SECTION J- LIST OF DOCUMENTS, EXHIBITS, AND OTHER ATTACHMENTS

The following documents are attached hereto and made a part of this contract:

J.1 Statement of Work

J.2 Design and Performance Specification for NASA Standard Initiator-1.

J.3 Data Requirements List (DRL) and Data Requirements Descriptions (DRD)

J.4 Safety and Health Plan

J.5 System Safety Program Plan

STATEMENT OF WORK (SOW)
FOR THE MANUFACTURE
OF THE
SOLID ROCKET MOTOR (SRM) IGNITION INITIATOR (SII)
(P/N SKD26100107-302)

CONTENTS PAGE

1.0 SCOPE

1.1 General

The contractor shall manufacture the Solid Rocket Motor (SRM) Ignition Initiator (SII) in accordance with the requirements of this Statement of Work (SOW) and the SKD26100109 document, the Design and Performance Specification for Solid Rocket Motor Initiator (SRM Initiator), which is attached.

The SIIs shall be loaded with a propellant mix previously approved for use in manufacturing the NASA Standard Initiator (NSI). Loading of the SII may be conducted in conjunction with the loading of a NSI production lot, or the SIIs may be loaded separately.

The contractor shall manufacture 500 units under the basic requirements of this contract.

2.0 TECHNICAL REQUIREMENTS

2.1 Lot Definition

A Lot is a group of SIIs containing components which have the same design, construction, and material, fabricated (controlled by one unchanged set of baseline documents) in an essentially continuous manufacturing process (i.e., no manufacturing interruption exceeding thirty (30) days). The explosive material used in each lot shall be from the same batch prepared and accepted under a single continuous process. A change in qualified personnel and equivalent equipment is allowed during manufacture of a lot. Submittal to JSC for acceptance of the lot shall occur after completion of all manufacturing, acceptance testing, and data reviews by the manufacturer. Lot designators shall be assigned by the NASA-JSC Contracting Officer's Technical Representative (COTR).

2.1.1 Lot Size

Lot Size shall not exceed 250 serialized units.

2.2 Manufacturing

2.2.1 Gas for Cleaning

"Shop air" (compressed air not filtered and dried) shall not be used for cleaning purposes.

2.2.2 Liquids Contamination Prevention

Except for the liquid used to make the slurry, liquids shall be controlled so that they shall not come into contact at any time with the explosive mix. To prevent contamination of the explosive material(s) with liquids, the supplier's applicable manufacturing procedures shall specify that each device shall be completely dry prior to loading and that no liquids are to be utilized for cleaning or sealing preparation after addition of the explosive materials and prior to sealing. The procedures shall specify that the immediate area of explosive loading shall be free of such liquids as methanol, Freon, solvents, and alcohol. In the event that spillage of explosive material necessitates cleaning

of the loading area with liquids, all parts must be removed from the area until after such cleaning is completed, the area is completely dry, and the liquids have been removed. If liquids are used to clean a loaded unit, after sealing and prior to leak testing, any unit failing leak testing shall not be reworked, and the unit shall be rejected.

2.2.3 In-Process Radiographs (N-RAYS)

An N-Ray of each initiator shall be made after the cup adhesive curing process but before explosive loading in order to verify the charge cup is properly seated. The view shall be normal to the longitudinal axis, pins furthest apart.

A detailed inspection record and film review criteria shall be submitted to the COTR prior to loading, per JSC Data Requirements Description DRD 1.

2.2.4 Final Radiographs (N-RAYS)

After final assembly, all SIIs shall be N-Rayed in two positions (90° apart and normal to the longitudinal axis) to verify correct assembly to drawing requirements. The N-Rays shall be made using a reactor source of energy as specified in JSC 20431, NASA-JSC Neutron Radiography Specification. The SIIs shall be filmed in serial number sequence and the test data serialized in the same sequence.

Detailed inspection and film review criteria shall be included in the contractor document concerning N-Ray as specified in DRD 1. It shall contain, as a minimum, the following criteria to show the SII has successfully passed the acceptance radiographic test:

a. Verify that the explosive charge is present.

b. Verify that there are no missing or improperly oriented parts.

c. Verify that there are no foreign objects or material present.

d. Verify that the lot, part, and serial numbers are on the radiographs.

2.3 Propellant Requirements

2.3.1 Caloric Output

The contractor shall provide the caloric output of the explosive mix used to load each lot of SIIs. The caloric output shall be determined by test within one year prior to loading each lot of SIIs. Thermal output of the mix shall be between 1340-1450 cal/gm. The data shall be approved by the NASA-JSC COTR prior to loading each lot of SIIs, per DRD 10.

2.3.2 Unloaded Samples

The contractor shall provide the following unloaded samples:

a. a one (1) gram sample of the Zirconium (wet) to JSC for each propellant blend.

b. a one (1) gram sample of the Potassium Perchlorate to JSC for each propellant blend.

c. a one (1) gram sample of the blended propellant for each lot of initiators. This sample shall be taken just prior to the weighing of the propellant for loading.

All samples shall be identified by name, lot number or other identifying number, and date the sample is taken. The lot number or identifying number shall also be shown on the container from which the sample is taken. JSC shall supply the sample containers.

2.3.3 Sample Shipment

The contractor shall hold the unloaded samples in contractor bonded storage until the manufacture of the last lot of initiators has been completed. The contractor shall then ship all of the samples to the address listed:

NASA/JSC
TRANSPORTATION OFFICER
BLDG. 420
HOUSTON, TX 77058
Marked for: **THE PYROTECHNICS TEST FACILITY, BLDG. 352**

All sample and test shipments under this contract shall be to the location above.

2.4 Tensile Test Coupons

The contractor shall conduct tensile tests on three "standard" tensile bars (coupons) per American Society for Testing & Materials (ASTM) E8. The coupons shall be from the same Aerospace Material Specification (AMS) 5662 melt (lot) as the SII body material and shall be heat-treated simultaneously with the SII bodies. The following data shall be obtained from the tensile test coupons and recorded on the lot acceptance data sheets.

a. Tensile strength (185 KSI minimum)

b. Yield Strength at 0.2% offset (150 KSI minimum)

c. Elongation in 2 inches (10% minimum)

d. Reduction of area (12% minimum)

Failure to meet the minimum criteria as listed above shall be a cause for rejection of that lot of bodies heat-treated with those coupons. This information is required by DRD 8 covering the SII Body Material Tensile Test. Acceptance of the material test data by NASA-JSC COTR is required prior to the start of lot fabrication.

2.5 Government Furnished Equipment (GFE)

NASA-JSC shall supply the following items as GFE:

a. one (1) Initiator Resistance Measuring Equipment (IRME) unit

b. one (1) Initiator Firing Unit (IFU)

c. one (1) Faraday Cap for each deliverable SII

d. Shipping Containers (quantity as required)

3.0 REPORTING REQUIREMENTS

3.1 Design and Performance Requirements

The contractor shall manufacture initiators that meet the design and performance requirements specified by JSC document SKD26100109, the Design and Performance Specification for Solid Rocket Motor Initiator (SRM Initiator), attachment A. The initiators shall comply with the initiator drawing package, attachment B, referenced in the list of applicable documents in Section 4.0 of this SOW.

3.2 Manufacturing Methods and Testing Requirements

The manufacturing and testing of the SII shall be delineated in the appropriate contractor documents to be provided as part of the contract in compliance with SKD26100109, the Design and Performance Specification for Solid Rocket Motor Initiator (SRM Initiator), and the drawing package referenced in the list of applicable documents in Section 4.0 of this SOW. These documents shall have the NASA-JSC COTR and Quality Engineering (QE) approval prior to, or during, the phase review establishing the control documentation. Any changes to these documents after the phase review shall have COTR and QE approval prior to use of the new revision. These documents are required by DRD 4 covering the SII Control Documentation.

All components used in the fabrication of a lot SIIs shall have lot traceability complying with Section 3.5.6 of this SOW and be from single component lots.

3.2.1 Design and Fabrication of Tooling

Tooling required for pyrotechnic loading of the device shall be contractor furnished equipment per DRD 4 covering SII Control Documentation. Tooling used in fabrication of the initiators shall be controlled by part number, revision and serial number (S/N), if applicable, to clearly show traceability of tooling used. Where tooling is called out in a manufacturing procedure or acceptance test procedure, the serial number (S/N), if applicable, used shall be recorded in the traveler/procedure to maintain traceability.

3.3 Key Personnel

The contractor shall provide the NASA-JSC COTR a certification of key personnel responsible for management of the engineering, manufacturing, and quality functions required for accomplishing the requirements of this contract. If any personnel changes are made during the contract the vendor shall notify the COTR in writing prior to making the changes.

3.4 Conference and Review Requirements

The contractor shall support contractual specified conferences, reviews, and surveys including corrective action and recurrence controls. These reviews and surveys shall be conducted at contractor facilities per DRD 9 and will be chaired by the NASA-JSC COTR. The contractor shall support contractual specified conferences and reviews including corrective action and recurrence controls. The contractor shall also prepare and make available to the attendees all documentation necessary to accomplish the intended objectives.

3.4.1 Reviews

The following reviews shall be required.

a. Phase I, Baseline Review: A Baseline Review shall precede the start of manufacture of any initiators. This review shall include the control documentation referenced in Paragraph 4.1.1 of this SOW and DRD 4. NASA-JSC will direct the contractor with the authorization to proceed with the manufacture of the SIIs for qualification or production following reviews and the closeout of open review items.

b. Phase II, Production Review: A Production Review may be conducted at the contractor facility (chaired by the NASA COTR) prior to the start of manufacture of the production lot of SIIs. This review shall assure adequate evaluation and control of all proposed changes to the baseline, including the potential effect of the changes upon the qualification status of the NSI. The review shall also address proposed personnel changes and the current certification of personnel.

c. Phase III, Lot Acceptance/Certification Review: The Phase III Lot Acceptance/Certification Review shall be conducted, by the NASA at the contractor facility, prior to issuing a flight lot certificate as described below. This NASA review shall assure that the intent of the Phase I Baseline Review and the Phase II Production Review has been successfully satisfied. The Phase III review shall be conducted after the SIIs have been manufactured and presented to the Government for acceptance.

Acceptance/Certification shall be based on a detailed, critical review of all manufacturing, inspection, and acceptance data and records. The SIIs may be packaged for shipment after completion of the Phase III review. A flight lot certificate shall be issued by NASA for each lot of qualified SIIs prior to shipment from the supplier per DRD 3.

3.4.2 Surveys

The following Surveys shall be supported:

a. Safety, Reliability, and Quality Assurance (SR&QA) surveys shall be conducted by NASA at the contractor facility. The contractor shall support these surveys with the necessary documentation and personnel. The contractor shall provide data upon request which shall verify internal conformance to the SR&QA requirements.

b. NASA-JSC reserves the right to conduct one (1) full (major) survey at any time during the contract and/or once every twelve (12) months for contracts that exceed twelve (12) months in duration. The purpose of the survey is to review all contract or task requirements. Thirty (30) days prior to the full survey, the contracting officer (CO) or the COTR shall notify the contractor in writing of the intended survey. This survey will not exceed one (1) week (five (5) working days) duration.

c. NASA-JSC reserves the right to conduct an incremental survey at any time to support the resolution of a specific problem. One (1) week (five (5) working days) prior to the incremental survey, verification of this survey shall be given to the contractor either by telecon or letter from the NASA-JSC CO. An incremental survey is intended to cover only a specific area such as a process control problem or any other unsatisfactory detail that would be of such magnitude that the

resulting hardware would be unacceptable to NASA-JSC and this survey is shall be addressed by the contractor and is detailed in DRD 7.

d. For surveys that contain recommended actions, the surveyed organization shall respond within thirty (30) days after receipt of the survey report and submit a status report every thirty (30) days thereafter until all actions are closed, per DRD 9.

3.5 Quality Assurance Requirements

The contractor shall establish and maintain a Quality Management System (QMS) on the contract date that shall, as a minimum, adhere to the requirements of SAE AS9100, Quality Management Systems - Aerospace - Requirements. The QMS shall provide adequate assurance that the requirements of the technical system specifications shall be consistently met and compliance demonstrated. The QMS procedures, planning, and all other documentation and data that comprise the QMS shall be available to NASA-JSC for review. At the direction of NASA, existing quality documents that meet the requirements of this contract may continue to be used. NASA-JSC may perform necessary inspections, verifications, and evaluations, to ascertain conformance to requirements and adequacy of the implementing the procedures. The contractor shall require of sub-tier suppliers a QMS capable of achieving control of the quality of the services and supplies provided. NASA-JSC reserves the right to disapprove the services and supplies provided. NASA-JSC reserves the right to disapprove the quality program or portions thereof when it fails to meet its intended objectives. A quality plan, developed per the AS9100 requirements, shall be submitted in accordance with DRD 6.

A Defense Contract Management Agency (DCMA) Representative(s) shall reside at the contractor's facility during lot fabrication and test operations. DCMA personnel shall be allowed to continuously review the manufacturing operations during this period to assure the production of acceptable hardware. Incompatibilities between hardware, processes, and/or technical requirements shall be immediately discussed with the contractor and the JSC COTR. The contractor shall immediately initiate Material Review (MR)/Discrepancy Report (DR) action in the case of discrepant hardware or request contract change if required to eliminate any incompatibilities.

3.5.1 Problem Reporting and Corrective Action

The contractor shall provide and maintain a closed loop reporting system involving the contractor and suppliers for the reporting of all problems (failures, unsatisfactory conditions, and material review records) and shall establish corrective actions for all problems concerning flight, test, and training hardware where that hardware is representative of flight hardware, applicable Government Furnished Equipment (GFE), and spare hardware. The contractor shall insure that problem reporting and corrective action systems of its suppliers meet NASA-JSC requirements.

Problem reporting, analysis, resolution, and status shall comply with the requirements of JSC 28035 and be accomplished in accordance with DRD 7.

3.5.2 Material Review (MR)

All MR dispositions shall be approved by the NASA-JSC COTR prior to their use (except scrap and return to vendor) per DRD 3. A copy of the

MR shall be sent to the NASA-JSC CO and COTR for review. Formal notification of MR approval shall be provided by the NASA-JSC CO or the COTR. A contingent review of the MR can be obtained by telephone from the COTR; however, formal approval shall not be provided until review of the written MR and disposition. Use of the material prior to formal approval is at the contractor's risk. The NASA-JSC COTR approval of the MR shall also be coordinated with the cognizant JSC Quality Assurance Division personnel.

3.5.3 Customer Verification of Subcontracted Product

Determination of which parts/components require Government Source Inspection (GSI) at the sub-tier vendor shall be established at the closure of the Phase I Review. The procuring organization shall submit the procurement documents to the designated NASA-JSC quality representative, as necessary, prior to procurement release.

a. When the government elects to perform GSI at a procurement source, the following statement shall be included with the procuring documents:

   "All work in this order is subject to inspection and test by the government at any time and place. The government quality representative with delegated quality assurance functions on this procurement shall be notified immediately upon receipt of this order. The government representatives shall be notified 48 hours in advance of the time articles or materials are ready for inspection or test."

b. Procurements that do not require GSI shall include the following statement:

   "The government has the right to inspect any or all of the work included in this order at the suppliers plant."

3.5.4 Procurement Controls

Procurement documents shall be controlled and maintained to ensure compliance with applicable quality and technical requirements. Procurements shall include the following:

a. Purchased raw material shall be accompanied with chemical and/or physical test results. The required test results will be agreed to at the Phase I Review.

b. Age Controlled and limited-life product records for articles and materials having definite characteristics of quality degradation or drift with age and/or use shall indicate the date and test time or cycle at which useful life was initiated, the life or cycles used, and the date, test time, or cycle at which the useful life is expended.

3.5.5 Raw Material Controls

Raw materials shall be inspected and tested (e.g. chemical and/or physical analysis and/or performance testing) to determine conformance to applicable drawings and specifications. The required test results will be agreed to at the Phase I Review. Reports of actual test results shall be identified with particular materials. Unless otherwise specified or agreed to at the Phase I Review additional testing and analysis is not required provided a test report is available from the manufacturer and can be traced to the certifications of the material

used. Raw material shall be segregated and controlled to prevent the use of materials that do not conform to specifications or while awaiting completion and receipt of satisfactory test results.

3.5.6 Traceability

A system shall be in place to ensure identification of all materials/products, whether separately produced discrete items, or material produced in batches, to ensure traceability to the original source/manufacturer and to determine verification status. This system shall be maintained throughout the life of this contract, including material/product receipt, all stages of production, delivery, and installation for a period of twenty (20) years past the delivery date.

3.6 Safety Requirements

The Safety requirements listed below shall apply.

a. The contractor shall comply with all federal, state, and local codes and standards applicable to work performed on this contract.

b. In the event of serious injury or illness to personnel or damage to equipment and/or property in excess of $10,000 arising from this contract, the contractor shall notify the Occupational Safety & Institutional Assurance Division, code NT, at 281-483-4345, within twenty-four (24) hours of such occurrence. The contractor shall conduct an investigation into the causes of the accident and implement corrective measures. However, NASA-JSC reserves the right to conduct investigation into such occurrence as necessary. The contractor shall provide support as required.

c. The contractor shall perform hazard analyses in sufficient depth to identify and correct conditions which could cause serious personal injury or illness, or significant damage to property limited to manufacturing and processing of toxic materials, test facilities systems, test set-ups, test operations, radio frequency hazards, auto-ignition temperatures, pollution, and environmental contamination.

3.7 Control of Inspection, Measuring, and Test Equipment

Control of Inspection, Measuring, and Test Equipment shall be in accordance with ISO 10012-1, Quality Assurance for measuring Equipment.

3.8 Program Status Report

The contractor shall provide the COTR with a monthly status update in accordance with DRD 9.

4.0 DOCUMENTATION REQUIREMENTS

4.1 General

The contractor shall furnish documentation as set forth in the Data Requirements List (DRL) and the DRDs.

4.1.1 Control Documentation

A record set of all NASA, JSC approved documents pertaining to the materials, manufacturing, quality control, and acceptance of the initiators procured under this contract shall be provided to NASA-JSC per DRD 4.

All drawings, quality control procedures, process, and manufacturing specifications used and all changes to these documents used in the production and testing of the SII shall be approved by the NASA-JSC CO and COTR prior to implementation. This document set shall be established as a baseline for the production of the initiators and shall be maintained throughout the duration of the contract. It shall include one copy of each approved baseline document and each change, as well as a lot effectivity matrix/list for all changes. In addition, an appropriate document shall list by number, title, revision, and date all documents in the record set (both contractor and subcontractor/supplier) and revisions thereto, including a change-effectivity matrix, by lot per DRD 4.

4.2 Applicable Documents

4.2.1 Applicability

The contractor shall comply with the following referenced documents with the same force and effect as if they were given in full text. Drawings are available in from the Engineering Drawing Control Center at (281) 483-4014.

4.2.2 NASA-JSC Applicable Documents

DOCUMENT NUMBER	REVISION	DOCUMENT TITLE
SEB26100005	G	Pin Header Assembly-Glass Seal
SDB26100006	E	Header Body, Two Pin Initiator
SDB26100007	B	Pin, Glass Seal, Header
SDB26100008	C	Disk, Sealing
SDB26100009	F	Charge Cup, NASA Standard Initiator
SDB26100010	B	Disk, Insulating
SDB26100011	B	Washer, Insulating
SDB26100013	C	Cup, Closure
SDB26100016	C	Marking Drawing, Initiator
SDB26100022	NC	Specification for Propellant, NASA Standard Initiator
SDB26100023	NC	Specification for Bridgewire, NASA Standard Initiator
SDB26100024	A	Specification for Adhesive, Charge Cup/Body, NASA Standard Initiator
SDB26100025	A	Specification for Adhesive, Charge Cup/Pin Seal, NASA Standard Initiator
SDB26100026	A	Specification for Potting, Electrical Connector, NASA Standard Initiator

SED26100107	D	Initiator, SRM Ignition
SKD26100109	NC	Design and Performance Specification for Solid Rocket Motor (SRM) Initiator (SRM Initiator)
SDD26107110	NC	Housing, SRM Initiator, Single Piece
SED26107102	B	Body, Welded, SRM Ignition
SED26107103	NC	SRM Initiator Subassembly
SDD26107104	NC	Marking Drawing, SRM Ignition
SAD26107106	NC	Drawing Tree, SRM Initiator, SRM Ignition
SEB26100021	F	Fixture, 10cc Bomb
SLB26100054	B	Wrench, NSI, Installation Tool
SEB26100060	L	Faraday Cap Assembly
SKD26100128	NC	Initiator firing Unit (IFU)
JSC20431	March, 1985	JSC Neutron Radiography Specification
JSC 28035	May, 2001	Problem Reporting and Corrective Action Requirements for Johnson Space Center Government Furnished Equipment
NSTS 08060	J	Space Shuttle System Pyrotechnic Specification

The drawings, specifications, parts lists, and procedures established as a baseline (control) set by the Phase I/Phase II review shall become a part of this statement of work.

4.2.3 Other Applicable Documents

Number	Title
SAE AS9100	Quality Management Systems - Aerospace - Requirements
ISO 10012-1	Control of Inspection, Measuring, and Test Equipment
MIL-STD-2073-1	Standard Practice for Military Packaging

4.2.4 Selection of Specifications and Standards

Unless otherwise specified, specifications and standards for materials, parts, and processes shall be selected by using MIL-STD-143 as a guide. Where not covered by Government documents, specifications shall be subject to approval by the NASA-JSC contracting officer or COTR.

5.0 SHIPPING INSTRUCTIONS

All shipments shall be accordance with Section F, JSC Clause 52.247-94 Shipping Instructions (April 2006), of this solicitation.

REQUEST FOR PROPOSAL # NNJ07HA91R

MANUFACTURE OF THE SOLID ROCKET MOTOR IGNITION INITIATOR

SECTION J.2: DESIGN AND PERFORMANCE SPECIFICATION FOR THE SOLID ROCKET MOTOR IGNITION INITIATOR

RELEASED
Date 6-7-91 Rev NC Init

UNLESS OTHERWISE SPECIFIED: DIMENSIONS ARE IN INCHES. TOLERANCES ON: .0 ± .10, .00 ± .03, .000 ± .010, ANGULAR ±	SIGNATURES	DATE
	DR	
	ENG L. J. Wynn	5-29-91
	CH	
	APP W. C. Hollman	5-29-91
	QE	5-31-91
	MATL W. L. Osteen	6/3/91
	STRESS Stanley P. Wise	6-3-91
	AUTH	6/3/91

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION
LYNDON B. JOHNSON SPACE CENTER HOUSTON, TEXAS

DESIGN AND PERFORMANCE SPECIFICATION FOR SOLID ROCKET MOTOR INITIATOR (SRM INITIATOR)

EQUIP TYPE
☒ FLT HDWR
☐ GSE W/I/F TO FLT
☐ OTHER (SPECIFY)

CODE IDENT NO.	SIZE	DWG NO.	REV.
21356	A	SKD26100109	N/C

SCALE NONE	PPD EP5	SHEET 1 OF 15

26100109

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RELEASED
Date 6·7·91 Rev NC Init mm

DOCUMENT TYPE

PROCUREMENT SPECIFICATION

TITLE

SPECIFICATION FOR THE PRODUCTION OF THE SOLID ROCKET BOOSTER INITIATOR, (SRM INITIATOR) NASA P/N SED26100107-302

1.0 DESIGN REQUIREMENTS

1.1 SELECTION OF SPECIFICATIONS AND STANDARDS

Unless otherwise specified, specifications and standards for materials, parts, and processes shall be selected by using Standard MIL-STD-970 as a guide. Where not covered by Government documents they shall be subject to approval by the Contracting Officer's Technical Representative (COTR).

1.1.1 APPLICABLE DOCUMENTS

Number	Title
MIL-P-116G,	Preservation & packaging, methods of Amendment 2
MIL-G-45204	Gold Plating, Electrodeposited
MIL-S-8879A	Screw Threads, controlled radius root with Amendment 1 increased minor diameter, general specification
ANSI B46.1	Surface Texture, surface roughness waviness and lay
MIL-STD-970	Specifications and Standards, Order of Precedence for the Selection of
MIL-STD-453(1)	Inspection, Radiographic
NHB 5300.4 (1D2)	Safety, Reliability, Maintainability and Quality Provisions for the Space Shuttle Program
MS16142 (or) 33649	Boss, Fluid Connection, Internal MS Straight Thread
MS 29513 (or) MS 83248A	Packing, Performed, Hydrocarbon Fuel Resistant, O-ring
MSFC 40M38298	Connector, Electrical, Special Miniature Flight Circular, Environment Resisting, 200 degrees C.

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AFM 71-4	Packaging and Materials Handling, Preparation of Hazardous Materials for Military Air Shipment
MIL-S-6721	Steel, Corrosion, and Heat Resistant (Chemically Stabilized) Plate, Sheet, and Strip
AMS 3302	Rubber Silicone, General Purpose
FED-STD-595	Color, Requirements for Individual Color Chips
QQ-S-766	Steel Sheet, Corrosion Resisting
AMS 7466	Bolts and Screws, Nickel Alloy, Corrosion and Heat Resistant
ASTM-A-240	Heat Resisting Chromium and Chromium-Nickel Stainless Steel Plate, and Strip for Fusion-Welded Unfired Pressure Vessels
AMS 5662D	Alloy Bars, Forgings, and Rings, Corrosion and Heat Resistant, Inconel 718

1.2 DESIGN

1.2.1 COMPONENTS

The SRM initiator shall include the following components:

a. Body assembly design shall include electrical connector

b. Electrical header with two pins (one bridgewire)

c. Charge Cup

d. Pyrotechnic charge

e. Insulating disks and washer

f. End closure

g. All hardware required to complete assembly, including sealing materials and o-ring.

1.2.1.1 CONSTRUCTION

All details of construction of the SRM initiator shall provide for maximum reliability, safety of personnel, minimum weight, and maximum operating utility. All materials used in the construction of the initiator shall be of high uniform

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quality and be capable of withstanding the electrical and environmental conditions specified herein. No components shall work loose in service and all components shall be capable of withstanding the strains, impacts, vibrations, and other conditions incidental to shipping, storage, installation, and service use. Construction of the initiator shall be such that installation and removal by qualified personnel may be accomplished easily, safely , and without damage. Each SRM initiator component shall be designed to provide the highest quality commensurate with that of best component development and consistent with the requirements of this specification. The initiator shall be designed to preclude inadvertent premature initiation when subjected to the environmental conditions specified herein, and electrical no-fire specified in 1.2.1.8 and 1.2.1.9.

1.2.1.2 CONFIGURATION AND DIMENSIONS

The SRM initiator body shall be as shown in the NASA JSC Specification Control Drawings (SCD), SDB26107101.

1.2.1.3 PYROTECHNIC END

The pyrotechnic or output end of the SRM initiator shall be rolled threaded as shown on the SCD. The SRM initiator with "0" ring shall form a hermetic seal when mated with the next using device.

1.2.1.4 PYROTECHNIC MIX

The initiator shall use an explosive mix of Zirconium - Potassium Perchlorate.

In addition to providing the main charge, a portion of each lot's explosive mix will be used in a slurry mixture with an appropriate solvent to be applied on the bridgewire prior to loading.

1.2.1.5 INITIATOR END CLOSURE

The SRM initiator end closure shall consist of a 347 stainless steel metal plate or disc welded to the body.

1.2.1.6 BRIDGEWIRE CIRCUIT

The initiator shall contain a 304 stainless steel bridgewire circuit electrically insulated from the case and spot-welded to each pin. 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 made of alumina having high electric resistivity and dielectric strength. The measured ambient bridgewire resistance shall be 1.05 +/-0.10 ohms.

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1.2.1.7 ELECTRICAL CONNECTOR

The electrical connector end of the initiator shall mate with MSFC Specification 40M38298, part number NBS9E8-2SE. The connector pin shall be gold-plated in accordance with the provisions of Specification MIL-G-45204, Type I, Grade C, Class 2.

1.2.1.8 MAXIMUM NO-FIRE CURRENT

The SRM initiator shall not ignite when the bridgewire is subjected to a direct current of one ampere for five minutes within the temperature range of +300 degrees F to -260 degrees F. This requirement shall be met without the aid of external heat sinks. The SRM initiator shall be capable of ignition and performance as specified herein after being subjected to the no-fire current test.

1.2.1.9 MAXIMUM NO-FIRE POWER

The SRM initiator shall not ignite when the bridgewire is subjected to a DC power of one watt for five minutes within the temperature range of +300 degrees F. to -260 degrees F. This requirement shall be met without the aid of external heat sinks. The SRM initiator shall be capable of ignition and performance as specified herein after being subjected to the no-fire power test.

1.2.1.10 ALL-FIRE PARAMETERS

The SRM initiator shall ignite in accordance with the performance requirements specified herein when subjected to the following current levels: 5 to 22 amperes from -260 degrees F. to, but not including, -65 degrees F.; 3.5 to 22 amperes from -65 degrees F. to +300 degrees F. and discharge from a 1000 microfarad capacitor charged to 20 volts minimum and 40 volts maximum from -260 degrees F. to +300 degrees F. and a 680 microfarad capacitor charged to 40 volts from -260 degrees F. to +300 degrees F.

1.2.1.11 SPECIAL TOOLS AND TEST EQUIPMENT

The SRM initiator shall be designed to require a minimum of special tools and test equipment. Approval of design features necessitating the use of special tools and test equipment shall be obtained from the COTR before proceeding with production.

1.2.1.12 SURFACE WEAR

Mating surfaces shall be sufficiently smooth and wear resistant to minimize the generation of metal-to-metal and seal wear particles. Surface roughness limitations shall be in accordance with Standard ANSI B46.1.

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1.2.1.13 MATERIAL COMPATIBILITY

All exposed materials and parts of the SRM initiator shall not be susceptible to deterioration or corrosion when subjected to the environmental extremes specified herein .

1.2.1.14 TORQUE

The SRM initiator shall be designed to withstand 150 inch-pounds of torque applied to the wrenching area without damage.

1.2.1.15 HERMETIC SEALING

The SRM initiator shall be hermetically sealed by fusion of metallic or glass materials. The selected methods of sealing shall include any one or a combination of the following methods:

a. Fusion of metallic materials by welding

b. Fusion of glass materials by heat or pressure (Glass used for sealing material shall be visible in N-ray)

1.2.1.16 WORKMANSHIP

The SRM initiator, including all parts and accessories, shall be constructed and finished in a thorough manner. Particular attention shall be given to neatness, precision of fitted parts and assemblies and thoroughness of marking, welding, brazing, plating, machining, fitting, and freedom of parts from burrs and sharp edges that might cause the initiator to malfunction or cause injury to operating personnel.

1.2.2 MATERIALS, PARTS, AND PROCESSES

All parts and processes used in the design and construction of the SRM initiator shall be of high and uniform quality commensurate with good design, shall be capable of withstanding the mechanical, electrical, and environmental conditions specified herein, and shall be reviewed and approved by the COTR.

1.2.2.1 THREADED MATERIALS

All threads on the SRM initiator shall be fabricated from Inconel 718 and be rolled.

1.2.3 FINISH

The finished surfaces of the SRM initiator shall have no protective coating or plating unless specifically approved by the JSC COTR.

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1.2.4 INTERCHANGEABILITY

All parts having the same part number shall be dimensional and functionally interchangeable.

1.2.5 NUMERICAL RELIABILITY

The SRM initiator shall have a probability of success of no less than 0.999 with a confidence level of 90 percent under the environmental conditions, operating time, and the all fire currents as specified herein.

1.3 QUALIFICATION REQUIREMENTS

1.3.1 ENVIRONMENTS

The SRM initiator shall perform as specified during and after exposure to any of the following environments.

1.3.1.1 QUALIFICATION

The criteria described below represent the environmental conditions and levels to which the SRM initiator will be subjected. The initiator shall perform as specified herein after exposure to these environments.

a. Temperature	From minus -260 degrees F. to plus 300 degrees F.
b. Vibration	Random vibration will be experienced in each of three mutually perpendicular axes as follows:
Duration 5 min/axis	LEVELS From 0.01 g2/HZ at 10 HZ with a 6 db/octave increase to 0.8 g2/HZ at 100 HZ. Constant at 0.8 g2/HZ from 100 HZ to 400 HZ with a 3 db/octave decrease to 0.16 g2/HZ at 2,000 HZ.
Sinusoidal	0.3g at 5 HZ with a linear increase of 2 g at 25 HZ, increasing to 10 g at 100 HZ. Also 10 g from 100 HZ to 2,000 HZ.
c. Temperature - Vibration	Vibration per 1.3.1.1b between +300 degrees F. and 260 degrees F.
d. Shock	At 100 g's; 11 +/-1 ms rise

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	and 1 +/-1 ms decay.
e. Temperature - Vacuum	At 10-6 Torr from +300 degrees F. to -260 degrees F. for 2 hrs.
f. Temperature, Cycling	Laboratory ambient to -260 degrees F. and to +300 degrees F. 1 hr. low temperature and 1/2 hr high temperature for 20 cycles.
g. Thermal Shock	Ambient to -320 degrees F. to ambient (3 times) until thermal stabilized. Ambient to -320 degrees F. for 11 hrs. (1 time) and back to ambient.
h. Pressure, Vacuum	At 10 to -10 Torr for 360 hours.
i. Pressure, Internal Static	Acceptance tested @ 15,000 PSI.
j. Pressure, Between o-rings	Acceptance tested @ 3,460 PSI

1.3.1.2 NO-FIRE THERMAL ENVIRONMENTS

The SRM initiator shall not fire during exposure to a temperature of 400 degrees F. for one hour. The SRM initiator shall not be required to fire subsequent to such exposure.

1.3.2 STORAGE LIFE

The SRM initiator shall have a storage life of 10 years when temperatures are maintained within a range of +15 to +120 degrees F.

1.3.3 PERFORMANCE

1.3.3.1 OUTPUT PRESSURE

The SRM initiator shall be designed to produce the following pressures under the conditions listed below:

a. A pressure of 650 +/-125 psig in a 10 cubic centimeter volume within a temperature range of -65 to +300 degrees F. There is no upper pressure limit for -260 degrees F.

b. A minimum pressure of 5,000 psig in a 0.5 cubic centimeter volume at a pressure of 10-6 Torr from -260 to +300 degrees F.

1.3.3.2 FUNCTION TIMES

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The SRM initiator shall be designed to function and reach 525 psig in a 10 cubic centimeter closed bomb as specified below:

Firing Mode	Firing Temperature	Function Time (milliseconds)
Capacitor Discharge (680 mfd. at 40 v.d.c.)	Ambient	1.3 maximum
Capacitor Discharge (680 mfd. at 40 v.d.c.)	-260 degrees F.	10 maximum

1.3.4 LEAKAGE CURRENT

Within five minutes after firing the leakage current shall not exceed 50 milliamperes at 28 volts dc, when applied between the following points.

a. Pin A to Pin B

b. Two pins shorted together and the case

If in excess of 10 percent of the units in lot acceptance, or any qualification test group, exceeds 50 milliamperes after firing, this shall be considered failure of the lot. The SRM initiator shall be removed from the firing chamber before performing the above test.

1.3.5 DIELECTRIC STRENGTH

The SRM initiator shall withstand an AC voltage of 200 (+/- 10) volts root mean square (rms), 60 Hertz, for 60 seconds between the case and both pins shorted together without breakdown. The leakage current shall not exceed 500 microamperes. The initiator shall not ignite or otherwise be degraded. The initiator shall be capable of igniting and conforming to the requirements of this specification after being subjected to the dielectric strength test.

1.3.6 CONTINUITY CURRENT

The SRM initiator shall be capable of withstanding 25 applications of a 50 milliampere pulse, having a duration of one minute through the bridgewire, without degradation.

1.3.7 ENVIRONMENTAL SEAL

The connector end and mating connector environmental seal leakage shall not exceed 10-4 cubic centimeters per second of helium when measured at one atmosphere differential pressure.

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2.0 ACCEPTANCE PERFORMANCE REQUIREMENTS

2.1 TEST FIRING

Whenever a test firing is made, the following recorded traces shall be required:

a. Current through the bridgewire versus time

b. Peak pressure/or accelerometer current versus time

2.2 WEIGHT OF EXPLOSIVE MIX

Each SRM initiator shall be loaded with 114 (+/-4) milligrams of explosive mix. A weighing before and after loading shall be performed on each device and recorded on a data sheet.

2.2.1 ENERGY CONTENT

The caloric output of the mix shall be 1340 calories per gram minimum to 1450 calories per gram maximum.

The propellant batch used for loading the SRM Initiator shall be a blend which has been approved by NASA for loading the NASA Standard Initiator.

2.3 NONDESTRUCTIVE ACCEPTANCE TESTS

Prior to delivery and as a condition of acceptance, the supplier shall conduct the following acceptance tests on each SRM initiator. It shall be the option of the COTR to determine whether rejected units or lots shall be reworked. In the case of rework, the supplier shall correct all deficiencies prior to resubmitting rejected units or lots for acceptance tests. Documented evidence of rework and corrective action shall be submitted to the COTR and shall be made a part of the data package.

2.3.1 HEADER SHOCK AND LEAKAGE TESTS

Prior to fabricating the header/body subassemblies, 100 percent of the header assemblies shall be subjected to thermal shock exposure as follows: Place the header assemblies in an oven and condition to 500 +/-25 degrees F. for 30 minutes. Remove the header assemblies from the oven and submerge them in LN2 within one minute. Leave the header assemblies in the LN2 until stabilized (bubbles calm down), remove from LN2 and reheat to 500 +/-25 degrees F. for 30 minutes then remove from oven and quench in ambient tap water. Following thermal shock, two percent of each lot of header assemblies (20 minimum) shall be welded into NSI-1 or SRM initiator bodies and subjected to a 40,000 psi hydrostatic pressure applied to the head/body subassembly for 30 seconds (no backup of the flange area or back shell is

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permitted). These units shall then be subjected to the 15,000 psi static pressure test in paragraph 2.3.2. Units exhibiting leaks in the weld area may be reworked and retested. Final acceptance of the header lot is contingent on no evidence of leaks in any of these units. Upon completion of this test, these units will be scrapped.

2.3.2 HEADER/BODY STATIC PRESSURE LEAKAGE TESTS

Prior to loading, all SRM initiator header/body interfaces shall be covered with a liquid and pressurized to 15,000 psig nitrogen for 30 seconds through the threaded end of the initiator body. The body shall be installed in an MS33649-3 or MS 16142-3 port using a Parker 5-565 "0" ring or an equivalent installation. There shall be no evidence of leakage through or around the header, pins, or o-ring. Any initiator which does not meet the static pressure leak test may be reworked, retested, and if it passes the test, retained within its original lot. All records must reflect rework action and compliance with this paragraph.

2.3.3 Loaded Units

All loaded units shall be subjected to the nondestructive tests specified in Table I prior to the lot acceptance firings specified in 2.4. Any SRM initiator failing to meet any test of Table I shall be rejected, but such rejection shall not be cause for rejection of the entire lot. However, any initiator which fires while being subjected to the nondestructive acceptance tests delineated in Table I, excluding electrostatic sensitivity, may, at the NASA JSC COTR's discretion, be cause for rejection of the entire lot. These tests may be conducted in any sequence, except that examination of the product shall be subsequent to the n-ray and x-ray tests and insulation resistance shall be performed after electrostatic testing. The data sheet shall show these sequence requirements have been met.

TABLE I

Acceptance Test (All Initiators)

Name of Test	Applicable Paragraph
SRM Initiator Leakage Test	2.3.3.1
Examination of Product	2.3.3.2
Insulation Resistance Test	2.3.3.3
Bridgewire Resistance Test	2.3.3.4
N-ray Test	2.3.3.5

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X-ray Test	2.3.3.5
Electrostatic Sensitivity	2.3.3.6

2.3.3.1 SRM INITIATOR LEAKAGE TESTS

a. HERMETIC SEAL TEST

Leakage from the loaded sealed SRM initiator shall not exceed 5 x 10-6 cc/sec of helium when measured at one atmosphere pressure differential. In preparing the initiator for the leakage test, the initiator shall first be subjected to a maximum pressure of 1 inch Hg absolute for a minimum of five minutes then to helium at two atmospheres minimum for twenty minutes after which a one atmosphere helium environment must be maintained until removal for test. The leak rate measurement shall be made within twenty minutes after removal from the helium environment and shall be recorded on the test data sheet. The indicated leak rate must be 1 x 10-6 cc/sec maximum to assure an actual rate of 5 x 10-6 cc/sec.

b. PROOF PRESSURE BETWEEN O-RINGS

There shall be no evidence of leakage past the primary or secondary o-rings when the SRM initiator body is installed into a Safe and Arm device and pressurized with high purity dry nitrogen to 3,460 psig. The pressure is to be applied between the two o-rings.

2.3.3.2 EXAMINATION OF PRODUCT

Each SRM initiator shall be carefully examined to verify that marking, and workmanship comply with the requirements of this specification.

2.3.3.3 INSULATION RESISTANCE TEST

The resistance between the body assembly and the initiator terminals shall be measured for each initiator by applying a potential of 250 (plus or minus 5%) volts direct current for 15 seconds minimum. The measured resistance shall be recorded and shall be 2 megohms minimum. No more than two measurements shall be made.

2.3.3.4 BRIDGEWIRE RESISTANCE TEST

The bridgewire resistance of each initiator shall be measured and recorded on the test data sheet. The measured resistance shall be 1.05 (plus or minus 0.1) ohms at laboratory ambient temperature. A NASA JSC supplied IRME must be used for obtaining the recorded measurement.

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2.3.3.5 RADIOGRAPHS

Each initiator shall be x-radiographed and neutron radiographed to verify correct and proper installation of SRM initiator internal components, including absence of contamination.

2.3.3.6 ELECTROSTATIC SENSITIVITY TEST

Each SRM initiator of the lot shall be subjected to an electrostatic discharge of 25,000 (+200, -0) volts from a 500 (+/-50) picofarad capacitor between both pins shorted together and the SRM initiator body.

2.4 DESTRUCTIVE LOT ACCEPTANCE TESTS (DLAT)

2.4.1 DLAT SAMPLE SIZE

a. The DLAT sample size is 10% of lot or minimum of 10 units whichever is greater.

TABLE II LOT SAMPLE TEST QUANTITY

SPEC. PARA.	TEST REQ'D	QUANTITY
2.4.2	Vibration Test	DLAT qty.
2.4.3	Ambient Firing	1/2 of DLAT qty.
2.4.4	-260 Degree F. Firing	1/2 of DLAT qty.

b. Lot size equals DLAT quantity plus deliverable quantity

2.4.2 VIBRATION TEST

Prior to beginning the firing portion of the DLAT, all units chosen for DLAT will be randomly vibrated per paragraph 1.3.1.1b while thermally stabilized at 0 degrees F. Subsequent to vibration, the bridgewire resistances will be checked. A failure of one or more bridgewires during vibration will cause the lot to be rejected. At the successful conclusion of these tests, the units will be test fired as specified.

2.4.3 AMBIENT FIRING

All SRM initiators in the sample for ambient firing shall be tested as follows: Each unit shall be installed in a test fixture such that the free volume is 10 +/-0.2 cubic centimeters, NASA/JSC part number SEB 26100021, and stabilized at laboratory ambient temperature. Two pressure transducers shall be connected to the firing chamber to record pressure versus time with a permanent record recording device. One of them shall be designated as the primary

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transducer and shall be so indicated on the data sheets prior to the start of acceptance testing. The secondary transducer "peak pressure" and "time to 525 psig" readings shall be recorded on the data sheets for informational purposes only. Acceptance or rejection of the lot shall be based solely on recordings from the primary transducer. The secondary pressure transducer information shall be used for acceptance criteria only when (1) the primary system did not produce a recording, or (2) the recording produced by the primary system is outside the specification requirements and is obviously not similar in waveform to the previous primary transducer recordings.

The initiation mode for the ambient test firing shall be capacitor discharge with 680 microfarads charged to 37-40 volts d.c. The firing line resistance shall be 0.6 +0/-0.1 ohms. The output and firing characteristics (pressure, and current versus time) of each SRM initiator fired shall be recorded and used to determine the acceptability of the lot and to provide data for statistical analysis by NASA JSC.

2.4.4 -260 DEGREE F. FIRING

The requirements for the -260 degree F. test firing shall be the same as specified in paragraph 2.4.3 for ambient except the test fixture shall be stabilized at -260 +/-10 degrees F.

2.4.5 ACCEPTANCE CRITERIA

2.4.5.1 AMBIENT FIRING

The time to first pressure shall not exceed 1.0 millisecond from application of current. Time to 525 psig shall not exceed 1.3 milliseconds from application of current. The range of times to first pressure shall not exceed 0.3 milliseconds. The range of times from first pressure to 525 psig shall not exceed 0.3 millisecond. The peak pressure shall be between 525 to 775 psig.

2.4.5.2 -260 DEGREE F. FIRING

The time to 525 psig shall not exceed 10 milliseconds from application of current. NOTE: Indicated peak pressure can be greater than 775 psig.

2.5 POST FIRE INSPECTION

All destructive test samples shall maintain structural integrity (such as no visible evidence of gas leakage, fragmentation, loss of pins from header assembly) during and after the firing. Any failure shall be cause for rejection of the lot.

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