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MILITARY SPECIFICATION

INITIATORS, ELECTRIC, GENERAL DESIGN SPECIFICATION FOR

This specification is approved for use by all Departments and Agencies of the Department of Defense

1. SCOPE

1.1 This specification furnishes general requirements for design and establishes uniform methods for testing electric initiators and electric initiator subassemblies. The purpose of the testing program is to determine the electric characteristics, soundness of mechanical design, output, and resistance to deleterious service environments. For purposes of this specification the term electric initiator includes items classified in FSC 1377 such as hot wire initiators, exploding bridgewire initiators, conductive mix initiators etc. Electric primers are not covered in this specification.

The term electric initiator does not include complete assemblies which have electric initiators as subassemblies, but include only the subassemblies themselves. In addition, electric initiators must be safe for handling, transportation, storage and use and must not deteriorate to a degree which would render their performance or safety doubtful under normal service handling, adverse storage and transportation. RF susceptibility requirements and tests have not been included in this specification because the general requirements and necessary tests are not available at the present state of the art. Implicit in the one watt and one ampere maximum no-fire requirements of this specification is the recognition of the hazards of electromagnetic radiation to ordnance (HERO). This one watt and one ampere requirement in conjunction with other design requirements stated herein does not solve the HERO problem; however they do serve as a means of reducing hazards from all spurious electric sources including electromagnetic radiation. General requirements for weapon systems to preclude HERO are established in MIL-P-24014 (Wep).

1.2 Classification - Initiators c ered by this specification are divided into two classes:

Class A - Includes initiators that are capable of being actuated within one second (exclusive of delay element time, if present) from a 28 ± 2 volt source capable of delivering not less than 10 amperes.

Class B - Includes initiators that are not capable of being actuated within one second (exclusive of delay element time, if present) from a 28 ± 2 volt source capable of delivering not less than 10 amperes.

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-D-1000	Drawing, Engineering and Associated Lists
MIL-P-24014	Preclusion of Hazards from Electromagnetic Radiation to Ordnance, General Requirements for
MIL-T-60530	Technical Data For Frankford Arsenal Material

STANDARDS

Military

MIL-STD-100	Engineering Drawing Practices
MIL-STD-202	Test Methods for Electronic and Electric Component Parts
MIL-STD-331	Fuze and Fuze Components, Environmental and Performance Tests For
MIL-STD-810	Environmental Test Methods

NAVY DEPARTMENT

WR 43	Preparation of Qualification Assurance Provisions

PUBLICATIONS

4120.3M	Standardization Policies, Procedures and Instructions

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

3. REQUIREMENTS

3.1 Approval for Use of Initiators by Service Personnel - Before any initiator or device utilizing an initiator can be used by Service personnel, it must be approved by the cognizant design agency. Approval for Service use will be granted only after it has been demonstrated that the initiator has met all the requirements of this specification and adequate documentation for procurement as Government furnished equipment is completed and the release to production form has been authenticated. Interim approval can be granted prior to availability of documentation provided it has been demonstrated that the initiator has met all the requirements of this specification. Interim approval shall not exceed six months.

3.2 General. The requirements for design given in this section are considered to be the minimum requirements to which electric initiators shall be subjected.

3.3 Design

3.3.1 General. The initiator shall be of the simplest and most efficient design (consistent with the originally proposed use) for the widest possible variety of applications. It shall be as simple and safe to assemble and install as practicable. All inert and explosive materials shall be referenced by approved Government specifications where possible. Proprietary materials shall not be used unless specifically approved in writing from the cognizant Government design Agency.

3.3.2. Internal Free Volume. The internal free volume shall be minimized consistent with good design practice.

3.3.3. Weight. The weight of all initiators shall be minimized consistent with good design practice.

3.3.4. Inert Materials. Selection of inert materials shall satisfy the environmental, strength, and weight requirements set forth in the specifications for the unit of intended application. Materials which are nutrients for fungi shall not be used unless specifically approved by the cognizant Government design Agency.

3.3.5. Contacts. The design shall include a provision for shorting all contacts to each other. In the case of pins, a shorting cap shall be supplied, and in the case of leads, the ends shall be bared for purpose of twisting together. Once the initiator is assembled, the contacts shall be shorted (with leads folded to avoid open loops) at all times except for tests of functional purposes. Where two or more contacts are present, per initiator, coding shall be provided for purpose of identification.

3.3.6. Sealing. The initiators shall be sealed and shall pass the leakage requirement of 3.3.14, environment requirements of 3.5 and functional requirements of 3.6.

3.3.7. Bridge Material. Carbon shall not be used as bridge material unless specifically approved by the cognizant Government design Agency.

3.3.8. Bridge Circuit Insulation and Insulation Barrier. The bridge circuit shall be electrically insulated from the case except in those instances where an insulated bridge initiator is not compatible with the device of intended application. A continuous insulation barrier shall be provided between the case and any explosive, propellant or pyrotechnic material which is in contact with the bridge circuit. The barrier shall be of a material having high electric resistivity and dielectric strength.

3.3.9. Bridge Circuit Resistance, Bridge Circuit Continuity or Dielectric Withstanding Voltage. The initiator shall be designed such that the measurement of bridge circuit resistance, bridge circuit continuity, or application of dielectric withstanding voltage when tested as specified in 4.4.1 and 4.4.2 will not dud, adversely affect, or cause the initiator to fire.

3.3.10. Explosive, Propellant, Delay Composition, or Pyrotechnic Material. Any explosive, propellant, delay composition, or pyrotechnic material used in an initiator shall be approved by the cognizant Government design Agency.

3.3.11. Marking. Marking, where applicable, shall be non-defaceable (normally stamp or etch) through normal handling and use and shall include designation, lot number, date of manufacture, and manufacturer's identification.

3.3.12. Radiographic Examination. Each initiator shall be subjected to radiographic examination such as X-ray, neutron bombardment, gamma rays etc. as specified in 4.1.2.2. Radiographic plates shall be identified by date, initiator part number. lot number and serial number.

3.3.13. Performance Reliability. The initiators shall meet all performance requirements at a reliability of not less than 99 percent at a confidence level of 95 percent. The method of analysis shall be in accordance with 4.1.4.

3.3.14. Leakage. The initiators shall pass a dry gas leak test. Initiators which exhibit a leak rate in excess of 10^{-5} cc per second of air at a pressure differential of 1 ± 0.1 atmosphere shall be considered defective. The leak test shall be conducted as specified in 4.1.2.3.

3.4 Electrical Characteristics.

3.4.1 Dielectric Withstanding Voltage. Each initiator produced under a contract shall be subjected to a dielectric withstanding voltage of 500 volts DC for 60 seconds. The leakage current shall not exceed 0.1 milliampere. The test shall be conducted as specified in 4.4.1. Initiators which exhibit a leakage current in excess of that stated above shall be considered defective and discarded.

3.4.2 Bridge Circuit Resistance or Bridge Circuit Continuity.

3.4.2.1 Initiators with or without Bridge Circuit Gap. For each initiator produced under a contract the bridge circuit resistance or bridge circuit continuity (whichever is applicable) of each bridge circuit shall be as specified in 4.4.2.

3.4.2.2 Initiators with conductive mix materials. If conductive mix materials are used, the conductive mix resistance measurement requirement shall be as specified by the cognizant design agency.

3.4.3 Maximum No-Fire and Minimum 50 Millisecond All-Fire Stimuli.

3.4.3.1 General. For purposes of specifying maximum no-fire and minimum 50 millisecond all fire stimuli, initiators covered by this specification are divided into two Classes:

"Class A" and "Class B". Initiators used for these tests shall be randomly selected. If any initiator fails to meet the requirements of 3.4.3, the engineering design lot shall be considered defective and discarded.

3.4.3.1.1 Class A. Includes any initiator that is capable of being actuated within one second (exclusive of delay element time, if present) from a 28 ± 2 volt source capable of delivering not less than 10 amperes.

3.4.3.1.2 Class B. Includes any initiator that is not capable of being actuated within one second (exclusive of delay element time, if present) from a 28 ± 2 volt DC source capable of delivering not less than 10 amperes.

3.4.3.2 Maximum No-Fire Stimuli, Class A

3.4.3.2.1 Power-Current. The initiator shall not fire within 5 minutes when subjected to a current of 1 ampere minimum per bridge with an associated power of 1 watt minimum per bridge. The initiator shall meet this requirement at 70° ± 5°F. and 220° ± 5°F. The test method shall be as explained in 4.4.3.

3.4.3.2.2 Static Discharge. The initiator shall not fire or dud when subjected to the 25000 volt simulated human electrostatic discharge of 4.4.3.2. The initiator shall meet this requirement at 70° ± 5°F. and a relative humidity of 50 percent or less.

3.4.3.2.3 Stray Voltage. The initiator shall be capable of withstanding the effects of a stray voltage environment without pre-igniting (firing). The initiator shall meet this requirement at 70° ± 5°F. The test method shall be as described in 4.4.3.3.

3.4.3.3 Minimum 50 Millisecond All-Fire Stimulus, Class A. The minimum 50 millisecond all-fire stimulus as defined in 6.2.7 shall be measured as described in 4.4.4. The initiator shall meet this requirement at 70° ± 5°F. - 80° ± 5°F, and 225° ± 5°F.

3.4.3.4 Maximum No-Fire Stimuli, Class B.

3.4.3.4.1 Parameter(s). The maximum no-fire stimulus as defined in paragraph 6.2.9 shall be determined as specified in para 4.4.5.1.

3.4.3.4.2 Static Discharge. The initiator shall not fire or dud when subjected to the 25000 volt simulated human electrostatic discharge of 4.4.3.2. The initiator shall meet this requirement at 70° ± 5°F and a relative humidity of 50 per cent or less.

3.4.3.5 Minimum 50 Millisecond All-Fire Stimuli, Class B. The requirements for the minimum 50 millisecond all-fire stimulus as defined in 6.2.7 shall be as specified in 4.4.6.

3.4.4 Bridge Circuit Resistance-Subsequent to Actuation Class A and B. If there is a requirement that a fired initiator shall have a minimum open circuit resistance after firing, then the cognizant design agency shall specify the open circuit resistance requirement and the method of test shall be that given in 4.5.

3.5 Environmental.

3.5.1 Forty Foot Drop. To ensure fail-safe capability, the initiator shall not fire when dropped from a height of 40 feet as specified in 4.6.1 and shall be safe for handling and disposal.

3.5.2 Six Foot Drop. The initiator shall not fire when dropped from a height of 6 Feet as specified in 4.6.2. After being subjected to the drop test, the initiators shall meet the design performance requirements when test fired.

3.5.3 Shock. The initiator shall be capable of withstanding shock conditions as specified in 4.6.3. After being subject to the shock test, the initiator shall meet the design performance requirements when test fired.

3.5.4 Vibration. The initiator shall be capable of withstanding vibration conditions as specified in 4.6.4. After being subject to the vibration test, the initiator shall meet the design performance requirements when test fired.

3.5.5 Temperature-Shock/Humidity/Altitude. The initiator shall be capable of withstanding temperature-shock/humidity/altitude cycling conditions as specified in 4.6.5 and shall meet the design performance requirements when test fired.

3.5.6 Cook-Off. The maximum temperature to which an initiator can be exposed for a period of one hour without cookoff shall be established (within 25° F). Test method shall be as specified in 4.6.6.1.

3.5.7 High Temperature Exposure. The maximum temperature (Within 25°F) to which an initiator may be exposed for 12 hours and perform satisfactorily at 225°F shall be determined. Test method shall be as specified in 4.6.6.2.

3.5.8 Salt Fog. The initiator shall meet the salt fog test as specified in 4.6.7. After being subject to the salt fog test, the initiator shall meet the design performance requirements when test fired.

3.6 Functional (All Fire Stimulus). The initiator shall meet the all fire stimulus requirements of 3.4.3.3 and 3.4.3.5 at - 80° ± 5°F, +70° ± 5°F. and + 225° ± 5°F.

3.7 Damage and Deterioration. Damage to or deterioration of any internal or external part of the initiator which could in any manner prevent it from meeting any requirement of this specification shall provide reason to consider the initiator as having failed to meet the test to which it was subjected. Initiators from the 40-foot drop test shall not be subject to this requirement.

3.8 Special requirements. Those special requirements which are in conflict with the requirements of this specification shall be resolved in favor of the special requirements only if necessary for satisfactory operation of the initiator in the unit of proposed use and subject to approval by the Government design agency. It is recognized that the maximum no-fire requirements of section 3.4.3 cannot be imposed on all weapons systems because of limited power supplies or dimensional requirements which limit the ability of the initiator to dissipate one watt for 5 minutes. Where the maximum no-fire requirements of 3.4.3 are irreconcilable with the available power supply or dimensional requirements, the contractor shall come as close as possible to the requirements stated herein, compatible with the weapons system, and must get written authority from the Government design agency to deviate from these requirements.

3.9 Contractural Documentation and Data Requirements. The Government design agency, when preparing the contract for an initiator, shall include, as a minimum, on the DD form 1423, the following data requirements (the contract should specify whether the documentation is to be prepared by a Government agency or by the contractor):

1. Copies of results of all tests performed by the prime or subcontractor during development and evaluation/qualification of an initiator and any statistical analysis of these results.

2. Drawings in accordance with MIL-D-1000 Category E, Form 1 or contractor drawings in sufficient detail as to parts, special processes and techniques to permit government preparation of Category E, Form 1 drawings.

If full disclosure cannot be obtained for Category E, Form 1 drawings in accordance with MIL-D-1000 then a source or specification control drawing, as defined in MIL-STD-100 shall be submitted or contractor drawings and data in sufficient detail to permit government preparation of the source or specification control drawing.

3. Detail drawings of test sets used during testing to permit manufacture of identical test sets for follow on production testing.

4. Production and acceptance specifications in accordance with Defense Standardization Manual DSM 4120.3-M.

5. Classification of characteristics in accordance with the cognizant design agency requirements.

(i.e. WR-43 (Navy), MIL-T-60530 (Army) and _____ (Air Force).)

6. Complete manufacturing drawings of the initiator and of test sets used in the development and evaluation/qualification of initiators should be submitted to the cognizant design agency no later than concurrently with the test report.

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 use 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.

4.1.1 Materials. Inspection and testing of component parts and assemblies shall be made to determine compliance with 3.3. Where defects, incompatibility or inferior quality is evident and the Government design agency deems a material analysis, the contractor will be required to submit samples or specimens to the contracting officer for analysis and approval.

4.1.2 Examination of Product. Examination of all products shall be made to determine if the initiator meets the requirements with respect to workmanship, marking, conformance to drawings, and for any visible defects.

4.1.2.1 Dimensional Inspection. Each part of a new initiator shall be 100 percent dimensionally inspected for conformance to the applicable drawing. Should replacement of a part in the initiator be necessary, the replacement part shall be 100 percent dimensionally inspected for conformance to the applicable drawing.

4.1.2.2 Radiographic Inspection. All initiators shall be inspected by radiographic means as specified in 3.3.12 and plates examined for defects.

4.1.2.3 Leakage. A leak test shall be conducted with a dry gas leak detector of sufficient sensitivity to ascertain if initiators meet the leak rate requirement of 3.3.14.

4.1.3 Instrumentation. Any suitable instrumentation system may be used e.g. oscillograph, oscilloscope, digital readout, magnetic tape; transducers used with this system may be any state of the art type e.g. piezoelectric, strain gage, variable reluctance, capacitive, potentiometer, etc. However, a five percent system accuracy which includes such factors as non-linearity, frequency response, temperature effects and resolution etc. shall be required. Documented calibration records on the system as a whole or individual components shall be maintained and available for reference.

4.1.4 Safety and Functional Reliability. The number of initiators required to meet the reliability and confidence level of this specification for go - no-go testing is 298. The Government design agency has the prerogative of specifying the test procedures and methods of statistical analysis which will be used to determine the minimum 50 millisecond all-fire stimuli or the Government design agency may accept a procedure proposed by the testing laboratory. Para 6.3 summarizes some of the problems in applying various statistical type analyses.

4.2 Test Conditions. The test conditions are described under the individual tests to which they apply. Initiators shall be fired in the temperature conditioning cabinet at the applicable test temperature. If it is not possible to fire in the temperature conditioning cabinet, the initiator shall be fired as quickly as possible after removal from the cabinet and in no case shall the elapsed time exceed five minutes. During the performance of the tests of 4.4.1 through 4.4.6 the possibility of an initiator firing exists; therefore safety procedures equivalent to those taken during the destructive tests shall be followed. All functional tests of initiators are to be performed with the equipment mounted and loaded in a manner to simulate as closely as possible service conditions.

4.3 Engineering Design Tests. The engineering design tests are conducted to determine the technical characteristics as indicated by the initiator design. Determination includes the measurements of the inherent structural, electrical, or other physical and chemical properties, and may utilize data obtained from previous tests. These tests are characterized by controlled conditions and the elimination of human error in judgement, as much as possible, through the use of environmental chambers, measurement techniques, and statistical analysis. These tests include all the tests in Table I, an explanation of which is given in paragraph 4.3.1. The engineering design test shall be conducted at a Government laboratory or, if by a contractor, shall be witnessed and the test procedures approved by Government personnel as assigned by the Government design agency.

4.3.1 Explanation of Table I. The following is an explanation of the working procedure to be utilized when working with Table I.

A total of 416 initiators are to be tested and all are ultimately destroyed in the minimum 50 millisecond all-fire test, or the cook-off test, or the 40 foot drop test. Reading from left to right along the top row, the 416 initiators are divided into 21 groups consisting of 50, 6, 6, 20, 20 etc. For example:

The first group consists of 50 initiators. Reading down the first column it is seen from the "X" designations that this group of 50 initiators is to be subject to the following tests in the sequence given:

Dielectric withstanding voltage
Radiographic
Leakage
Resistance
Static Discharge
Resistance
Stray Voltage
Resistance
Power current or Stimulus 70°F

and finally destroyed in the Minimum 50 millisecond all fire test at 70°F. Note that some tests, such as resistance are repeated.

The second group consists of 6 initiators. Reading down, it is seen from the "X" designations that this group of 6 initiators is to be subject to the following tests in the sequence given:

Dielectric Withstanding Voltage
Radiographic
Leakage
Resistance

TABLE I. ENGINEERING DESIGN TEST SCHEDULE

TEST	REF. PARA.	NUMBER OF INITIATORS (GROUPS)																					TOTAL
		50	6	6	20	20	20	20	20	20	20	20	2	2	2	2	2	2	2	2	2	116	416
Dielectric withstanding Voltage	4.4.1	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	416
Radiographic	4.1.3.2	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	416
Leakage	4.1.3.3	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	416
Resistance	4.4.2	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	416
Static Discharge	4.4.3.2	X																					50
Resistance	4.4.2	X																					50
Stray Voltage	4.4.3.3	X																					50
Resistance	4.4.2	X																					50
Power Current or Stimulus 70°F	4.4.3.1 4.4.5.1	X																					50
Resistance	4.4.2	X																					50
40 Foot Drop	4.6.1		X																				6
6 Foot Drop	4.6.2			X																			6
Shock	4.6.3				X								X	X	X	X	X	X	X	X	X		38
Vibration	4.6.4					X							X	X	X	X	X	X	X	X	X		38
Temperature-Shock/Humidity/ Altitude	4.6.5						X																32
CookOff	4.6.6.1							X															20
High Temperature Exposure	4.6.6.2								X														20
Salt Fog	4.6.7									X													20
Radiographic	4.1.3.2			X	X	X	X						X	X	X	X	X	X	X	X	X		84
Resistance	4.4.2			X	X	X	X		X	X			X	X	X	X	X	X	X	X	X		124
Leakage	4.1.3.3			X	X	X	X						X	X	X	X	X	X	X	X	X		84
Static Discharge	4.4.3.2			X	X	X	X		X	X			X	X	X	X	X	X	X	X	X		124
Resistance	4.4.2			X	X	X	X		X	X			X	X	X	X	X	X	X	X	X		124
Power Current or Stimulus 70°F	4.4.3.1 or 4.4.5.1			X	X	X	X			X			X	X	X	X	X	X	X	X	X		104
Power Current or Parmeters 225°F	4.4.3.1 or 4.4.5.1								X		X												40
Resistance	4.4.2			X	X	X	X		X	X	X		X	X	X	X	X	X	X	X	X		144
Min. 50 Milli sec, All-Fire 70°F	4.4.4	X		X	X	X				X			X			X			X			X	298
Min. 50 Milli sec, All-Fire -80°F	4.4.6						X					X		X				X			X		46
Min. 50 Milli sec, All-Fire 225°F	4.7								X		X				X				X				46

and finally destroyed in the 40 foot Drop. Similar reasoning applies to each of the 21 groups.

The total in the right hand column is the number of initiators subject to that particular test in its respective row. For example, adding up 20, 20, 2, 2, and 2 yields a total of 46 initiators subject to the 50 millisecond all-fire test at -80°F.

4.3.2 Test Plan. The contractor shall submit a test plan prior to engineering design testing.

4.3.3 Test Report. The contractor shall submit a test report after completion of engineering design testing.

4.3.4 Rejection and Retest (Engineering Design Tests). Failure of any initiator to conform to the applicable requirements of this specification shall be cause for rejection of the design of the initiator. However, if it can be determined that the initiator failed to meet the requirements as a result of previous firing of the initiator, the failure and reason for failure shall be noted and the firing repeated using another initiator. If the failure can be attributed to design or other defect, the initiators to be used in engineering design testing may be reworked, have parts replaced or redesigned to correct the defects, and all the tests shall be repeated. Before the tests are repeated, full particulars concerning the failure and action taken to correct the defects shall be submitted to the cognizant Government design agency.

4.3.5 Final Design Configuration and Same Production Run. Only initiators of final design configuration and from the same production run shall be subjected to engineering design testing.

4.4 Test Methods

4.4.1 Dielectric Withstanding Voltage. To determine if the initiator meets the dielectric withstanding voltage requirements of 3.3.9 and 3.4.1, a dielectric withstanding voltage of 500 ± 25 volts d.c. shall be applied for 60 seconds between pairs of pins or leads in all combinations prior to assembly of the bridge and between the shorted pins or leads (all pins or leads shorted to each other external to the initiator) and the case after complete assembly of the initiator. In each test, the leakage current shall be measured with an accuracy of 5 percent. These tests shall be conducted in accordance with MIL - STD 202 Method 301.

4.4.2 Bridge Circuit Resistance or Bridge Circuit Continuity. To determine if the initiator meets the requirements of 3.3.9 and 3.4.2.1 the test method shall be as follows: For an initiator which does not contain a bridge circuit gap the resistance of each bridge circuit shall be measured with an accuracy of one percent using a test which subjects the bridge circuit to a current of less than 50 milliamperes. These tests shall be conducted in accordance with MIL - STD - 202,

Method 303 except that the measurement shall be made at or corrected to 70°F. For an initiator which does contain a bridge circuit gap as defined in 6.2.5 the bridge circuit continuity, excluding the gap, shall be determined using a test circuit which subjects the bridge circuit to a current of less than 50 milliamperes.

4.4.3 Maximum No-Fire Stimuli, Class A

4.4.3.1 Power Current. To determine if the initiator meets the power current stimulus of 3.4.3.2.1, a direct current of not less than one ampere supplying a minimum of one watt shall be applied to the bridge circuit for a period of at least five minutes. For an initiator having more than one bridge, the current shall be applied to all bridge circuits. The test current shall be regulated throughout the period of application to within 2 Percent. If a rectified current is used, the ripple content shall not exceed 5 per cent rms of the test current. The initiator shall be conditioned at 70 ± 5°F or 225 ± 5°F. as appropriate (see Table I) for a period of 12 hours.

4.4.3.2 Static Discharge. To determine if the initiator meets the requirements of 3.4.3.2.2 a 500 ± 5 percent picofarad capacitor charged to 25000 ± 500 volts and 5000 ± 5 percent ohm resistor shall be connected in a 5 microhenry total inductance series circuit between pairs of pins or leads in all combinations and between the shorted pins or leads (all pins or leads shorted to each other external to the initiator) and the case of the initiator. The series connection shall be maintained for 60 seconds. Switching in this circuit shall be accomplished by bringing together two 0.5 ± 0.05 inch spherical metal electrodes from an initial separation of 3 inches in air. Each series test shall constitute a separate test. Initiators used for this test shall be temperature conditioned for a minimum time of 12 hours at 70° ± 5°F.

4.4.3.3 Stray Voltage. To determine if the initiator meets the requirements of 3.4.3.2.3, each initiator shall be subjected to 2000 pulses of direct current. Each pulse shall be of 300 milliseconds duration and pulse rate shall be 2 per second. Each pulse shall have a minimum amplitude of 100 ± 5 milliamperes. The initiator shall be temperature conditioned at 70° ± 5°F for a period of 12 hours.

4.4.4 Minimum 50 Millisecond All-Fire Stimulus, Class A. To determine if the initiator meets the minimum 50 millisecond all-fire stimulus requirement of 3.4.3.3 a direct current pulse of not more than 5 amperes shall be applied to the bridge circuit. For an initiator having more than one bridge, the current pulse shall be applied to one bridge circuit only. The test current shall be a d.c. current pulse, regulated throughout the period of application, to within 2 per cent of the desired value. If a rectified current is used, the ripple content shall not exceed 5 percent rms of the test current. The initiators shall be preconditioned at 70 ± 5°F., - 80° ± 5°F., or at 225° ± 5°F. as appropriate, (see Table I) for a period of 12 hours.

4.4.5 Maximum No-Fire Stimuli Class B

4.4.5.1 Power Current. To determine the maximum no-fire stimulus as required by 3.4.3.4.1, the bridge circuit shall be pulsed with current from the power supply (firing unit) of the unit of intended application or with a current which simulates that current. One parameter of the firing circuit, e.g. voltage, current, capacitance, etc., shall be chosen and shall be varied according to the requirements of the statistical test used. In each case, the parameter varied shall be adjusted to within 2 percent of the required value. For initiators having more than one bridge, only one bridge circuit shall be pulsed with current. Initiators used for this test shall be temperature conditioned for a minimum time of 12 hours at + 70 ± 5°F.

4.4.5.2 Static Discharge. To determine if the initiator meets the requirements of 3.4.3.4.2 a 500 ± 5 percent picofarad capacitor charged to 25000 ± 500 volts and 5000 ± 5 percent ohm resistor shall be connected in a 5 microhenry total inductance series circuit between pairs of pins or leads in all combinations and between the shorted pins or leads (all pins or leads shorted to each other external to the initiator) and the case of the initiator. The series connection shall be maintained for 60 seconds. Switching in this circuit shall be accomplished by bringing together two 0.5 ± 0.05 inch spherical metal electrodes from an initial separation of 3 inches in air. Each series test shall constitute a separate test. Initiators used for this test shall be temperature conditioned for a minimum time of 12 hours at 70° ± 5°F.

4.4.6 Minimum 50 Millisecond All-Fire Stimulus, Class B. To determine the minimum 50 millisecond all-fire stimulus as required by 3.4.3.5 the bridge circuit shall be energized from the power supply (firing unit) of the unit of intended application or from a source which simulates that supply. One parameter of the firing circuit e.g. voltage, current, capacitance, etc. shall be chosen and shall be varied according to the requirements of the statistical test used. In each case, the parameter varied shall be adjusted to within 2 percent of the required value. For initiators having more than one bridge, only one bridge circuit shall be energized. Initiators used for this test shall be temperature conditioned for a minimum time of 12 hours at - 80° ± 5°F.

4.5 Bridge Circuit Resistance Subsequent to Actuation, Class A and B. To determine if the initiator meets the requirement of 3.4.4, when applicable, all initiators which will be tested according to the minimum 50 millisecond all-fire tests specified in 4.4.4 or 4.4.6 shall be subjected to the following test: The bridge circuit resistance of each bridge circuit shall be measured in accordance with MIL STD 202, Method 302 using test condition B (500 volt ± 10 per cent). This test shall be conducted within a period of 5 minutes subsequent to actuation of the initiator.

4.6 Environmental Tests.

4.6.1 Forty Foot Drop. To determine if the initiators meet the requirement of 3.5.1, the forty foot drop test shall be conducted in accordance with test 103 of MIL STD 331 except as modified herein. Six unprotected initiators are to be dropped and impacted in each of the following orientations:

2 unprotected initiators nose up

2 unprotected initiators nose down

2 unprotected initiators horizontal

4.6.2 Six Foot Drop. To determine if the initiators meet the requirements of 3.5.2, six unprotected initiators are to be dropped and impacted onto a 2 inch thick steel plate imbedded in concrete, in each of the following orientations where possible:

2 unprotected initiators nose up

2 unprotected initiators nose down

2 unprotected initiators horizontal

4.6.3 Shock. To determine if the initiators meet the shock requirement of 3.5.3 the initiators shall be tested as follows. Initiators are to be mounted in the device of intended use or in a suitable test vehicle.

If the test is conducted using a suitable test vehicle, the degree of support shall be the same as that afforded by the device of intended application. The shock pulse shall be applied to the initiator's mounting points in both directions along each of three mutually perpendicular axes. The shape of each shock pulse shall approximate as nearly as possible a half sine wave. The amplitude of each shock pulse shall exceed 200 g's for 1.5 ± 0.4 milliseconds and it shall exceed 65 g's for 9 ± 0.9 milliseconds. Initiators shall be free from visible damage or leaks (if applicable), and shall perform satisfactorily in function tests subsequent to this test.

4.6.4 Vibration. To determine if the initiators meet the requirements of 3.5.4 they shall be tested to the vibration test of Table 514-1 aircraft category, procedure 1, parts 1, 2, and 3, with curve H of MIL STD 810 except that each resonant and cyling period shall be divided equally among - 65°F., 70°F., and 200°F. The time of vibration shall be continuous and not accumulative at each temperature.

4.6.5 Temperature-Shock/Humidity/Altitude. To determine if the initiators meet the requirements of 3.5.5, the initiators shall be subjected to the temperature-shock/humidity/altitude test as outlined below.

The schedule has been arranged in such a manner that operations are not required outside normal working hours except for such supervision as may be necessary to insure proper operation of the test equipment.

It is not mandatory that the day/clock time schedule given below be followed: however, it is mandatory that the time, environmental, and sequence requirements be adhered to. It is also noted that only two conditioning chambers are required to accomplish this test. No less than two chambers may be used and still accomplish the temperature shock portion of this test. If it is desired to use three chambers, it is permissible provided the time, environmental, and sequence requirements are met. The fluctuations from the specified temperatures shall not exceed 5°F. When the temperature/altitude chamber door is opened to place test items inside, the chamber pressure will become atmospheric. The time required to return the chamber pressure to 0.65 pounds per square inch (psi) shall not exceed 1 hour.

Test specimens shall be supported on screen trays or racks so that all areas are exposed to the prescribed atmospheric conditions at all times throughout the test.

Procedure

Monday	0800 -	Place test items in a chamber maintained at +70°F at 50 percent relative humidity (RH).
	1200 -	Raise chamber temperature to + 160° F and the RH to 95 percent. The chamber temperature shall reach +160°F at 95 percent RH not later than 1300.
	1600 -	Remove test items from above chamber and immediately place in a chamber maintained at - 65°F at a pressure altitude of 70,000 feet. (0.65 psi)
Tuesday	0800 -	Remove test items from above chamber and immediately place in a chamber maintained at +70°F at 50 percent RH.
	1200 -	Remove test items from above chamber and immediately place in a chamber maintained at - 65°F at a pressure altitude of 70,000 feet. (0.65 psi)
	1600 -	Remove test items from above chamber and immediately place in a chamber maintained at + 160°F at 95 percent RH.

Wednesday 0800 - Reduce chamber temperature to + 70°F at 50 percent RH. The chamber temperature shall reach + 70°F at 50 percent RH not later than 0900.

1200 - Raise chamber temperature to + 160°F at 95 percent RH. The chamber temperature shall reach + 160°F at 95 percent RH not later than 1300.

1600 - Remove test items from above chamber and immediately place in a chamber maintained at - 65°F at a pressure altitude of 70,000 feet. (0.65 psi)

Thursday 0800 - Remove test items from above chamber and immediately place in a chamber maintained at + 70°F at 50 percent RH.

1200 - Remove test items from above chamber and immediately place in a chamber maintained at - 65°F at a pressure altitude of 70,000 feet. (0.65 psi)

1600 - Remove test items from above chamber and immediately place in a chamber maintained at + 160°F at 95 percent RH.

Friday 0800 - Reduce chamber temperature to + 70°F at 50 percent RH. The chamber temperature shall reach + 70°F at 50 percent RH not later than 0900.

1200 - Raise chamber temperature to + 160°F at 95 percent RH. The chamber temperature shall reach + 160°F at 95 percent RH not later than 1300.

1600 - Remove test items from above chamber and immediately place in a chamber maintained at - 65°F at standard ambient pressure.

This schedule shall be followed for a total of 4 weeks (28 days) except that on the second and fourth weekends the soak time shall be from 1200 on Friday until 0800 on Monday at a temperature of + 160°F at 95 percent RH. At the conclusion of the temperature-shock/humidity/altitude test, the test items shall be allocated to the tests specified in Table I.

4.6.6 Cook-Off and High Temperature Exposure

4.6.6.1 Cook-Off. Four initiators shall be placed in an oven preheated to the highest temperature which it is estimated that the initiators will withstand for 1 hour. If no initiator cooks off during 1 hour, the temperature shall be increased 25°F. and the test repeated with four new initiators. The test shall be repeated in 25° increments until cook-off of at least one initiator occurs within a 1 hour period. If cook-off occurs in the first group tested, the temperature shall be decreased 25°F. and the test repeated with four new initiators. The test shall be repeated in 25° decrements until cook-off does not occur within a 1 hour period.

The purpose of this test is explained in the requirements in 3.5.6.

4.6.6.2 High temperature exposure. To determine if the initiators meet the requirements of high temperature exposure of 3.5.7, 10 initiators shall be placed in an oven preheated to a temperature 25°F. less than the maximum determined for exposure without cook-off in 4.6.6.1. The temperature shall be maintained for 12 hours. If no initiator cooks off, the 10 initiators shall be cooled to 70°F and functionally tested. If any initiator cooks off, or fails to meet design performance requirements after cooling, the test shall be repeated with additional groups of initiators, decreasing the temperature in increments of 25°F until design performance requirements are met.

4.6.7 Salt Fog Test. To determine if the initiators meet the requirements of 3.5.8, the salt fog test shall be conducted according to Procedure 1 of MIL-STD-810.

4.7 Functional Test. The initiators, and where practicable, their firing test devices shall be temperature conditioned and maintained at the required temperature for at least1 hour after the temperature of all parts has been stabilized; then the initiators shall be test fired. A simulated test device and initiator with a temperature sensitive element shall be used as a grain temperature monitor during temperature conditioning. Functions shall comply with the requirements of 3.6. If the initiator cannot be test fired within the temperature chamber, the test devices shall be fired within 5 minutes after removal from the chamber. Whenever it is necessary to repeat low (-65°F) temperature conditioning of a cold device, all condensation shall be removed from the device before it is returned to the temperature conditioning chamber.

5. PREPARATION FOR DELIVERY

Not Applicable

6. NOTES

6.1 Intended Use. This specification is intended to prescribe practices to be followed in the design of electrical initiators and prescribes test procedures for the evaluation of the initiators by subjecting them to simulated and accelerated environmental conditions and to functional tests as necessary to insure satisfactory electrical and functional performance and reliability when initiators are utilized or stored under the range of conditions encountered in service.

6.2 Definitions. For purposes of this specification the following are definitions of items or terms pertaining to electric initiators.

6.2.1 Initiator. Any single discrete unit, device or subassembly whose actuation is caused by the application of electric energy which in turn initiates an explosive, propellant, or pyrotechnic material contained therein. The term "initiator" does not include complete assemblies which have electric initiators as subassemblies but includes only the subassemblies themselves. The following are definitions of typical examples of electric initiators.

6.2.1.1 Hot Wire Initiator. Any initiator whose bridgewire is heated by the direct application of electric energy to effect initiation.

6.2.1.2 Exploding Bridgewire Initiator. An initiator whose bridgewire must be vaporized in a few microseconds (usually five or less) by the direct application of electrical energy in order to effect initiation.

6.2.1.3 Conductive Mix Initiator. An initiator in which the bridge consists of a conductive explosive, propellant or pyrotechnic material which is in direct contact with the initiator contacts. Actuation is caused by passing current through the conductive material thereby heating it directly.

6.2.2 Bridge. A resistive element (usually in the form of a wire used to span the gap between two contacts) through which electric energy is converted to heat (also light and shock in exploding bridges) for the purpose of initiating an explosive, propellant, or pyrotechnic material directly.

6.2.3 Contact. That part of the bridge circuit, usually in the form of a wire or small metal rod, which serves to complete the electric circuit between the bridge and the electric connector of the power source.

6.2.4 Bridge Circuit. The open circuit containing the bridge, contacts and electric elements permanently in series or parallel with the bridge circuit. It does not include any electric elements connected externally to the contacts such as shorting or firing leads.

6.2.5 Bridge Circuit Gap. A non-linear resistive element, usually in the form of a spark gap or semiconductor, which forms a part of the bridge

circuit and which limits the bridge circuit current until a potential equal to or greater than the bridge circuit gap breakdown is applied to the circuit.

6.2.6 Output. A measurable parameter, such as pressure, current, voltage, resistance, shock wave duration, dent, mechanical force, etc. which can be related to the expected performance of the initiator.

6.2.7 Minimum 50 Millisecond All-Fire Stimulus. The least firing stimulus which causes initiation within 50 milliseconds of not less than 99.0 per cent of all initiators of a given design at a level of confidence of 95 per cent. For electric initiators which contain a delay element the firing stimulus shall be applied for not less than 50 milliseconds, but the actuation time shall be extended to include the maximum delay time specified for the delay element.

6.2.8 Firing Time. Firing time is the total elapsed time from the time of application of the firing all-fire stimulus to the time of initiator actuation, exclusive of delay element time, if present.

6.2.9 Maximum no-fire stimulus. The greatest firing stimulus which does not cause initiation within five minutes of more than 1.0 percent of all electric initiators of a given design at a level of confidence of 95 per cent. For electric initiators which contain a delay element the firing stimulus shall be applied for 5 minutes exclusive of delay element time if present.

6.3 Summary of some Problems in Applying Various Statistical Type Analyses. Various statistical type analyses have been prepared and are used in order to determine safety and reliability; for example: Bruceton method, Probit method etc. Statisticians have pointed out the fallacy of a blanket use of these various methods and the extreme care necessary in their application. Much effort is being conducted in search of an ideal method for this type of testing. AMP Report No. 101.1R SRG - PN 40 or NAVORD Report No. 2101 in conjunction with an article ("A Statistical Precise Method of Estimating the Bio-Assay and Quantal Response, Based on the Logistical Distribution Function")in the Journal of American Statistical Association 48, pages 565-599, September, 1953 elucidates on one of the methods. In light of these difficulties, the only really safe method of reliability testing is the standard GO, NO-GO type.

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