and all additional testing required by MIL-E-9426.

3.7 **Nomenclature.** The contractor shall follow the procedure outlined in MIL-N-18307 and MIL-STD-875 when submitting the DD Form 61 for nomenclature. The nomenclature requested by the contractor on DD Form 61 shall be concurred in by the Naval Air Systems Command prior to use.

3.8 **Marking.** Identification marking for each STS component excluding cartridges and CAD's shall be clearly and permanently (nondefaceable through normal storage and service handling) marked in accordance with MIL-STD-130 with the STS component nomenclature (see 3.7), manufacturer part number/serial number, contract number, lot number, manufacturer's symbol or federal stock number/federal supply code number, and date of manufacture, as applicable. Name plates shall conform to MIL-P-514 requirements for composition A, Class 2 or composition C identification plates, or MIL-P-19834. Cartridge and CAD marking requirements are defined in MIL-D-21625 and MIL-D-23615, respectively. No other markings shall be placed on the STS component except those required by 3.8.1.

3.8.1 **Inlet/outlet ports.** STS component ports shall be labeled "inlet" or "outlet", as applicable, and the direction of flow indicated with permanent red arrows. In addition, all STS ports/fitting ends shall be covered with suitable and effective shipping caps or plugs in accordance with MIL-C-5501, type and/or class as applicable, when the STS component is not installed.

3.9 **Contractual documentation and data requirements.** The cognizant government contracting agency when preparing a contract which includes STS development shall include, as a minimum, on the DD Form 1423 the following data requirements:

3.9.1 **Comprehensive test plans outlining all proposed test procedures and schedules.** The test plans shall include test objectives and descriptions of each planned test, equipment and facilities to be used, performance characteristics/accuracy of test instrumentation and recording devices to be used, and data to be recorded.

3.9.2 **Reports in accordance with MIL-STD-831 of all tests performed by the prime or subcontractor during development (see 3.17) and service release of the STS.** Copies of instrumentation and photography records shall be submitted with the reports. Motion picture films shall be furnished on standard reels.

3.9.3 For transmission lines and associated equipment (see 6.3.2), requirements shall be as follows:

3.9.3.1 Drawings including special tooling required in accordance with MIL-D-1000 Category E, Form 1. Also packaging and packing drawings to supplement 3.9.3.4.1 of this specification.

3.9.3.2 If full disclosure cannot be obtained for Category E, Form 1 drawings in accordance with MIL-D-1000 then a source control drawing, as defined by MIL-D-1000 Category F, Form 3 shall be submitted. Also the source control drawing shall include packaging and packing information in sufficient detail to meet the requirements of section 5 of this specification. If Category F, Form 3 drawings are submitted, complete drawings containing restrictive use notation shall be supplied to facilitate in-service support/malfunction investigation.

3.9.3.3 Detail and assembly drawings of test sets, including special tooling required, in accordance with MIL-D-1000 Category E, Form 3 and procedures used during testing, to permit manufacture and use of identical test sets for follow on production testing.

3.9.3.4 Design, production, and acceptance specifications in accordance with Defense Standardization Manual DSM 4120.3-M.

3.9.3.4.1 Packaging and preservation procedures. See 6.4.

3.9.3.5 Classification of characteristics in accordance with WR-43.

3.9.3.6 Complete manufacturing drawings of the item and of test sets used in the development and evaluation/qualification of the item shall be submitted to the cognizant design agency concurrently with or prior to the submittal of the test report. (See 3.9.3.7).

3.9.3.7 Reports in accordance with MIL-STD-831 of all tests performed by the prime or subcontractor during development and qualification of the item and any statistical analysis of these results.

3.9.4 The contractor shall prepare the above data, drawings, specifications, etc., for cognizant design agency approval.

3.10 **Performance.** The STS shall satisfy all design, acceptance/inspection, environmental, and functional requirements specified herein, and maintainability (see 3.6.9), reliability, and performance outlined in the system specification(s).

3.11 **Signal tranmission subsystem interface(s).** Prior to commencing STS acceptance/inspection, environmental, and functional testing specified herein, interface hardware deemed necessary by the cognizant design agency to duplicate STS operational performance shall have successfully met all the requirements and completed all tests required by their applicable military/detailed specification and shall be from an acceptable lot which has been tested in accordance with the applicable production acceptance specification.

3.12 **Acceptance/inspection testing.** The STS/subassemblies/components for use in service release testing shall be accepted and/or inspected in accordance with the requirements of 4.5.

3.13 **Environmental testing.**

3.13.1 **Shock.** The STS shall withstand shock conditions as specified in 4.7.1. After subjection to the shock test, the STS shall meet the design performance requirements when test fired.

3.13.2 **Temperature and humidity cycling.** The STS shall withstand the temperature and humidity cycling conditions as specified in 4.7.2 and shall meet the design performance requirements when test fired.

3.13.3 **Vibration.** The STS shall withstand vibration conditions as specified in 4.7.3. After subjection to the vibration test, the STS shall meet the design performance requirements when test fired.

3.13.4 **Salt fog.** The STS shall withstand exposure to salt fog as specified in 4.7.4 and shall meet the design performance requirements when test fired.

3.13.5 **Dust.** The STS shall withstand exposure to dust as specified in 4.7.5. After subjection to the dust test, the STS shall meet the design performance requirements when test fired.

3.14 **Functional testing.**

3.14.1 Operation at 200° F and sea level pressure. See 4.8.2.

3.14.2 Operation at 70° F and sea level pressure. See 4.8.3.

3.14.3 Operation at 80,000 ft altitude and -65°F. See 4.8.4.

3.15 **Structural integrity testing.**

3.15.1 Locked shut operation at -65° F and 200° F, at sea level pressure. See 4.8.5.

3.16 **Damage and deterioration.** Damage to or deterioration of any internal or external subassembly/component/part of the STS after environmental testing which could in any manner prevent it from meeting functional requirements shall be reason to consider the STS as having failed to meet the test to which it was subjected.

3.17 **Design verification testing.** DVT (Design Verification tests) are advanced stage subsystem development tests which are performed on the STS for the purpose of substantiating the STS/subassembly/component design for its intended mission. As a minimum requirement prior to commencing STS DVT, cartridges, CAD's, electric initiators, transmission lines and associated equipment (see 6.3.2) shall have successfully completed all DVT tests required by MIL-D-21625, MIL-D-23615, or the detailed component design specification. Also, all STS hardware shall have successfully met all nondestructive testing requirement of MIL-D-21625, MIL-D-23615, MIL-I-23659, or the applicable detailed component design specification. These tests shall include, as a minimum, the tests listed in Table I. Successful completion of STS and component DVT's and concurrence and approval by the cognizant design agency provides the assurance to permit a STS design freeze decision to be made.

Table I

DESIGN VERIFICATION TESTING

| Test | Number of STS test articles required | Number of STS subassemblies required per configuration | Applicable section for test procedures | Functional test at indicated temperature |
|---|---|---|---|---|
| Inspection | 9<br>Expend to test listed below | 2 | 4.5.1 | |
| Shock | 2 | | 4.7.1 | 2 at 70° F |
| Temperature and humidity cycling | 3 | | 4.7.2 | 3 at 70° F |
| Vibration | 2 | | 4.7.3 | 2 at 70° F |
| Salt fog | 1 | | 4.7.4 | 1 at 70° F |
| Dust | 1 | | 4.7.5 | 1 at 70° F |
| Locked shut | | 2 | 4.8.5 | 1 at -65° F<br>1 at 200° F |

3.18 **Criteria of acceptance.** After successful completion of DVT (see 3.17), release to service can be given only after the STS satisfies the environmental, functional, material, design and construction, and documentation and data requirements, and after successful performance in the complete testing program as set forth in Table II. If the tests are to be performed by a contractor or by an independent testing laboratory, the test facility must be approved by the cognizant design agency and the tests witnessed by government personnel. A certified copy of the test data shall be submitted to the cognizant design agency for approval prior to granting release to service. Applicable documentation in accordance with the requirements of 3.9 shall be prepared as determined by contractual agreement and submitted along with the test data. Distribution of STS test articles for the various environmental and functional tests shall be in accordance with Table II.

## 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 purchase 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 when such inspections are deemed necessary to assure supplies and services conform to prescribed requirements.

Table II

SERVICE RELEASE TESTING

| Test[1] | Number of STS test articles required | Applicable section for test procedures | Functional test at indicated temperature |
|---|---|---|---|
| Inspection | 12<br>Expend to test listed below | 4.5.1 | |
| High temperature (200° F) | 3 | 4.8.2 | 3 at 200° F |
| Normal Temperature (70° F) | 3 | 4.8.3 | 3 at 70° F |
| High altitude | 3 | 4.8.4 | 3 at -65° F |

[1]The three STS test articles not allocated to the destructive test of Table II are to be used for instrumenation verification and/or investigative purposes, as appropriate. Upon Table II completion, any test articles not expended to functional testing shall be retained or furnished to a designated Navy activity. The master STS test article mock-up shall be made available to the testing facility (contractor, independent testing laboratory, or government) for Table II tests.

4.2 **Materials.** Inspection and testing of STS components and parts shall be made to determine compliance with 3.3. Where defects or inferior quality are evident, and the Government deems material analysis necessary, the contractor will be requested to submit samples or specimens to the cognizant design agency for analysis and approval.

4.3 **Measurements and records.** All environmental and functional tests of the STS shall be performed with the equipment installed and mounted in a manner to simulate service conditions as closely as possible. Applicable performance parameters such as the following shall be recorded during functional tests :

a. Pressure versus time for subsystem cycle time

b. Velocity (at end of power stroke)

c. Displacement of load (or simulated) versus time

d. Thrust versus time for subsystem cycle time

e. Acceleration versus time

f. Resistive load versus time

g. Time interval between actuating firing mechanism and beginning of movement of load or start of pressure rise

h. Time interval between actuating firing mechanism and completion of operating cycle.

4.3.1 **Instrumentation.** Any state-of-the-art type of instrumentation and recording equipment may be used, e.g., oscillograph, oscilloscope, or magnetic tape. Transducers may be any state-of-the-art type, e.g., piezoelectric, strain gage, variable reluctance, capacitive, or potentiometer. However, accuracy of all test apparatus shall conform to requirements of MIL-STD-810. Documented calibration records shall be maintained and be available for inspection by the cognizant design agency.

4.4 **Rejection and retest.** Failure of any STS subjected to the environmental and functional tests to conform to the applicable requirements of this specification or the predetermined critical design requirements may be cause for (1) individual components(s) lot rejection (see 3.6) (2) STS retest and/or (3) individual components(s) qualification retest. Full particulars concerning the failure, recommended action to correct the defect(s), and plan for retest shall be submitted to the cognizant design agency for approval. The retest must be approved by the cognizant design agency.

4.5 **Acceptance/inspection testing.**

4.5.1 **Acceptance testing.** Individual tests shall be conducted on each component submitted for STS environmental and functional test. If any item fails a part of the nondestructive test, the cognizant design agency may reject the entire lot (see 3.6). Following concurrance and approval by the cognizant design agency, the contractor shall correct all deficiencies prior to resubmitting the rejected articles for nondestructive retest. Nondestructive tests shall consist of those specified in 4.5.1.1 and 4.5.1.2.

4.5.1.1 **Cartridges and cartridge actuated devices.** For cartridges, electric initiators, and CAD's, nondestructive testing shall be in accordance with MIL-D-21625, MIL-I-23659, and MIL-D-23615, respectively.

4.5.1.2 **Other equipment.** For all other equipment, the contractor shall develop and/or review vendor/supplier nondestructive tests and procedures to ensure the adequacy of each item prior to environmental and functional testing. The plan specifying nondestructive testing and procedures shall be approved by the cognizant design agency.

4.5.2 **Inspection testing.** Each STS shall satisfactorily complete the individual tests specified in the STS acceptance test program prior to environmental and functional testing. The STS inspection program shall be developed by the prime contractor and submitted to the cognizant design agency for concurrence and approval. Certification of 4.5.1 is required prior to commencing STS assembly and inspection testing.

4.6 **Photographic coverage.** Photographic coverage shall be in accordance with 4.6.1 and 4.6.2 for all tests prescribed herein. Additional photographic coverage may be specified and required by the cognizant design agency.

4.6.1 **Pretest photographs.** Still photographs shall be taken of each installed STS test article prior to initiation of each environmental and functional test. Particular emphasis shall be given to photographing the installed configuration/mounting of critical components/connections.

4.6.2 **Posttest photographs.** Following each environmental and functional test, still photographs shall be taken of any significant damage to components. Still photographs shall be taken of the undisturbed, recovered condition of all components suspected to have malfunctioned or failed.

4.7 **Environmental testing.** All temperatures specified in 4.7.1 through 4.7.5 shall have a tolerance of not more than ± 5°F. If the STS cannot be test fired within the temperature chamber, it shall be fired within five minutes after removal from the chamber. Whenever it is necessary to repeat low (-65° F) temperature conditioning of a cold STS, all condensation shall be removed from the STS before it is returned to the temperature conditioning chamber.

4.7.1 **Shock.** This test shall be conducted in accordance with method 516, procedure I of MIL-STD-810. The shock pulse wave form shall be terminal peak sawtooth. The peak amplitude shall be 20g and the duration shall be 11 msec. After being subjected to the shock test, the STS test articles shall be test fired at 70° F.

4.7.2 **Temperature and humidity cycling.** This test provides for cycling between temperatures of -65° F, 70° F and 160° F (90 percent relative humidity) with additional storage at -80° F and 160° F for two periods of two days each. Provision has been made for withdrawal of STS at two times during the cycling (see schedule below). This is to provide an opportunity to observe the extent of progressive deterioration, if such exists. The schedule has been arranged in such a manner that operations are not required outside regular working hours

except for such supervision as may be necessary to insure proper operation of the controlled temperature cabinets. STS installation and mounting shall be in accordance with 4.3. STS test articles shall be free of visible damage and shall produce satisfactory performance when test fired. Each STS will be conditioned at 70° F for functional tests. The schedule to be followed is:

| | | |
|---|---|---|
| Monday | 1300 | Place in cabinet or room maintained at -65° F; |
| | 1600 | Remove from -65° F room and place in room maintained at 160° F, (90% relative humidity) and allow to remain overnight; |
| Tuesday | 0800 | Remove from 160° F and place in 70° F; |
| | 1300 | Remove from 70° F and place in -65° F; |
| | 1600 | Remove from -65° F and place in 160° F (90% relative humidity); |
| Wednesday | 0800 | Remove from 160° F and place in 70° F; |
| | 1300 | Remove from 70° F and place in -65° F; |
| | 1600 | Remove from -65° F and place in 160° F (90% relative humidity); |
| Thursday | 0800 | Remove from 160° F and place in 70° F; |
| | 1300 | Remove from 70° F and place in -65° F; |
| | 1600 | Remove from -65° F and place in 160° F (90% relative humidity) |
| Friday | 0800 | Remove from 160° F and place in 70° F; |
| | 1300 | Remove from 70° F and place in -65° F; |
| | 1600 | Remove from -65° F and place in 160° F (90% relative humidity); |
| Saturday and Sunday | | Maintain in 160° F (90% relative humidity); |
| Monday | 0800 | Remove from 160° F and place in 70° F; |

| | | |
|---|---|---|
| | 1300 | Remove from 70° F and place in -65° F; |
| | 1600 | Remove from -65° F and place in 160° F (90% relative humidity); |
| Tuesday | 0800 | Remove from 160° F and place in 70° F; |
| | 1300 | Remove from 70° F and place in -65° F; |
| | 1600 | Remove from -65° F and place in 160° F (90% relative humidity); |
| Wednesday | 0800 | Remove from 160° F and place in 70° F; |
| | 1300 | Remove from 70° F and place in -65° F; |
| | 1600 | Remove from -65° F and place in 160° F (90% relative humidity); |
| Thursday | 0800 | Remove from 160° F and place in 70° F; |
| | 1300 | Remove from 70° F and place in -65° F; |
| | 1600 | Remove from -65° F and place in 160° F (90% relative humidity); |
| Friday | 0800 | Remove from 160° F and place in 70° F; |
| | 1300 | Remove from 70° F and place in -80° F; |
| Saturday and Sunday | | Maintain at -80° F; |
| Monday | 0800 | Remove from -80° F and place in 70° F |
| | | Remove one STS, condition at 70° F and fire. |

The second 2-week period follows the same schedule of temperature and humidity cycling and storage. Withdrawal during the second two-week period is as follows:

Fourth Monday withdraw one STS, condition at 70° F and fire.

The completion of the two periods occurs at 0800 on the 5th Monday after starting. At this time, the remaining STS is to be removed, conditioned at 70° F and fired.

4.7.3 **Vibration.** This test shall be conducted in accordance with the vibration test selection chart in Table 514.1-I using curve Z of MIL-STD-810, except that for each resonant and cycling period the test specimens shall be vibrated as follows: (1) one at -65° F, and (2) one at 200° F. After vibration testing has been completed, the STS test articles shall be test fired at 70° F.

4.7.4 **Salt fog.** This test shall be conducted in accordance with method 509 of MIL-STD-810. After the salt fog test has been completed and without disassembling the STS, the external surfaces may be rinsed with tap water prior to test firing the test article at 70° F.

4.7.5 **Dust.** This test shall be conducted in accordance with method 510 of MIL-STD-810 except that the high temperature shall be 200° F. After the dust test has been completed, the test article shall be test fired at 70° F.

4.8 **Functional testing.**

4.8.1 **General.** Functional testing at extreme temperatures and under high altitude conditions will be performed where possible in a controlled condition room or chamber. STS test article physical size and amount of travel will generally be the limiting factors. All temperature specified in 4.8.2 through 4.8.5 shall have a tolerance of not more than ± 5° F. Test data shall be recorded as applicable. See 4.3.

4.8.2 **High temperature tests (200° F).** The STS test articles and equipment are to be conditioned at a temperatures of 200° F for a time required by the longest lead time component to reach thermal equilibrium plus 1 hour and then fired. When necessary, the test articles may be removed from the conditioning chamber, set up, and fired within a period of 5 minutes.

4.8.3 **Normal temperature tests (70° F).** The STS test articles are to be fired at a temperature of 70° F. Conditioning and removal/set-up times shall be as specified in 4.8.2.

4.8.4 **High altitude tests (80,000 ft altitude and -65° F).** The STS test articles shall be conditioned at a temperature of -65° F, until temperature equilibrium is reached. The absolute pressure in the chamber shall then be reduced to 0.82 inch of mercury (corresponding to an altitude of 80,000 feet above sea level). These conditions shall be maintained for 1 hour. At the end of this time, the STS test articles are to be fired in the conditioned state. If the STS contains a barometrically controlled device(s), the chamber pressure shall be increased at the appropriate rate(s) specified in the test plan (see 3.9.1) until the device(s) operates. Test data shall be recorded.

4.8.5 **Structural integrity tests.** Two STS subassemblies for worse case configuration(s) (determined by the contractor and approved by the cognizant design agency) shall be conditioned, one subassembly at a temperature of -65° F and the other at a temperature of 200° F and fired under locked-shut conditions to demonstrate conformance to 3.6.6.2. It is not required that the subassemblies be operable after test. Conditioning and removal/setup times shall be as specified in 4.8.2.

4.9 ***Packaging, packing, and marking inspection.*** Inspection of packaging and packing of STS cartridges, CAD's, and associated equipment and container markings shall be made to determine compliance with section 5 of the detailed specification (see 3.9.3.4).

## 5. PREPARATION FOR DELIVERY

5.1 **Packaging, packing and marking.** Packaging and packing, and inner and outer container markings of cartridges and CAD's for service release testing shall be in accordance with MIL-D-21625 and MIL-D-23615, respectively. For associated equipment including transmission lines employed for service release testing, packaging, packing, and marking shall meet the requirements of 49 CFR 171-178, as applicable.

## 6. NOTES

6.1 **Intended use.** The signal transmission subsystems covered by this specification are intended to provide the signal routing, sequencing, safing and arming, and actuation for aircraft associated systems. A STS may be composed of cartridges, electric initiators, CAD's, and/or associated equipment.

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

a. Title, number, and date of this specification

b. Selection of applicable level of packaging and packing and marking requirements. See section 5.

c. Quantity (see Table II)

d. Data requirements (see 3.9).

6.3 **Definitions.**

6.3.1 **Cognizant design agency.** Unless the contract specifically indicates otherwise, all reference herein to "the cognizant design agency" are defined as referring to the Naval Air Systems Command.

6.3.2 **Associated equipment.** Associated equipment includes any component which is an integral part of the STS, i.e. accepts, interprets, and/or transmits a signal(s), but does not fall within the scope of MIL-D-21625, MIL-D-23615, MIL-I-23659, or other applicable military specifications.

6.3.3 **Ballistic signal transmission subsystem subassembly.** A BSTS subassembly shall consist of (1) the energy source, i.e. CAD with cartridge(s) installed, or "sealed-in" type CAD and (2) downstream STS components to the final point of most severe "locked shut" condition.

6.3.4 **Locked-shut condition.** A locked-shut firing is defined as a BSTS subassembly firing simulating the most adverse conditions for the containment of internal pressures produced when the subassembly fails to operate normally in the intended manner. The exact nature of this operational anomaly (failure of a piston to move, mechanism to operate, port to vent, etc.) is dependent upon the particular BSTS design.

6.4 **Packaging, packing, and marking.** Specify the appropriate method of preservation in accordance with MIL-P-116, including contract preservative required or without contact preservative as appropriate. Packing shall be specified by level A or level C and meeting the requirements of MIL-STD-794. Marking of packaging and packing shall be in accordance with MIL-STD-129, and 49 CFR 171-178, as applicable.

6.5 **Contractor furnished equipment (CFE).** For cartridge and CAD CFE, refer to MIL-D-21625 and MIL-D-23615, respectively.

6.5.1 Quality assurance levels for CFE associated equipment supplied for service release and production lot acceptance testing shall be subject to the approval of the cognizant design agency.

6.5.2 Production lot size for associated equipment supplied by a contractor for initial service use shall be subject to the approval of the cognizant design agency.

6.6 **Government furnished equipment (GFE).** For cartridge, CAD, and electric initiator GFE, refer to paragraphs 3.6.1 and 3.6.2.

Custodian
Navy–AS

Preparing Activity
Navy–AS

Project No. 1377-N591

☆U.S. GOVERNMENT PRINTING OFFICE: 1976-703-020/199

# STANDARDIZATION DOCUMENT IMPROVEMENT PROPOSAL

OMB Approval
No. 22-R255

INSTRUCTIONS: The purpose of this form is to solicit beneficial comments which will help achieve procurement of suitable products at reasonable cost and minimum delay, or will otherwise enhance use of the document. DoD contractors, government activities, or manufacturers/ vendors who are prospective suppliers of the product are invited to submit comments to the government. Fold on lines on reverse side, staple in corner, and send to preparing activity. 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. Attach any pertinent data which may be of use in improving this document. If there are additional papers, attach to form and place both in an envelope addressed to preparing activity.

DOCUMENT IDENTIFIER AND TITLE MIL-D-81980(AS)
Design and Evaluation of Signal Transmission Subsystem, Gen Spec for

NAME OF ORGANIZATION AND ADDRESS

CONTRACT NUMBER

MATERIAL PROCURED UNDER A
☐ DIRECT GOVERNMENT CONTRACT ☐ SUBCONTRACT

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

   B. RECOMMENDATIONS FOR CORRECTING THE DEFICIENCIES

2. COMMENTS ON ANY DOCUMENT REQUIREMENT CONSIDERED TOO RIGID

3. IS THE DOCUMENT RESTRICTIVE?
   ☐ YES ☐ NO *(If "Yes", in what way?)*

4. REMARKS

SUBMITTED BY *(Printed or typed name and address - Optional)*

TELEPHONE NO.

DATE

**DD FORM 1 JAN 72 1426** REPLACES EDITION OF 1 JAN 66 WHICH MAY BE USED

S/N 0102-014-1802

FOLD

DEPARTMENT OF THE NAVY
Naval Air Systems Command
Washington, D.C. 20361

POSTAGE AND FEES PAID
DOD 316

OFFICIAL BUSINESS
PENALTY FOR PRIVATE USE $300

Naval Air Systems Command (AIR-52021)
Department of the Navy
Washington, D.C. 20361

FOLD