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MILITARY SPECIFICATION

MOCKUP TESTING, ELECTRIC SYSTEM, PILOTED AIRCRAFT AND GUIDED MISSILE, GENERAL REQUIREMENTS FOR

1. SCOPE

1.1 This specification covers the general requirements for testing of the electric-system mockups prior to prototype flight of piloted aircraft or guided missiles. (See 6.3.1.)

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-C-45662 Calibration System Requirements

STANDARDS

Military

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 Laboratory test facilities

3.1.1 Test-generator drives

* 3.1.1.1 *Direct drives*. If a direct coupling to the main propulsion engine is used to drive the generators in the aircraft or guided missile,

the generator-system mockup may be driven by laboratory drives. The characteristics of these drives shall conform to the drive characteristics as installed in the aircraft or guided missile with regard to the following:

a. Speed range - idle to full military power. As a minimum requirement, the laboratory-drive speed range shall be equal to that of the actual drive.

b. Stiffness - initial speed (steady-state speed prior to shock-load application) minus the maximum speed change with shock application or removal of maximum test load, expressed as a percentage of initial speed. Stiffness shall be determined at several initial speeds within the generator or accessory-drive speed range, as applicable. The allowable difference between the laboratory-drive and the actual-drive stiffness shall be ±10 percent.

c. Maximum acceleration - maximum rate of change of speed. The allowable difference between the laboratory-drive and the actual-drive maximum acceleration shall be ±10 percent. This requirement applies under maximum rated generator load and within the rated speed range of the test generator or accessory drive, as applicable.

3.1.1.1.1 Direct-drive tolerance. If the laboratory-drive characteristics differ more than allowed from the actual drives, either an analytical study or an aircraft or guided-missile test shall be made to determine the effect of this difference on the system performance for both normal and abnormal operating conditions.

* 3.1.1.2 Accessory drive. The generator-system mockup shall be driven by the actual drive (e.g., pneumatic, hydraulic, auxiliary power plant) used in the aircraft or guided missile if direct coupling of the generator to the engine is not used in the air vehicle. The laboratory input to the accessory drive during these phases shall either duplicate or simulate the aircraft or guided-missile installation. Requirements for hydraulic and pneumatic drives are listed below.

3.1.1.2.1 Hydraulic drives. The laboratory input to the drives shall meet the requirements of 3.1.1.1a and 3.1.1.1c.

3.1.1.2.2 Pneumatic drives. The laboratory air supply to the drives shall be such that it can be controlled within the normal range of the actual engine air supply with regard to the following conditions:

a. Temperature

b. Air supply (air weight flow)

c. Pressure

d. Rate of pressure change.

3.1.1.2.3 Accessory-drive tolerance. The requirements of 3.1.1.1.1 shall apply.

3.1.1.3 Multiple drives. At least two separate generator drives shall be used in tests of interconnected multiple-generator systems if two or more drives are used in the aircraft or guided missile. If practicable, the number of laboratory drives shall equal the number installed in the aircraft or guided missile.

3.1.2 Environmental test equipment. Environmental test equipment (e.g., vibration, altitude, cooling, heating) shall be provided to perform the required component and system tests.

* 3.1.3 Instrumentation. Instrumentation methods shall be selected so that electrical equivalence of the system will not be affected. One example would be sensing of currents downstream of the generator regulation point so that series impedance will not be added to the generator control loop. Instruments used in the test shall be laboratory type having inaccuracies not exceeding ±3 percent (oscillograph excepted). Each instrument shall be calibrated under MIL-C-45662 requirements prior to the start of testing and at intervals not exceeding 90 days during the test program.

* 3.1.4 Load banks. Laboratory load banks may be used to simulate the power requirements of actual load equipment; however, substitution shall not adversely affect the system test results. The load bank shall provide the capacity for rated continuous loads and overload rating of the generation equipment. Alternating-current (ac) load banks shall include linear reactors for power factor control as required in the rating of the ac generator. Short-circuit application and interrupting capability shall be provided for any point in the system.

* 3.1.5 Ground support equipment. Ground equipment proposed or contemplated for electrical support of the aircraft or missile shall be available to power the system mockup during the course of the tests outlined herein. The ground power supply shall connect to the electric power system through the external power circuit.

3.2 Mockup

3.2.1 Mockup components

* 3.2.1.1 Selection. Except as noted in 3.1.4, components comprising the electric system shall be duplications of production equipment to be used in the aircraft or guided missile. The components shall have passed component acceptance tests specified in the detail specification prior to incorporation in the mockup.

3.2.1.1.1 Equipment which has unknown or marginal performance characteristics on the type of power system under test, or equipment which is sensitive to electrostatic or inductive coupling, shall be mockup tested.

3.2.1.2 Equipment inspection. Prior to testing, all equipment shall be inspected for loose and broken parts, chafed insulation, and general condition. Brush covers, blast-air housing, or other cover plates shall be removed during inspection. On rotating machines, the condition of the sliprings, commutator, brushes, et cetera, shall be noted. The rotor shall be turned to insure that the bearings are free. On completion of the inspection, all parts shall be reassembled in their proper condition. Lock wiring shall be replaced where necessary. Equipment subject to considerable wear shall be reinspected periodically during mockup testing.

*

3.2.1.3 Types of electrical tests. Each component of the electric-system mockup shall be sufficiently tested prior to or concurrent with system tests to assure that:

a. It is functioning satisfactorily and within allowable tolerances as defined by the applicable detail specification

b. Sufficient characteristics are known to electrically identify the device and permit detailed system analysis.

3.2.1.3.1 Electric component test items. The following characteristics of mockup components shall be determined by tests, when applicable. If necessary to assure conformance to the requirements of this specification or at the option of the testing facility, the list shall be supplemented with additional items. For items designated by an asterisk, the information shall be determined for the specific equipment under test; otherwise, type characteristics will be sufficient. Tests need not be conducted if results of inspection, qualification, or other tests approved by the procuring activity and satisfying the requirements specified herein are available.

a. Resistance*

(1) Insulations*

(2) Windings and coils*

(3) Internal (batteries)*

b. Transient characteristics*

(1) Time constants*

(2) Impedances*

c. Saturation curves*

d. Polarity*

e. Phase rotation*

f. Volt versus ampere characteristics*

g. Voltage-time discharge*

h. Electrolyte check*

i. Steady-state power requirements

(1) Operating voltage limits

(2) Operating frequency limits

(3) Maximum operating power

(4) Maximum operating volt-amperes

(5) Minimum operating power factor

(6) Maximum warmup time

j. Operating time

k. Efficiency or heat rejection

l. Contact performance (moving or rotating).

3.2.1.4 Component environmental tests. Mockup components that have unknown or questionable performance characteristics under anticipated aircraft or guided-missile operational environmental conditions shall be functionally tested while operating under these conditions or probable combinations thereof. These tests may be run in conjunction with system tests.

3.2.1.5 Discrepancies. Any discrepancies in material or equipment furnished by the Government (GFAE), or deviations from its detail specification, or evidence of poor workmanship, shall be brought to the attention of the procuring activity.

3.2.2 System mockup. A mockup of the electric system shall be tested as follows.

* 3.2.2.1 Installation. The mockup airframe shall be a structure simulating the electric system areas. Materials used for conducting paths shall be the same as used in the aircraft or guided missile. The ground plane to the generation equipment shall approximate that of the aircraft or guided missile. The mockup design shall maintain as closely as practicable electrical equivalence to the complete aircraft or guided-missile system. The size, length, spacing, and methods of harnessing and supporting generation equipment feeders and control wiring shall be maintained as closely as practicable as designed for the aircraft or guided missile. Load feeders shall be constructed to simulate typical wiring and ground paths to the utilization equipment.

3.2.2.2 Electrical tests. Electrical tests shall be performed to assure a satisfactory electric system prior to flight of the prototype aircraft or guided missile. These tests shall:

a. Include all possible normal operating conditions

b. Incorporate where applicable, emergency and abnormal conditions such as faults, component failures, malfunctioning of equipment, and improper operating procedures

c. Demonstrate that the system fulfills its design requirements and objectives and verifies design calculations. This shall entail the functioning of all system components installed in the mockup.

d. Establish the allowable adjustment tolerances of control elements based on system performance

e. Determine that the system electric-power characteristics conform to the applicable military specifications

f. Determine that the ground equipment proposed or contemplated for electrical support is adequate and compatible with the aircraft or missile electric system undergoing testing. The electric-system mockup shall be powered from the ground unit that will support the aircraft or missile in service. Ground power compatibility tests may be conducted at any time during course of the mockup tests.

3.2.2.2.1 Types of electrical tests. The system mockup shall be tested to determine the system characteristics or, where applicable, the effect on the system of those items listed below. If necessary to assure conformance to the requirements specified herein or at the option of the testing facility, the list shall be supplemented with additional items. Tests need not be conducted if results of inspection, qualification, or other tests approved by the procuring activity and satisfying the requirements of this specification are available for the specific type of system under test.

a. Voltage

(1) Regulation - main bus or regulation point (steady state)

(2) Regulation - load bus or load (steady state)

(3) Phase unbalance

(4) Transient limits and stability

(5) Phase displacement

(6) Waveform (crest factor, subharmonic, and harmonic content)

(7) Amplitude modulation

(8) Phase rotation

(9) Ripple

(10) Interruption (power transfer or fault clearing)

(11) Drift (during warmup)

b. Frequency

(1) Regulation (steady state)

(2) Transient limits and stability

(3) Modulation

c. Capacity

(1) Normal

(2) Overload

(3) Fault

(4) Minimum

d. Parallel operation

(1) Real-load division

(2) Reactive-load division

(3) Stability

(4) Synchronizing

e. Manual control

(1) Range of adjustments

f. Protection

(1) Undervoltage

(2) Overvoltage

(3) Underfrequency

(4) Overfrequency

(5) Ceiling excitation

(6) Generator, wire, and bus fault (including interrupting capacity and coordination)

(7) Reverse current

(8) Reverse power

(9) Miscellaneous control-system faults

(10) Coordination

g. Loads

(1) Switching

(2) Automatic transfer

(3) Voltage self-modulation

(4) Compatibility with power supply.

3.2.2.3 Ground power. The system mockup shall be tested in accordance with 3.2.2.2.1 when using ground power as described in 3.2.2.2(f) to assure satisfactory electric support during ground operations. These tests shall be in addition to those required when power is supplied from simulated or actual aircraft or missile power-generating systems.

3.2.2.4 Battery power supplies. If batteries constitute the primary electric-power supply, the actual batteries shall be used during those test phases when the electric-system characteristics may be appreciably affected by the power supply. Tests other than the above may be performed using the laboratory power supply.

3.2.2.4.1 Emergency power supplies. When a battery is used as an emergency power supply, tests shall be conducted to determine the maximum time the battery can supply adequate power to the connected emergency loads after failure of the main electric system has occurred.

3.2.2.5 Environmental tests. If the predicted aircraft or guided-missile operational environment for any mockup component could appreciably affect the results of the system mockup tests, this effect on the system shall be determined by test or calculation.

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 Mockup tests. Mockup testing shall be done in accordance with the requirements specified herein. When specified in the contract (see 6.2), a detailed test procedure, applicable to the particular aircraft or guided missile, shall be prepared by the contractor to cover all requirements of this specification and shall be submitted to the procuring activity

for approval. Tests performed in accordance with the approved test procedure shall be considered to fulfill the test requirements of this specification. Minor details of the approved test procedure may be modified without procuring activity approval provided the purpose of the applicable test is not changed. Every effort shall be made to choose the most economical test methods without sacrificing the end results. The test procedure shall include the following:

a. Mockup description

b. Purpose of each test

c. Detailed procedure for each test

d. Required instrumentation for each test

e. Type, manufacturer, and function of test components, noting whether Contractor-Furnished-Aeronautical Equipment or Government-Furnished Aeronautical Equipment.

* 4.2.1 Duration. The following minimum requirements shall govern the mockup duration:

a. The electric-system mockup shall be kept intact for the duration of the aircraft or guided-missile flight-test program.

b. At the end of the period specified in 4.2.1a, the aircraft or guided-missile manufacturer, in conjunction with the procuring activity, shall determine the length of time to keep the mockup intact.

* 4.3 Preparation and submission of test report. When specified in the contract (see 6.2), the contractor shall submit a final report of the mockup testing of the aircraft or guided-missile electric systems and equipment. This report shall follow, as nearly as practicable, the logical sequence and the headings and subheadings of the test outlined in the contractor's test procedure as approved by the procuring activity. The report shall be prepared in accordance with MIL-STD-831. The following shall be included:

a. Detailed mockup description

b. Exact testing procedure followed, and reasons for any changes from the approved test procedure

c. Detailed results of the mockup testing

d. Serial, type, manufacturer of test instruments, and date of last calibration

e. Serial, type, and manufacturer of test components, including applicable specifications

f. Applicable environmental test conditions

g. Appropriate photographs, sketches, diagrams, and curves to explain test installations and results

h. Recommendations and conclusions

i. An appendix recording all pertinent changes made in the system (including circuitry and equipment) during mockup testing.

4.3.1 Deviations. Any departures of the mockup test installation from the aircraft or guided-missile production installation drawings, which may appreciably affect the test-system performance, shall be noted in the test report. Reasons for the departure and an analysis of the effect on the system performance shall be given.

5. PREPARATION FOR DELIVERY

* This section is not applicable to this specification.

6. NOTES

* 6.1 Intended use. This specification is intended for use by contractors in determining methods and procedures for testing electric-system mockups of aircraft and guided missiles.

6.2 Ordering data. Procurement documents should specify the following:

a. Title, number, and date of this specification

* b. Test procedure and test report to be submitted in accordance with Contractor Data Requirements List DD Form 1423 (see 4.2 and 4.3)

c. Point of delivery

*

6.3 Definitions

* 6.3.1 Mockup. The term mockup as used herein should be construed to mean either a facsimile of the electric system or the actual system. However,

the components that make up the electric system will be components designed to detail specifications which will be the equipment used in the aircraft or guided-missile electric system.

6.3.2 Electric system. The term electric system as used herein should be construed to mean power-generation equipment and controls, batteries, conversion equipment, distribution circuits, and associated control and protection equipment between power supplies and load equipment. Load equipment should be considered only to the extent of its effect on, or how it is affected by, the operation of the system.

* 6.4 The margins of this specification are marked with an asterisk to indicate where changes 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 base on the entire content irrespective of the marginal notations and relationship to the last previous issue.

Custodian:
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SPECIFICATION ANALYSIS SHEET

Form Approved
Budget Bureau No. 22-R255

INSTRUCTIONS: This sheet is to be filled out by personnel, either Government or contractor, involved in the use of the specification in procurement of products for ultimate use by the Department of Defense. This sheet is provided for obtaining information on the use of this specification which will insure that suitable products can be procured with a minimum amount of delay and at the least cost. Comments and the return of this form will be appreciated. Fold on lines on reverse side, staple in corner, and send to preparing activity. Comments and suggestions submitted on this form do not constitute or imply authorization to waive any portion of the referenced document(s) or serve to amend contractual requirements.

SPECIFICATION

ORGANIZATION

CITY AND STATE

CONTRACT NUMBER

MATERIAL PROCURED UNDER A

☐ DIRECT GOVERNMENT CONTRACT ☐ SUBCONTRACT

1. HAS ANY PART OF THE SPECIFICATION CREATED PROBLEMS OR REQUIRED INTERPRETATION IN PROCUREMENT USE?

A. GIVE PARAGRAPH NUMBER AND WORDING.

B. RECOMMENDATIONS FOR CORRECTING THE DEFICIENCIES

2. COMMENTS ON ANY SPECIFICATION REQUIREMENT CONSIDERED TOO RIGID

3. IS THE SPECIFICATION RESTRICTIVE?

☐ YES ☐ NO *(If "yes", in what way?)*

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

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

DATE

DD FORM 1 JAN 66 1426

REPLACES EDITION OF 1 OCT 64 WHICH MAY BE USED.

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