MILITARY SPECIFICATION

IGNITER, JET ASSISTED TAKE-OFF (JATO) PROPULSION SYSTEM GENERAL DEVELOPMENT SPECIFICATION FOR

This specification is approved for use within the Naval Air Systems Command, Department of the Navy and is available for use by all departments and agencies of the Department of Defense.

1. SCOPE

1.1 Purpose. This specification establishes the minimum requirements for the design, verification, and qualification of JATO rocket motor ignition systems, hereinafter referred to as "igniters." The igniters are components of solid propellant rocket motors for JATO applications (see 6.1). Implicit within this specification are requirements for the shipping container design.

1.2 Igniter types. Igniters covered by this specification are of two types (see 6.2.1):

Type I: Integral igniter
Type II: Non-integral igniter

Type I igniters are designed to be installed in the rocket motor at the time of manufacture and are designed to remain there for their entire life cycle. Type II igniters, on the other hand, are designed to be installed in the rocket motor by the user only at the time of use. Type II igniters are normally handled, shipped, and stored separately from the rocket motor.

1.3 Integrated programs. If the igniter is being developed in conjunction with a rocket motor, considerable savings in effort and resources may be achieved by integrating the requirements of MIL-R-85880 and this specification.

2. APPLICABLE DOCUMENTS

2.1 Government documents.

2.1.1 Specifications, standards, and handbooks. The following specifications, standards, and handbooks form apart of this specification to the extent specified herein. Unless otherwise specified, the issues of these documents shall be those listed in the issue of the Department of Defense Index of Specifications and Standards (DoDISS) and supplement thereto, cited in the solicitation.

SPECIFICATIONS

FEDERAL

TT-C-490	Cleaning Methods for Ferrous Surfaces and Pretreatment for Organic Coatings
TT-P-1757	Primer Coating, Zinc Chromate, Low-Moisture-Sensitivity

AMSC N/A FSC 1340

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MIL-P-116	Preservation, Methods of
DOD-D-1000	Drawings, Engineering and Associated Lists
MIL-S-5002	Surface Treatments and Inorganic Coatings for Metal Surfaces of Weapons Systems
MIL-C-5541	Chemical Conversion Coatings on Aluminum and Aluminum Alloys
MIL-H-6088	Heat Treatment of Aluminum Alloys
MIL-H-6875	Heat Treatment of Steels, Process for
MIL-F-7179	Finishes, Coatings, and Sealants for the Protection of Aerospace Weapons Systems
MIL-F-7190	Forgings, Steel, for Aircraft/Aerospace Equipment and Special Ordnance Applications
MIL-S-7742	Screw Threads, Standard, Optimum Selected Series: General Specification for
MIL-B-7883	Brazing of Steels, Copper, Copper Alloys, Nickel Alloys, Aluminum and Aluminum Alloys
MIL-I-8500	Interchangeability and Replaceability of Component Parts for Aerospace Vehicles
MIL-W-8611	Welding, Metal Arc and Gas, Steels, and Corrosion and Heat Resistant Alloys; Process for
MIL-A-8625	Anodic Coatings, for Aluminum and Aluminum Alloys
MIL-F-18264	Finishes: Organic, Weapons System, Application and Control of
MIL-A-21180	Aluminum-alloy Castings, High Strength
MIL-P-23377	Primer Coatings: Epoxy-Polyamide, Chemical and Solvent Resistant
MIL-I-23659	Initiators, Electric, General Design Specification for
MIL-S-45743	Soldering, Manual Type, High Reliability, Electrical and Electronic Equipment
MIL-W-46132	Welding, Fusion, Electron Beam, Process for
	Human Engineering Requirements for Military Systems, Equipment and Facilities
MIL-R-81128	Rocket Motors, identification of Parts and Assemblies, Requirements for
MIL-H-81200	Heat Treatment of Titanium and Titanium Alloys
MIL-C-83286	Coating, Urethane, Aliphatic Isocyanate, for Aerospace Applications
MIL-A-83377	Adhesive Bonding (Structural) for Aerospace and Other Systems, Requirements for
MIL-R-85880	Rocket Motor, Jet Assisted Take-off (JATO) Propulsion System, General Development Specification for

STANDARDS

FEDERAL

FED-STD-H28	Screw-Thread Standards for Federal Serices

MILITARY

DOD-STD-100	Engineering Drawing Practices
MIL-STD-129	Marking for Shipment and Storage
MIL-STD-130	Identification Marking of U.S Military Property
MIL-STD-331	Fuze and Fuze Components, Environmental and Performance Tests for
MIL-STD-453	Inspection, Radiographic
DoD-STD-480	Configuration Control - Engineering Changes, Deviations and Waivers
MIL-STD-490	Specification Practices
MIL-STD-648	Design Criteria for Specialized Shipping Containers
MIL-STD-785	Reliability Program for Systems and Equipment Development and Production
MIL-STD-810	Environmental Test Methods and Engineering Guidelines

MIL-STD-838	Lubrication of Military Equipment
MIL-STD-882	System Safety Program Requirements
MIL-STD-889	Dissimilar Metals
MIL-STD-961	Military Specifications and Associated Documents, Preparation of
MIL-STD-970	Standards and Specifications, Order of Preference for the Selection of
MIL-STD-980	Foreign Object Damage (FOD) Prevention in Aerospace Products
MIL-STD-1251	Screws and Bolts Preferred for Design, Listing of
MIL-STD-1252	Inertia Friction Welding Process, Procedure and Performance Qualification
MIL-STD-1472	Human Engineering Design Criteria for Military Systems, Equipment and Facilities
MIL-STD-1515	Fastener Systems for Aerospace Application
MIL-STD-1521	Technical Reviews and Audits for Systems, Equipment, and Computer Software
MIL-STD-1598	Studs Preferred for Design, Listing of
MIL-STD-1648	Criteria and Test Procedures for Ordnance Exposed to an Aircraft Fuel Fire
MIL-STD-1661	MARK and MOD Nomenclature System
MIL-STD-1670	Environmental Criteria and Guidelines for Air-Launched Weapons
MIL-STD-1754	Fastening Devices Preferred for Design, Listing of
MIL-STD-1755	Keys and Pins Preferred for Design, Listing of
MIL-STD-1756	Rings, Retaining, Preferred for Design, Listing of
MIL-STD-1758	Insert, Screw Thread, Preferred for Design, Listing of
MIL-STD-2100	Propellant, Solid, Characterization of (Except Gun Propellant)
DOD-STD-2101	Classification of Characteristics
DOD-STD-2105	Hazard Assessment Tests for Navy Non-Nuclear Ordnance

HANDBOOKS

MILITARY

MIL-HDBK-5	Metallic Materials and Elements for Aerospace Vehicle Structures
MIL-HDBK-17	Plastics for Aerospace Vehicles
MIL-HDBK-23	Structural Sandwich Composites
MIL-HDBK-132	Protective Finishes for Metal and Wood Surfaces
MIL-HDBK-157	Transportability Criteria
MIL-HDBK-691	Adhesive Bonding
MIL-HDBK-694	Aluminum and Aluminum Alloys
MIL-HDBK-695	Rubber Products: Recommended Shelf Life

2.1.2 Other Government and publications. The following other Government documents and publications form a part of this specification to the extent specified herein. Unless otherwise specified, the issues shall be those in effect on the date of the solicitation.

CODE OF FEDERAL REGULATIONS

14 CFR 49	Aeronautics and Space
46 CFR 146	Shipping
49 CFR 100-199	Hazardous Materials, Regulations, Department of Transportation

PUBLICATIONS

INSTRUCTIONS

NAVAIRINST 5100.7	Technical Guidance for Naval Air Systems Command Safety Programs for Explosive Ordnance, Law Systems and Lithium Batteries

NAVSEAINST 80105	Technical Requirements for Insensitive Munitions
NAVSEAINST 8020.8	Department of Defense Explosives Hazard Classification Procedures

OTHER DOCUMENTS

NAVAIR 11-1-117	Identification of Ammunition
NAVSEA OD 30393	Design Principles and Practices for Controlling Hazards of Electromagnetic Radiation to Ordnance (HERO Design Guide)
NAVSEA OD 44811	Safety and Performance Tests for Qualifications of Explosives
NAVSUP PUB 505	Packaging and Handling of Dangerous Material for Transportiation by Military Aircraft (NOTAL)

(Copies of specifications, standards, handbooks, publications, and other Government documents required by contractors in connection with specific acquisition functions should be obtained from the contracting activity or as directed by the contracting activity.)

2.2 Othe publications. The following document forms a part of this specification to the extent specified herein Unless otherwise indicated, the issue in effect on date of invitation for bids or request for proposal shall apply

AMERICAN NATIONAL STANDARDS INSTITUTE (ANSI)

ANSI Y145	Dimensioning & Tolerancing for Engineering Drawings

(Application for copies should be addressed to the American National Standards Institute, 1430 Broadway, New York, NY 10018.)

(Nongovernment standards and other publications are normally available from the organizations which prepare or which distribute the documents. These documents also may be available in or through libraries or other informational services.)

2.3 Order of precedence. In the event of a conflict between the text of this specification and the references cited herein, the text of this specification shall take precedence Nothing in this specification, however, shall supersede applicable laws and regulations unless a specific exemption has been obtained.

2.4 Document cross-reference. A cress-reference between the cited documents and the text of this specification is presented in the Appendix.

3. REQUIREMENTS

3.1 Program conduct. The contractor shall conduct a structured engineering program leading to the design of an igniter which satisfies all criteria of this specification. The program shall be structured in three phases as specified in 3.1.1 through 3.1.3.

3.1.1 Phase I - Desire Development. Phase I covers program initiation and all basic engineering efforts necessary to define an igniter design which satisfies requirements of this specification. During this phase, the contractor shall prepare program planning documentation. The contractor shall select materials, prepare engineering drawings, and fabricate and test components. Phase I shall include performance of all testing and analyses necessary to demonstrate the technical soundness of the basic design including ail components. This phase shall culminate with a Preliminary Design Review.

3.1.2 Phase II - Design Verification. Phase II covers testing of the complete design to establish readiness for design qualifcaion. This phase includes the manufacture of design verification test samples in accordance with preliminary fabrication documents. The design shall be evaluated for its ability to tolerate the more severe stimuli of the igniter's expected life cycle environment Based on Phase II fabrication experience and test results, fabrication documentation shall be prepared for Phase III. This phase shall culminate with a Critical Design Review.

3.1.3 Phase III - Design Qualification. Phase III encompasses manufacture and testing of the final igniter design. igniters shall be subjected to a full spectrum of environmental, safety and performance tests. Satisfaction of all requirements shall be demonstrated so that the design can be certified for military use. This phase shall culminate with a Functional Configuration Audit.

3.2 General designs requirements.

3.2.1 Design features.

3.2.1.1 Safing-arming device. Type I igniters shall have a mechanical safing feature that provides a mechanical barrier or out-of-line device in the igniter pyrotechnic train during shipping and storage A means for verifying the safe or armed position, when installed in the rocket motor, shall be provided.

3.2.1.2 Factor of safety. The igniter structural components shall be designed to withstand the maximum_ operating pressure (MEOP see 4.2.25) with a factor of safety (FS) defined by

$$FS = \frac{\text{Computed Strength}}{\text{Required Strength at MEOP}}$$

for deformation. The deformation criterion shall be that the cumulative effects of plastic, elastic, and thermal deformations do not adversely affect performance or safety. Igniter factor of safety shall be no less than 1.5. Stress calculations for the factor of safety shall be based on the maximum design loads, the yield strength of material, and the minimum material conditions in accordance with MIL-HDBK-5.

3.2.1.3 RF Immunity. The igniter shall incorporate features to preclude initiation by ambient electromagnetic energy typical of operations in military environments. The igniter shall be designed using the design guidelines given in OD 30393 to minimize or eliminate hazards of electromagnetic radiation to ordnance (HERO).

3.2.1.4 Igniter leads. The igniter leads shall be designed for connection and disconnection of the electrical terminals and flexion of the conductor without any damage.

3.2.1.5 Interface compatibility. The igniter shall conform to the mechanical and electrical interface criteria specified in the acquisition documents (see 6.2.1).

3.2.1.6 Damage prevention. All edges of igniter electrical cable accesses shall be provided with internal fillets, or rubber, plastic, or fiber protection if they might otherwise damage the cable insulation and electromagnetic shielding.

3.2.1.7 Circuit redundancy. Unless otherwise specified in the contract (see 62.1), the igniter shall have two independent firing circuits.

3.2.1.8 Shorting of Ignition leads. The design shall incorporate a means of shorting the leads of the ignition system when a Type II igniter is in the shipping condition (see 631.1) or when a rocket motor employing a Type I igniter is in the shipping condition. The shorting device shall be capable of being removal and reinstalled.

3.2.1.9 Electrical insulation. There shall be an electrical insulating barrier between all parts of the firing circuits in an igniter and its case of at least 1.0 megohm at 500 Vdc for 30 minutes duration, minimum, unless otherwise specified in the contract (see 6.2.1).

3.2.1.10 Initiator. The initiator used in the igniter shall be designed and qualified in accordance with MIL-I-23659.

3.2.1.11 Maximum no-fire stimulus. The maximum no-fire stimulus of the igniter shall be no less than 1.0 ampere dc and 1.0 watt for 5 minutes duration.

3.2.1.12 Autoignition temperature. The autoignition temperature of the igniter assembly shall be no less than 300°F.

3.2.1.13 Continuity measurement. The igniter design shall incorporate a means for verifying continuity of the ignition circuit with low current ohmmeters (50 milliamperes maximum) typical of ordnance operations when the igniter is in its operational condition (see 6.3.1.2).

3.2.1.14 Service lite. The igniter shall be designed to have a service life of not less than 10 years. In selecting design options, the contractor shall consider all expected life cycle environments (see 4.2.2.1).

3.2.1.15 Reliability. Selection of materials and design practices employed by the contractor shall promote high ignition reliability (see 4.4.6).

3.2.1.15.1 Design goal. As a design goal, the probability of the igniter meeting the performance requirements specified herein, during its service' life, shall be not less than 0.99.

3.2.1.15.2 Phase III reliability. Demonstrated reliability during Phase III shall not be less than 0.90 with a confidence of 90 percent.

3.2.1.16 Maintenance-free design. The igniter shall be designed such that it requires no maintenance during its service life To ensure a maintenance-free design, the contractor shall consider all expected life cycle environments (see 4.2.2.1).

3.2.1.17 Lettering color. Lettering color shall be in accordance with NAVAIR 11-1-117.

3.2.1.18 Igniter labeling data. The igniter shall be labeled with identification data in accordance with Method III or IV, Type 4 of MIL-H-8112. As a minimum, the igniter shall be labeled with the following identification data:

a. Nomenclature and MK/MOD number
b. Drawing number and revision letter
c. Department of Transportation Classification
d. Manufacturer's name
e. Date of ignition material manufacture
f. Lot number
g. Serial number
h. Special handling instructions and warnings

3.2.2 Design practices.

3.2.2.1 Design guidelines. The documents of table I shall be used for engineering design of the igniter. Design prctices employed by the contractor shall promote lightweight construction, simplicity of design, proper operation, and economy of manufacture.

Table I. Design practice documents.

Subject	Document(s)
Identification of parts	MIL-STD-129 MIL-STD-130 MIL-R-81128
Dissimilar metals	MIL-STD-889
Interchangeability of parts	MIL-I-8500
Engineering drawing practices	DOD-STD-100 DOD-D-1000
Human engineering	MIL-STD-1472 MIL-H-46855
Brazing	MIL-B-7883
Foreign object damage prevention	MIL-STD-980
Threads	FED-STD-H28 MIL-S-7742
Welding	MIL-STD-1252 MIL-W-6611 MIL-W-46132
Soldering	MIL-S-45743

3.2.2.2 Interchangeability of parts. All parts having the same part number shall be directly and completely interchangeable with each other in accordance with MIL-I-8500.

3.2.2.3 Prohibition on similarly threaded parts. Parts differing only in thread form are prohibited.

3.2.2.4 Standard tools and teat equipment. The igniter shall be designed so that standard tools and test equipment may be used, to the greatest possible extent, to accomplish all necessary assembly installation, and testing.

3.2.2.5 Foreign object damage prevention. The contractor shall employ the design practices of Appendix A MIL-STD-980 to prevent foreign object damage

3.2.2.6 Human engineering. The contractor shall incorporate the human engineering principles specified in MIL-H-46855 and MIL-STD-1472 into the design.

3.2.2.7 Interchangeability. Each igniter produced shall possess functional and physical characteristics necessary to provide equal performance reliability, and maintainability. Each igniter shall meet all interface requirements without selection or alteration.

3.2.3 Materials.

3.2.3.1 Design guidelines. The documents of table II shall be used in selecting materials and fabrication techniques. Materials shall be selected by the contractor for lightweight construction, simplicity of design, proper operation, and economy of manufacture

TABLEII. Material selection and fabrication documents.

Subject	Document(s)
Adhesives	MIL-HDBK-691 MIL-A-83377
Lubricants	MIL-STD-838
Metals	MIL-HDBK-5
Aluminum and aluminum alloys	MIL-HDBK-694
Aluminum castings	MIL-A-21180
Steel forgings	MIL-F-7190
Aluminum heat treatment	MIL-H-6088
Steel heat treatment	MIL-H-6875
Titanium heat treatment	MIL-H-81200
Plastics	MIL-HDBK-17
Sandwich composites	MIL-HDBK-23
Rubber parts	MIL-HDBK-695

3.2.3.2 Prohibited materials. The following materials are prohibited:

a. Radioactive materials
b. Mercury
c. Cacmium
d. Lead azide
e. Asbestos
f. Proprietary materials and components

3.2.3.3 Compatibility. Materials shall be selected considering mutual compatibility under all expected life cycle environments (see 4.2.2.1).

3.2.4 Material finishes.

3.2.4.1 Design guidelines. The documents of table III shall be used in selecting protective coatings and surface treatments. Finishes selected by the contractor shall be the minimum necessary for satisfactory protection, proper operation, economy of manufacture, and good appearance. Finishes shall be selected considering all expected life cycle environments (see 4.2.2.1).

TABLE III. Material finish docments.

Subject	Document(s)
Surface treatments for metals	MIL-S-5002
Finishes and coatings of metals	MIL-F-7179
Protective finishes	MIL-HDBK-132
Application and control of finishes	MIL-F-18264
Anodizing of aluminum	MIL-A-8625
Chemical conversion coatings	MIL-C-5541
Exterior coatings	MIL-C-83286
Pretreatment of ferrous surfaces	TT-C-490
Zinc chromate primer	TT-P-1757
Primer coatings	MIL-P-23377

3.2.4.2 Prohibited finishes. Cadmium plating shall not be used.

3.2.5 Fasteners.

3.2.5.1 Design guidelines. The documents of table IV shall be used in selecting fasteners.

TABLE IV. Fastener documents.

Subject	Document(s)
Screws and bolts	MIL-STD-1251
Fastener systems	MIL-STD-1515
Studs	MIL-STD-1568
Fastening devices	MIL-STD-1754
Keys and pins	MIL-STD-1756
Retaining rings	MIL-STD-1756
Threaded inserts	MIL-STD-1756

3.2.5.2 Nonstandard fasteners. Fasteners not covered by the documents of table IV shall conform to the specifications. standards, or other documents defined by Groups II through VI of MIL-STD-970. Fasteners described by documents in Groups VII and VIII of MIL-STD-970 shall be used only with the prior approval of the contracting activity.

3.3 Performance requirements. In the acquisition documents (see 6.2.1), the contracting activity shall specify the values of the performance parameters in terms of a static firing performance characterization (see 452.11).

3.4 Environmental resistance requirements. The igniter shall not sustain damage, initiate, or subsequently fail to operate in conformance with the requirements of 3.3 after exposure to the environments specified in 3.4.1 through 3.4.10.

3.4.1 Transporation vibration. When in its shipping condition (see 6.3.1.1), the igniter shall be capable of withstanding the vibration environment resulting from land, sea, or air transport. The maximum expected transportation distance is 3000 miles, and the packaged igniter or rocket motor is expected to be treated as secured cargo (see 45.2.1).

3.4.2 Thermal shock. When in its bare condition (see 631.3), the igniter shall be capable of withstanding the thermally induced stresses resulting from transfer between the extreme temperature environments of its life cycle (see 45.2.2).

3.4.3 High temperature storage. When in its bare condition (see 6.3.1.3), the igniter shall be capable of withstanding prolonged storage at the storage temperature upper limit (see 45.2 S).

3.4.4 Altitude. When in its shipping condition (see 631.1), the igniier shall be capable of withstanding the reduced pressure environment resulting from transport in a cargo airplane (see 45.2.4).

3.4.5 Rain. A Type II igniter in the bare condition (see 6.31.3) shall be capable of withstanding the blowing rain environment typical of a high intensity storm (see 45.25).

3.4.6 Salt fog. A Type II igniter in the bare condition (see 6.3.1.3) shall be capable of withstanding the aqueous salt atmosphere typical of coastal regions (see 45.2.6).

3.4.7 Sand and dust. A Type II igniter in the bare condition (see 6.3.1.3) shall be capable of withstanding the airborne dust environment associated with hot, dry regions of the earth (see 4.5.2.7).

3.4.8 Six-foot drop. When in its bare condition (see 6.3.1.3), the igniter shall be capable of withstanding a drop of six feet onto a hard surface as typical of a handling mishap (see 45.2.6).

3.4.9 Fungus. When in its bare condition (see 6.3.1.3), the igniter shall withstand the attack of fungi typical od humid tropical regions of the earth (see 452.9).

3.4.10 Humidity. A Type II igniter m me bare condition (see 6.3.1.3) shall be capable of withstanding the moist environment typical of warm, humid regions of the earth (see 4.5.2.10).

3.5 Other requirements.

3.5.1 System safety program. The contractor shall conduct a system safety program in accordance with Task 100 of MIL-STD-882. AS a design goal, all Category I and II hazards shall be eliminated. As a minimum, the probability of occurrence of Category I and II hazards shall be remote.

3.5.2 Hazard characteristics. The igniter shall be designed to pose minimum hazard consistent with its intended use.

3.5.2.1 Hazard classification. The igniter shall be designed so that its responses to the tests defined by NAVSEAINST 80208 are such that it qualities for a DOD hazard class/division no more severe than 1.3 and a shipping classification no more severe than Class B (see 4.4.2.2).

3.5.2.2 Sensitivity. The igniter shall be designed such that it exhibits acceptable sensitivity to the stimuli in table V.

TABLE V. Igniter sensitivity to stimuli.

Stimulus	Response criterion
Slow cook-off	NAVSEAINST 8010.5
Fast cook-off	NAVSEAINST 8010.5
Bullet impact	NAVSEAINST 8010.5
Fragment impact	NAVSEAINST 8010.5
Sympathetic detonation	NAVSEAINST 8010.5
Electromagnetic pulse	NAVSEAINST 8010.5
Electromagnetic radiation	NAVSEAINST 8010.5
Electrostatic discharge	MIL-STD-331
Forty-foot drop	DOD-STD-2105

3.5.3 Configuration management. The igniter shall be a configuration item as described by DOD-STD-480, and, as such, shall be subject to contiguration management.

3.5.4 Shipping container. For Type II igniters, the contractor shall design and demonstrate a shipping container in consonance with the igniter development program. The acquisition documents shall specify whether the container is to be of the reusable or disposable variety (see 6.2.1). The design criteria of MIL-STD-648 shall be employed.

3.5.5 Workmanship. The workmanship displayed in fabrication and assembly shall ensure the ability of the igniter to meet performance requirements under all expected environmental conditions. The dimensions, finishes, tolerances, and quality specified herein, and on applicable drawings, specifications, and inspection manuals shall be maintained. All components and assemblies shall be free from buns, contamination, sharp edges, corrosion, pits, cracks, dents, chipped paint, excessive wear, and foreign material.

4. QUALITY ASSURANCE PROVISIONS

4.1 Responsibility for inspection. Unless otherwise specified in the contractor purchase order, the contractor is responsible for the performance of all inspection requirements as specified herein. Except as otherwise specified in the contract or purchase order, the contractor 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 Responsibility for compliance. All items must meet ail requirements of sections 3.4, and 5. The inspection set forth in this specification shall become a part of the contractor's overall inspection system or quality program. The absence of any inspection requirements in the specification shall not relieve the contractor of the responsibility of assuring that all products or supplies submitted to the Government for acceptance comply with all requirements of the contract. Sampling in quality conformance does not author ize submission of known defective material, either indicated or actual, nor does it commit the Government to acceptance of defective material.

4.1.2 Responsibility of overall quality. The overall objective of the program is to develop a high quality design. To ensure success in meeting this objective the contractor shall exercise day-today control of the booster development program and promote quality assurance in several areas:

a. Fabricaiton
b. Testing
c. Analysis
d. Documentation and Reviews
e. Configuration Control

Although the acquisition documents may designate another activity for some portion of the testing, in most cases the contractor will be responsible for quality assurance in all the above areas.

4.2 Phase I - Design Development.

4.2.1 Tests.

4.2.1.1 Ballistics verfication tests. The contractor shall static fire not less than two rocket motors, incorporating all essential features of the design approach, to verify that the ballistic performance requirements are satisfied (see 33). Results of the ballistics verification tests shall be documented in the Design Development Report (see 4.2.35).

4.2.1.2 Energetic material hazard tests. The contractor shall generate (unless already available test data for each energetic material hazard characteristic listed in table Vi. Test results shall be reported in the Design Development Report (see 4.2.35).

TABLE VI. Energetic material hazard characteristic tests.

Test	Test Method
Cap test	NAVSEAINST 8020.8
Unconfined burning	NAVSEAINST 8020.8
Thermal stability	NAVSEAINST 8020.8
Impact sensitivity	NAVSEAINST 8020.8
Card gap	NAVSEAINST 8020.8
Friction sensitivity	OD44811
ESD sensitivity	OD44811
Differential thermal analysis	MIL-STD-2100

4.2.13 Cornponent compatibility tests. The contractor shall conduct compatibility tests to determine the effects of interaction among energetic materials, adhesives, lubricants, metallic and non-metallic materials Tests may include differential thermal analysis, accelerated aging studies, and other means to project the effects of time- The test results shall demonstrate that the igniter's service life is not compromised because of material incompatibilities inherent in the design. Results of compatibility testing shall be documented in the Design Development Report (see 4.235).

4.2.2 Analyses.

4.2.2.1 Life cycle environmental analysis. When specified in the contractor order, the contractor shall conduct a life cycle environmental analysis to determine the expected environments for the igniter. Typically, the life cycle consists of the following sequence:

a . Manufacture
b . Packaged into shipping container for Type II or loaded into rocket motor for Type I and then packaged
c . Transported to depot
d . Stored at depot
e . Transported to user
f . Unpackaged from shipping container
g . Built-up into operational configuration
h . Transported to lauynch site
i . Attached to platform
j . Platform launch
k . Expended remains scrapped

However, any given igniter may have a significantly different life cycle Using the guidelines of MIL-STD-810 and MIL-D-1670, the contractor shall consider the potential environment in terms of stimuli, such as temperature, pressure, shock, vibration, rain, humidity, salt spray, and dust. The following factors should also be taken into account for the possible environments to which material will be exposed:

a. Configuration of hardware
b. Environment that is encountered (climate of)
c. Platform with which the hardware interfaces
d. Interfaces with other equipment
e. Absolute and relative duration of exposure phase

f. Number of times phase will occur; intermittence of phase
g. Probability of occurrence of environmental conditions
h. Geographical location
i. Any other information which will help identify environmental conditions which may act upon the igniter,

The contractor shall include recommendations for the following:

a. Storage temperature lower limit (STLL)
b. Storage temperature upper limit (STUL)
c. Operating temperature lower limit (OTLL)
d. Operating temperature upper limit (OTUL)

The contractor shall determine whether helicopter transport is a part of the life cycle. Results of the life cycle environmental analysis shall be made available to the contracting activity for acceptance

4.2.2.2 Environmental design criteria and test plan. When specified in the contractor order, the contractor shall devise a plan which defines the specific environmental design and teat requirements and includes an environmental test plan for Phases II and Ill. The contractor shall utilize the data obtained under provisions of 4.2.2.1. Consideration shall be given to the following:

a. Probability of environmental occurrence alone or in combination
b. Expected effects and failure modes
c. Effect on hardware performance and mission success
d. Likelihood of problem's disclosure by the test methods
e. Occurrence of similar environmental stress in more than one life profile phase
f. Experience gained from other equipment similarly deployed

The plan shall be made available to the contracting activity for acceptance.

4.2.2.3 Structural analysis. The contractor shall conduct a structural analysis of the igniter design considering the effects of pressure loads. acceleration loads, and any other significant sources of stress. The contractor shall include in the analysis all components which contribute to the structural integrity of the igniter. Results of the structural analysis shall be documented in the Design Development Report (see 4.2.3.5).

4.2.2.4 Thermal analysis. The contractor shall conduct a thermal analysis of the igniter design. The contractor shall consider the combined effects of self-generated heat as well as any significant external heat sources. The contractor shall consider all components which may serve as heat paths or which maybe severely degraded by excessive heat. Results of the thermal analysis shall be documented in the Design Development Report (see 4.2.35).

4.2.25 Ballistic analysis. The contractor shall conduct a ballistics analysis of the igniter design to define expected perormance. The contractor shall consider the effects of the operating temperature limits. Maximum expected operating pressure (MEOP) shall be caluclated as part of the ballistics analysis. Results of the ballistics analysis shall be documented in the Design Development Report (see 4.2.35).

4.2.2.6 Interface analysis. The contractor shall conduct an interface analysis of the igniter design to demonstrate that it satisifes all mechanical and electrical interface requirements. Results of the interface analysis shall be documented in the Design Development Report (see 4.235).

4.2.2.7 Preliminary hazard analysis. When specified in the contract or order, the Contractor shall prepare a preliminary hazard analysis in accordance with Task 202 of MI L-STD-882 with emphasis on ordnance hazards. The hazard listings in NAVAIRINST 5100.7 should be used for guidance. The preliminary hazard analysis shall be made available to the contracting activity for acceptance.

4.2.3 Documentation and reviews.

4.2.3.1 Program plan. When specified in the contract or order, the contractor shall prepare a program plan which identifies tasks, responsibilities, and schedule in accordance with the program structure specified in 3.1. The program plan shall be made available to the contracting activity for acceptance no later than 60 days following initiation of Phase I.

4.2.3.2 System safety program plan. When specified in the contract or order, the contractor shall prepare a system safety program plan in accordance with Task 101 of MIL-STD-882. The system safety program plan shall be made available to the contracting activity for acceptance no later than 90 days following initiation of Phase I.

4.2.3.3 Quality assurance plan. When specified in the contractor order, the contractor shall prepare a quality assurance plan for the entire program. The quality assurance plan shall be made available to the contracting activity for acceptance no later than 30 clays prior to the Preliminary Design Review. The contractor shall include provisions for the following:

a . Serialization of all hardware and energetic components down to the piece part levels
b . 100% inspection of all hardware and energetic components
c . Traceability to constituent lot numbers
d . Traceability of non-piece part constituents (liner materials, inhibitor materials, lubricants)
e . Traceability of the fabrication tooling employed during manufacture
f . Maintenance of “as-built” configuration lists
g . X-ray inspection of environmental and static firing test units with sufficient detail to verify the presence and condition of all key components.

4.2.3.4 Marginality of success evaluation plan. When specified in the contractor order, the contractor shall prepare a marginality of success evaluation plan. The plan shall be designed to aid in the assessment of margins inherent in the design and to verify that tested units demonstrate no signs of incipient failure. The plan shall include provisions for the following:

a. Prestatic firing X-ray and visual inspection
b. Post-firing hardware examination for such things as dimensional changes, distortion, seal integrity, ejects, etc.
c. Comparison of actual versus predicted ballistic performance

The plan shall be made available to the contracting activity for acceptance in Phase 130 days prior to static firing the first igniter.

4.2.3.5 Design Development Report. When specified in the contractor order, the contractor shall prepare a design development report which summarizes the results of all efforts conducted during Phase 1. The design development report shall be made available to the contracting activity no later than 30 days prior to the Preliminary Design Review. The report shall be revised based on comments provided by the contracting activity and again made available for acceptance within 60 days following the Preliminary Design Review.

4.2.3.6 Level 2 engineering drawings. When specified in the contract or order, the contractor shall prepare Level 2 engineering drawings and associated lists in accordance with DOD-D-1OOO. The drawings shall be made available to the contracting activity no later than 30 days prior to the Preliminary Design Review The contractor shall maintain the original (master) drawings with revision records.

4.2.3.7 Configuration management plan. When specified in the contractor order, the contractor shall prepare a configuration management plan covering Phases II and III of the development program. acceptance authority shall be as specified herein (see 4.35 and 4.4.5). The plan shall be made available to the contracting activity for acceptance no later than 30 days prior to the Preliminary Design Review.

4.2.3.8 Development specification. When specified in the contract or order, the contractor shall prepare a Type B2, Critical Item Development Specification in accordance with MIL-STD-490 defining performance, design, development and test requirements for the igniter. The specification shall be developed according to the format specified in MIL-STD-961. The development specification shall be made available to the contracting activity no later than 30 days prior to the Preliminary Design Review.

4.2.3.9 WSESRB data package. When specified in the contract or order, the contractor shall prepare a Weapon System Explosives Safety Review Board (WSESRB) data package in accordance with NAVAIRINST 5100.7 The data package shall provide background information supporting the planned system safety program. The data package shall be made available to the contracting activity no later than 30 days prior to the Preliminary Design Review

4.2.3.10 WSESRB presentation. When specified in the contract or order, the contractor shall prepare a Weapon System Explosives Safety Review Board (WSESRB) presentation in accordance with NAVAIRINST 5100.7. The presentation shall be made to the WSESRB to obtain concurrence that the planned program satisfies current Navy requirememts. The presentation shall be given to the WSESRB no later than 30 days prior to the Preliminary Design Review.

4.2.3.11 Review agenda. When specified in the contract or order, the contractor shall provide the agenda for the Preliminary Design Review. The agenda shall set forth the place time, date, purpose, and objectives of the review. The agenda shall be made available to the contracting activity no later than 30 days prior to the Preliminary Design Review.

4.2.3.12 Preliminary Design Review. At the conclusion of the Phase I effort and when specified in the contract or order, the contractor shall conduct a Preliminary Design Review in accordance with MIL-STD-1521. Upon satisfactory completion of the Preliminary Design Review, the contracting activity will authorize initiation of Phase II.

4.2.3.13 Review minuts. When specified in the contractor order, the contractor shall prepare a record of the results of the Preliminary Design Review. A draft copy of the review minutes shall be made available to the contracting activity for review and comment no later than 30 days following the review. The final review minutes shall be distributed no later than 15 days after receipt of the contracting activity's comments.

4.3 Phase I - Design Verification.

4.3.1 Fabrication.

4.3.1.1 Manufacture of environmental test items. The contractor shall manufacture test units in accordance with the approved Level 2 drawings

4.3.1.2 Manufacture of inert test items. The contractor shall manufacture inert test items which replicate the mass properties of the live Type II igniter. The number of test items will be specified in the contract (see 6.2.1). These test units will be employed for handling and container tests.

4.3.2 Tests.

4.3.2.1 Environmental verification testing. The contractor shall demonstrate the igniter design is capable of wihtstanding representative life cycle stresses by subjection test items to the series of environments specified in table VII or VIII, as applicable.

TABEL VII. Environmental verification test matrix for Type I igniters.

Test	Test temperature[1]	Requirement paragraph	Inspection method	Configuration paragraph	Igniter serial number[2]							
					1-4	5-8	9-12	13-16	17-20	21-24	25-28	29-32
Vibration	STLL STUL	3.4.1	4.5.2.1	6.3.1.1	A	A	A	A				
Thermal shock High temperature storage	Variable STUL	3.4.2 3.4.3	4.5.2.2 4.5.2.3	6.3.1.3 6.3.1.3			B	B	A			
Six-foot drop Humidity	STLL STUL Variable	3.4.8 3.4.10	4.5.2.8 4.5.2.10	6.3.1.3 6.3.1.3	B	B	C	C				
Ballistic performance[3]	OTLL OTUL	3.3	4.5.2.11	6.3.1.3	C C	C C	D D	D D	B B	A	A	
Rocket motor performance[3]	OTLL OTUL	3.3	4.5.2.12	6.3.1.2								A A

[1]See paragraph 4.2.2.1 for description of temperatures.
[2]Letters denote test sequence.
[3]Performance tests are equally divided between temperature extremes.

TABLE VIII. Environmental verifiecation test matrix for Type II igniters.

Test	Test temperature[1]	Requirement paragraph	Inspection method	Configuration paragraph	Igniter serial number[2]							
					1-4	5-8	9-12	13-16	17-20	21-24	25-28	29-32
Vibration	STLL STUL	3.4.1	4.5.2.1	6.3.1.1	A	A	A	A				
Thermal shock High temperature storage	Variable STUL	3.4.2 3.4.3	4.5.2.2 4.5.2.3	6.3.1.3 6.3.1.3			B	B	A			
Six-foot drop	STLL STUL	3.4.8	4.5.2.8	6.3.1.3			C	C				
Humidity Rain Salt fog	Variable Ambient Ambient	3.4.10 3.4.5 3.4.6	4.5.2.10 4.5.2.5 4.5.2.6	6.3.1.2 6.3.1.2 6.3.1.2	B C D	B C D						
Ballistic performance[3]	OTLL OTUL	3.3	4.5.2.11	6.3.1.3	E E	E E	D D	D D	B B	A	A	
Rocket motor performance[3]	OTLL OTUL	3.3	4.5.2.12	6.3.1.2								A A

[1]See paragraph 4.2.2.1 for description of temperatures.
[2]Letters denote test sequence.
[3]Performance tests are equally divided between temperature extremes.

4.3.2.2 Thermal stabilization test. The contractor shall instrument an igniter with temperature sensing transducers. The igniter may employ live propellant or inert propellant with similar thermal properties. The instrumented igniter shall be placed in temperature conditioning chambers maintained at the operating or storage temperature limits, whichever is most extreme The temperature history of the igniter shall be recorded to establish the time required for the igniter to achieve a stable, uniform temperature. Based on these results, the contractor will recommend minimum conditioning times to the contracting activity. Results of the thermal stabilization test shall be documented in the Design Verification Report (see 4.3.4.6).

4.3.3 Analyses.

4.3.4.1 Program plan. When specified in the contractor order, the contractor shall update the structural analysis based on the test results in Phase II. The structural analysis shall be made available to the contracting activity for acceptance

4.3.4 Documentation and reviews.

4.3.4.1 Program plan. When specified in the contract or order, the contractor shall update the program plan within 60 days follwing initiation of Phase II. The revoked program plan shall be made available to the contracting activity for accompliance.

4.3.4.2 System safety plan. program plan. When specified in the contract or order, the contractor shall update the system safety program plan within 90 days following initiation of Phase II. The revised system safety program plan shall be made available to the contracting activity for acceptance.

4.3.4.3 Quality assurance plan. When specified in the contractor order, the contractor shall update the quality assurance plan within 90 days following initiation of Phase II. The revised quality assurance plan shall be made available to the contracting activity for acceptance.

4.3.4.4 Configuration management plan. When specified in the contractor order, the contractor shall update the configuration management plan within 90 days following initiation of Phase II. The revised configuration management plan shall be made available to the contracting activity for acceptance.

4.3.4.5 Radiograpic inspection procedure. When specified m the contract or order, and prior to the fabrication of any test items in Phase II, the contractor shall prepare a radiographic inspection procedure using quality level I of MIL-STD-453 as a guideline. The contractor shall make available the procedure along with sample films to the contracting activity for acceptance Any subsequent change to the radiograph inspection procedure shall be acceptable to the contracting activity.

4.3.4.5 Design verificaiton report. When specified in the contract or order, the contractor shall prepare a design verificaiton report which summarizes the results of ail efforts conducted during Phase Ii. The design verification r-shall be made available to the contracting activity no later than 30 days prior to the Critical Design Review. The report shall be revised based on comments provided by the contracting activity and again made abailable for acceptance within 60 days following the Critical Design Review.

4.3.4.7 Level 3 engineering drawings. When specified in the contractor order, the contractor shall prepare Level 3 engineering drawings and associated lists in accordance with DOD-D-1000. The contractor shall incorporate detailed classification of characteristics in accordance with DOD-STS-2101 into the drawings. Tolerancing shall be in accordance with ANSI Y145 The drawings shall be made available to the contracting activity no later than 30 days prior to the Critical Design Review.

4.3.4.8 Test readiness review. When specified in the contractor order, and prior to the initiation of the design verification testing, the contractor shall hold a test readiness review with the participation of the contracting activity. The contractor shall present data to demonstrate the following:

a. The test objectives are achievable
b. The test article's quality and "as-built" configuration are documented and traceable to serialized components
c. The test methodology is consistent with the test objectives
d. The test objectives and methodology are understood by the supporting activities.

4.3.4.9 Nomenclature request. When specified in the contract or order, the contractor shall prepare a Nomenclature Assignment Request (NAVSEA 503011) for an EX number in accordance with MIL-STD-1661. The request shall be made available via the contracting activity no later than 60 days prior to the Critical Design Review

4.3.4.10 Hazard assessment test plan. Based on hazard analysis (see 4.2.2.7) and anticipated reactivity of the igniter, the contractor shall develop a test plan for hazard classification (see 3.5.2.1) and sensitivity assessment (see 3.5.2.2). As a minimum, the requirements of MIL-STD-1648 and DOD-STD-2105 shall be addressed. When specified in the contract or order, the test plan shall be made available to the contracting activity no later than 30 days prior to the Critical Design Review.

4.3.4.11 Review agenda. When specified in the contract or order, the contractor shall provide the agenda for the Critical Design Review The agenda shall set forth the place, time, date, purpose, and objectives of the review. The agenda shall be made available to the contracting activity no later than 30 days prior to the Critical Design Review.

4.3.4.12 Critical Design Review. When specified in the contract or order and at the conclusion of the Phase II effort, the contractor shall conduct a Critical Design Review in accordance with MIL-STD-1521. Upon satisfactory completion of the Critical Design Review the contracting activity will authorize initiation of Phase III.

4.3.4.13 Review minutes. When specified in the contractor order, the contractor shall prepare a record of the results of the Critical Design Review. A draft copy of the review minutes shall be made available to the contracting activity for review and comment no later than 30 days follwing the review. The final review minutes shall be distributed no later than 15 days after receipt of the contracting activity's comments.

4.3.5 Configuration control. At the inception of Phase II, the contractor shall institute control of the configuration identification (as defined in DOD-STD-480) for the igniter design. The methods of configuration control may be selected by the contractor as long as they provide for the systematic evaluation, coordination. and implementation of changes.

4.3.6 Reliability assessment.

4.3.6.1 Reliability program. When specified in the contractor order, the contractor shall establish, implement, and document a reliability program using MIL-STD-785 as a guide Each igniter tested in Phase II shall be evaluated for reliability. If any igniter fails during one of these tests, the contractor shall diagnose the failure to root causes and provide corrective actions acceptable to the contracting activity.

4.3.6.2 Reliability growth curve. A reliability growth curve shall be maintained throughout Phase II to assess the igniter demonstrated (pass/fail) reliability at 90 percent confidence.

4.4 Phase III—Design Qualification.

4.4.1 Fabrication

4.4.1.1 Manufacture of environmental test items. The contractor shall manufacture environmental test items in accordance with the approved Level 3 drawings.

4.4.1.2 Manufacture of hazard test items. The contractor shall manufacture hazard test items in accordance with the approved Level 3 drawings.

4.4.1.3 Manufacture of electromagnetic compatibility test item. The contractor shall manufacture an electromagnetic compatibility test item with inert components. The test unit shall be equipped with 20 spare inert electrical initiation assemblies.

4.4.1.4 Manufacture of static display model. The contract or shall manufacture a cut-away model of the igniter. The model shall depict all components in proper relationship to one another. All components shall be inert. The model shall be equipped with a stand and carrying case.

4.4.1.5 Manufacture of containers. The contractor shall manufacture a sufficient number of containers to perform Phase III test and evaluation of Type II igniters.

4.4.2 Tests.

4.4.2.1 Environments qualification tresting. The contractor (or other activity designated by the contracting activity see 6.2) shall demonstrate that the igniter design is capable of with standing representative lii cycle stresses by subjecting test items to the series of environments specified in table IX or X, as applicable.

4.4.2.2 Hazard assessment tests. The contractor Shall subject the igniter to hazard assessment tests in accordance with the approved test plan (see 4.3.4.10). Results shall be interpreted in accordance with the definitions of NAVSEAINST 8010.5 and shall be reported in the Safety Test Report (see 4.4.4.6).

4.4.2.3 Interface demonstration. The contractor shall install a rocket motor with a Type II igniter on the designated platform(s) to demonstrate physical compatibility. The igniter maybe inert as long as all physical interface characteristics are maintained Type I and Type II igniters shall be electrically connected to the firing circuit to demonstrate physical compatibility of connectors. The installed igniter shall be photographed for documentation purposes. Results of the interface demonstrative shall be documented in the design qualification report (see 4.4.4.5).

TABLE IX. Environmental qualtification test matrix for Type I igniters.

Test	Test temperature[1]	Requirement paragraph	Inspection method	Configuration paragraph	Igniter serial number[2]												
					1-4	5-8	9-12	13-16	17-20	21-24	25-28	29-32	33-36	37-42	43-46	48-52	53-56
Vibration	STLL STUL	3.4.1	4.5.2.1	6.3.1.1	A	A						B	B				
Thermal shock	Variable	3.4.2	4.5.2.2	6.3.1.3			A					C	C				
High temperature storage	STUL	3.4.3	4.5.2.3	6.3.1.3				A				A	A				
Six-foot drop Fungus	STLL STUL Ambient	3.4.8 3.4.9	4.5.2.8 4.5.2.9	6.3.1.3 6.3.1.3					A	A	A	D	D				
Ballistic performance[3]	OTLL OTUL	3.3	4.5.2.11	6.3.1.3	B B	B B	B B	B B	B B	B B		E E	E E	A	A		
Rocket motor performance[3]	OTLL OTUL	3.3	4.5.2.12	6.3.1.2												A	A

[1]See paragraph 4.2.2.1 for description of temperatures.
[2]Letters denote test sequence.
[3]Performance tests are equally divided between temperature extremes.

TABLE X. Environmental qualification test matrix for Type II igniters.

Test	Test Temperature[1]	Requirement paragraph	Inspection method	Configuration paragraph	Igniter serial number[2]														
					1-4	5-8	9-12	13-16	17-20	21-24	25-28	29-32	33-36	37-40	41-44	45-50	51-56	57-60	61-64
Vibration	STLL STUL	3.4.1	4.5.2.1	6.3.1.1	A	A			A	A				B	B				
Thermal shock	Variable	3.4.2	4.5.2.2	6.3.1.3			A							C	C				
High temperature storage	STUL	3.4.3	4.5.2.3	6.3.1.3				A						A	A				
Altitude	Ambient	3.4.4	4.5.2.4	6.3.1.1					B	B				D	D				
Rain	Ambient	3.4.5	4.5.2.5	6.3.1.2					C	C				E	E				
Salt fog	Ambient	3.4.6	4.5.2.6	6.3.1.2					D	D				F	F				
Sand-dust	Ambient	3.4.7	4.5.2.7	6.3.1.2					E	E				G	G				
Six-foot drop	STLL STUL	3.4.8	4.5.2.8	6.3.1.3							A	A	A	H	H				
Fungus	Ambient	3.4.9	4.5.2.9	6.3.1.3															
Ballistic performance[3]	OTLL OTUL	3.3	4.5.2.11	6.3.1.3	B B	B B	B B	B B	F F	F F	B B	B B		I I	I I	A	A		
Rocket motor performance[3]	OTLL OTUL	3.3	4.5.2.12	6.3.1.2														A	A

[1]See paragraph 4.2.2.1 for description of temperatures.
[2]Letters denote test sequence.
[3]Performance tests are equally divided between temperature extremes.

4.4.3 Analysis.

4.4.3.1 Electromagnetic pulse analysis. When specified in the contractor order, the contractor shall conduct an electromagnetic pulse (EMP) analysis to assess the response of electroexplosive devices and other components which could result in hazardous conditions. The EMP analysis shall be made available to the contracting activity for accepance.

4.4.4 Documentation and reviews.

4,4.4.1 Program plan. When specified in the contract or order, the contractor shall update the program plan within 60 days following the initiation of Phase Iii. The revised program plan shall be made available to the contracting activity for acceptance.

4.4.4.2 System safety program plan. When specified in the contractor order, the contractor shall update the system safety program plan within 90 days following initiation of Phase III. The revised system safety program plan shall be made available to the contracting activity for acceptance.

4.4.4.3 Quality assurance plan. When specified in the contractor order, the contractor shall update the quality assurance plan within 90 days following initiation of Phase Iii. The revised quality assurance plan shall be made available to the contracting activity for acceptance.

4.4.4.4 Configuration management plan. When specified in the contractor order, the contractor shall update the configuration management plan within 90 days folllowing initiation of Phase III. The revised configuration management plan shall be made available to the contracting activity for acceptance.

4.4.4.5 Design qualification report. When specified in the contract or order, the contractor shall prepare a design qualification report which summarizes the results of all efforts conducted during Phase Iii. The design qualification report shall be made available to the contracting activity no later than 30 days prior to the Functional Configuration Audit. The report shall be revised based on comments provided by the contracting activity and again made available for acceptance within 60 days following the Functional Configuration Audit.

4.4.4.6 Safety test report. When specified in the contractor order, the contractor shall prepare a safety test report which documents the results of hazard assessment tests (see 4.4.2.2). The report shall be made available to the contracting activity no later than 60 days prior to the Functional Configuration Audit.

4.4.4.7 Test readinees review. When specified in the contractor order and prior to the initiation of qualification testing, the contractor shall hold a test readiness review with the participation of the contracting activity. The contractor shall present data to demonstrate the following:

a. The test objectives are achievable
b. The test article's quality and "as-built" configuration are documented and traceable to serialized components
c. The test methodology is consistent with the test objectives
d. The test objectives and metholdology are understood by the supporting activities

4.4.4.8 Nomenclature request. When specified in the contract or order, the contractor shall prepare a Nomenclature Assignment Request (NAVSEA 5030/1) for a MARK number in accordance with MIL-STD-1661. The request shall be made available via the contracting activity no later than 60 days prior to the Functional Configuration Audit.

4.4.4.9 Hazard classification data package. When specified in the contractor order the contractor shall prepare a hazard classification package consisting of:

a. Safety Test Report
b. DD Form 2231 (per NAVSEAINST 8020.8)
c NATO Data Card (per NAVSEAINST 8020.8)
d. Other supporting data which will be sufficient for the appropriate Department of Defense Agency Headquarters (i.e., NAVAIR Safety Office) to assign a final hazard classification to the igniter.

The data package shall be made available to the contracting activity no later than 30 days prior to the Functional Configuration Audit.

4.4.4.10 WSESRB data package. When specified m the contractor order, the contractor shall prepare a Weapon System Explosives Safety Review board (WSESRB) data package in accordance with NAVAIRINST 5100.7. The data package shall provide the necessary information to demonstrate that the igniter satisfies all safety requirements. The data package shall be made available to the contracting activity no later than 60 days prior to the Functional configuration Audit.

4.4.4.11 WSESRB presentation. When specified in the contractor order, the contractor shall prepare a Weapon System Explosives Safety Review Board (WSESRB) presentation in accordance with NAVAIRINST 5100.7. The presentation shall be made to the WSESRB to obtain concurrence that the igniter satisfies all safety requirements and that production may be authorized. The presentation shall be given to the WSESRB no later than 30 days prior to the Functional Configuration Audit.

4.4.4.12 Fabrication specifications. When specified in the contract or order, the contractor shall prepare a Type C2b, Critical Item Product Fabrication Specification, in accordance with MIL-STD-490, which defines the manufacture and acceptance requirements for the igniter. The specification shall be developed according to the format specified in MIL-STD-961. The fabrication specification shall include quality assurance provisions for first article and lot acceptance inspections and tests. The contractor shall incorporate detailed classification of characteristics in accordance with DOD-STD-2101 into the specification. In addition, the contractor shall prepare supporting specifications (propellant, liner, inhibitor) necessary to control fabrication of the igniter end item. The fabrication specifications shall be made available to the cotracting activity no later than 30 days prior to the Functional Configuration Audit.

4.4.4.13 Review agenda. When specified in the contract or order, the contractor shall provide the agenda for the Functional Configuration Audit. The agenda shall set forth the place, time, date purpose, and objectives of the audit. The agenda shall be made available to the contracting activity no later than 30 days prior to the Functional Configuration Audit.

4.4.4.14 Functional Configuration Audit. When specified in the contract or order, and at the conclusion of the Phase Ill effort, the contractor shall conduct a Functional Configuration Audit in accordance with MIL-STD-1521. Upon satisfactory completion of the Functional Configuration Audit and the acceptance of all documentation, the contracting activity will certify that Phase Ill is complete.

4.4.4.15 Review minutes. When specified in the contractor order, the contractor shall prepare a record of the results of the Functional Configuration Audit. A draft copy of the review minutes shall be made available to the contracting activity for review and comment no later than 30 days following the review. The final review minutes shall be distributed no later than 15 days after receipt of the contacting activity's comments.

4.45 Configuration control. At the inception of Phase III, and when specified in the contract or order, the configuration control procedures of DOD-STD-480 shall be instituted. Class 1 Engineering Change Proposals shall be made available to the contracting activity for acceptance. Class II Engineering Change Proposals may be implemented by the contractor provided the contracting activity concurs with the assigned classification.

4.4.6 Reliability assessment.

4.4.6.1 Reliability program. The contractor shall update the reliability program using MIL-STD-785 as a guide. Each igniter tested in Phase Ill shall be evaluated for reliability. If any igniter fails during one of these tests, the contractor shall diagnose the failure to root causes and provide corrective actions acceptable to the contracting activity.

4.4.6.2 Reliability growth curve. The reliability growth curve shall be updted throughout Phase III to assess the igniter demonstrated (pass/fail) reliability at 90 percent confidence.

4.5 Test/inspection methods.

4.5.1 Inspections.

4.5.1.1 Visual inspection. After assembly and after each environmental treatment, each igniter shall be visually inspected for evidence of degradation. Results of the visual inspection shall be recorded.

4.3.1.2 Radiographic inspection. After assembly and after each environmental treatment, each test item shall be radiographically inspected in accordance with the approved radiographic inspection procedure (see 4.3.4.5). Any discrepancy including charge imperfection, defective material, missing or misplaced internal components, shall be cause for rejection of the test item.

4.5.1.3 Circuit resistance. After assembly and after each environmental treatment, the resistance of each igniter shall be measured and recorded.

4.6.1.4 Operation of safing-arming device. After assembly and after each environmental treatment, the safing-arming device of each igniter shall be exercised to verify proper operation. Results of this inspection shall be recorded

4.5.1.5 Other inspections and examinations. The contractor shall carry out all provisions of the approved quality assurance plan in fabricating the test items.

4.5.2 Environmental treatments.

4.5.2.1 Transportation vibration. The igniter shall be subjected to a vibration environment in accordance with Category 1- Basic Transportation, Method 514.3 of MIL-STD-810 Test levels will be in accordance with figures 514.31 through 514.33 of MIL-STD-810. Maximum expected transportation distance is 3000 miles, and the packaged igniter is to be treated as secured cargo. During vibration testing, the packaged igniter shall be contained in a temperature controlled chamber maintained at the specified temperature.

4.5.2.2 Thermal shock. The igniter shall beheld in a conditioning chamber at the storage temperature upper limit (STUL) for the requisite thermal stabilization period. The igniter shall then be moved to another chamber at the storage temperature lower limit (STLL) within 5 minutes. The igniter shall be held in the low temperature chamber for the requisite thermal stabilization period. The hot-to-cold cycle shall be repeated a total of 3 times with no more than 5 minutes between transfers. (For ease of test, the length of the hot and cold dwell periods may be increased so that the total cycle duration is 24 hours.) The igniter shall then be removed and allowed to return to ambient temperature

4.5.2.3 High temperature storage. The igniter shall be placed in a conditioning chamber maintained at the STUL for a period of 6 weeks.

4.5.2.4 Altitude. The igniter shall be subjected to a low pressure environment in accordance with Procedure I- Storage, Method 500.2 of MIL-STD-810. The packaged igniter shall be held at an equivalent of 15,000 feet attitude for a minimum of 1 hour.

4.5.2.5 Rain. The igniter shall be exposed to a rainfall environment in accordance with Procedure I - Blowing Rain, Method 5062 of MIL-STD-810 The igniter shall be conditioned to a temperature 18° F greater than the rain temperature prior to testing. Rainfall rate shall be 4 inches per hour and wind velocity shall be 40 miles per hour. Test duration shall be 30 minutes.

4.5.2.6 Salt fog. The igniter shall be subjected to an aqueous salt atmosphere in accordance with Procedure I - Aggravated Screening, Method 509.2 of MIL-STD-810 Test duration shall be 48 hours. After exposure, the test unit shall be allowed to dry for 48 hours under ambient conditions.

4.5.2.7 Sand and dust. The igniter shall be subjected to an airborne dust environment in accordance with Procedure i - Blowing Dust, Method 510.2 of MIL-STD-810. Air velocity shall beat the limits of the test apparatus or 1750 feet per minute whichever is less, but in no case less than 300 feet per minute. Test duration shall be 24 hours.

4.5.2.6 Six-foot drop. The igniter shall be conditioned to the specified operating temperature limit and dropped onto a 2-inch thick steel plate (minimum Brinell hardness of 207) embedded in not less than 2 feet of concrete. Six feet, as measured from the lowest point of the test article, shall be the drop height. In each group of four test items, the drop attitudes shall be two horizontal and one each aft end down and forward end down.

4.5.2.9 Fungus. The igniter shall be subjected to a fungi-promoting environment in accordance with Method 508.3 of MIL-STD-810. The test duration shall be 28 days.

4.5.2.10 Humidity. The igniter shall be subjected to a warm, humid atmosphere in accordance with cycle 5, Procedure II, Method 507.2 of MIL-STD-810. The test duration shall be 30 days.

45.2.11 Ballistic performance static firing. The igniter, in its bare condition (see 6.3.1.3), shall be conditioned to the specified temperature. Within 10 minutes after removal from the conditioning chamber, the igniter shall be attached to a test fixture and static fired. The ignition current shall replicate that of the end use application Post-firing inspection shall be performed in accordance with the marginality of success evaluation plan (see 4.2.3.4)

4.5.2.12 Rocket motor performance static firing. The igniter shall be installed in a rocket motor in the manner representative of its operational condition (see 6.3.1.2). The rocket motor shall be conditioned to the specified temperature Within 10 minutes after removal from the conditioning chamber, the rocks motor shall be attached to a test fixture and static fired. The igniter current shall replicate that of the end use application. Post-firing inspection shall be in accordance with the marginality of success evaluation plan (see 4.2.3.4).

5. PACKAGING

5.1 Preservation. Igniters shipped outside of the contractor's facility shall utilize methods of preservation to protect material against corrosion, physical and mechanical damage and other forms of deterioration in accordance with the requirements of MIL-P-116

5.2 Packaging.

5.2.1 Shipment by military air. Igniters required to be shipped by military air shall be prepared for shipment according to the provisions of NAVSUP Publication 505.

5.2.2 Shipment by other than milittary air. Igniters to be shipped by a mode of transportation other than military air shall be prepared for shipment according to the provisions of MIL-STD-648, MIL-HDBK-157, 14 CFR 49,46 CFR 14G and 49 CFR 100-199.

5.3 Marking.

5.3.1 Item marking. Igniters intended for delivery shall meet the marking and labeling requirements of MIL-STD-130.

5.3.2 Container marking. Igniter shipping containers shall meet the marking and labeling requirements of 49 CFR 100-199, and MIL-STD-129.

5.4 Transportation. Igniters shipped outside the contractor's facility shall be shipped by approved modes of transportation in accordance with 49 CFR 100199.

6. NOTES

6.1 Intended use. The solid propellant rocket motor igniters described herein are JATO system components. The JATOs are used to assist manned aircraft, targests, and remotely piloted vehicles during takeoff.

6.2 Ordering data.

6.2.1 Acquisition requirements. Acquisition documents should specify the following:

a. Title, number and date of this specification

b. Type of igniter (see 1.2)

c. Mechanical interface requirements (see 3.2.1.5)

d. Electrical interface requirements (see 3.2.1.5)

e. Redundant ignition circuit requirements (see 3.2.1.7)

f . Performance parameter values (see 3.3)

g . Container reusability requirements (see 3.5.4)

h . Number of inert test items (see 4.3.1.2)

i . Maximum allowable ignition shock

j . Delivery destination

k . Provisions for any tests to be performed by someone other than the contractor (see 4.1)

l . Launch environment description (i.e., engine exhaust, thermal profile, vehicle acceleration profile, flight loads, etc.—see 4.2.2.3 and 4.2.2.4)

6.2.2 Data requirements. When this specification is used in an acquisition and data are required to be delivered, the data requirements identified below shall be developed as specified by an approved Data Item Description (DD Form 1664) and delivered in accordance with the approved Contract Data Requirements List (CDRL), incorporated into the contract. When the provisions of DOD FAR Supplement, Part 27, Sub-Part 27.475-1 (DD Form 1423) are invoked and the DD Form 1423 is not used, the data specified below shall be delivered by the contractor in accordance with the contract or purchase order requirements. Deliverable data required by this specification are cited in the following Paragraphs.

Paragraph No.	Data Requirement Title	Applicable DID No.
4.2.2.1	Life Cycle Environmental Profile Plan	DI-R-7124
4.2.2.2	Environmental Design Criteria and Test Plan	DI-R-7125
4.2.2.7	System Safety Hazard Analysis Report	DI-SAFT-80101
4.2.3.1, 4.3.4.1, 4.4.4.1	Program Plan	DI-A-1021
4.2.3.2, 4.3.4.2, 4.4.4.2	System Safety Program Plan	DI-SAFT-80100
4.2.3.3, 4.3.4.3, 4.4.4.2	Quality Program Plan	UDI-R-23743B
4.2.3.4	Verification, Demonstration and Evacuation Plan	DI-S-6170
4.2.3.5, 4.3.4.6, 4.4.4.5	Report, Design	DI-R-24039A
4.2.3.6, 4.3.4.7	Drawings, Engineering and Associated Lists	DI-E-7031
4.2.3.7, 4.3.4.4, 4.4.4.4	Software Configuration Management Plan	DI-MCCR-80009
4.2.3.8	Military Specification	DI-MISC-80001
4.2.3.9, 4.4.4.10	Characteristics and Performance Data	DI-E-3135
4.2.3.10, 4.4.4.11	Presentation Material	DI-A-3024A
4.2.3.11, 4.3.4.11, 4.4.4.13	Conference Agenda	DI-A-7088
4.2.3.12, 4.3.4.12	Design Review Data Package	DI-E-5423
4.2.3.13, 4.3.4.13, 4.4.4.15	Conference Minutes	DI-A-7089
4.3.3.1	Structural Design Criteria Report (Aircraft)	DI-S-30567
4.3.4.5	Test and Inspection Report	DI-E-1150
4.3.4.8, 4.4.4.7	General Test Plan/Procedure	DI-T-3707A
4.3.4.9, 4.4.4.8	MK/MOD Nomenclature Assignment Request	DI-E-2000A
4.3.4.10, 4.4.4.9	Explosives Hazard Classification Data	DI-L-3311B
4.4.3.1	Report, Electromagnetic Pulses (EMP) Hardening	UDI-R-22551A
4.4.4.6	Safety Assessment Report	DI-SAFT-80102
4.4.4.12	Critical Item Product Fabrication Specification	DI-E-30132
4.4.4.14	Plan, Configuration Audit	DI-E-2036
4.4.5	Engineering Change Proposals (ECPS) and Requests for Deviations and Waivers (Long Form)	DI-E-2037

(Data item descriptions related to this specification, and identified in section 6 will be approved and listed as such in DOD 5000.19L, Vol. II, AMSDL. Copies of data item descriptions required by the contractors in connection with specific acquisition functions should be obtained from the Naval Publications and Forms Center or as directed by the contracting officer.)

6.3 Definitions.

6.3.1 Igniter teat configurations. To provide realism in environmental testing, igniters maybe in one of several conditions to simulate various aspects of the life cycle

6.3.1.1 Shipping condition. For Type I igniters, the igniter shall be installed in the rocket motor which in turn shall be installed in its shipping container. For Type II igniter the igniter shall be packaged in its shipping container. The storage condition is considered to be the same as the shipping condition.

6.3.1.2 Operational condition. The igniter shall be installed in the rocket motor which in turn shall be generally ready for its intended use.

6.3.1.3 Bare condition. The igniter shall be in the configuration representative of its condition prior to installation in the rocket motor.

6.4 Relationship of requirements ot quality assurance provisions. A cross-reference between the requirements of section 3 and the quality assurance provisions of section 4 is presented in table Xl.

6.5 Typical program schedule. A typical program schedule showing specification requirements is presented as shown in figure 1.

6.6 Subject term (key word) Listing.

Ignition systems, JATO
Ignition systems, rocket motor
JATO units
Motor, rocket
Rocket motor

Preparing activity

NAVY-AS
(Project No. 1340-N 752)

TABLE XI. Relationship of requirements to quality assurance provisions.

Requirement		Quality Assurance Provision(s)		
		Inspection	Analysis	Test
3.2.1.1	Safing-arming device	4.5.1.4		
3.2.1.2	Factor of safety		4.2.2.3	
3.2.1.3	RF immunity			4.4.2.2
3.2.1.4	Igniter leads	4.4.4.12		
3.2.1.5	Interface compatibility		4.2.2.6	4.4.2.3
3.2.1.6	Damage prevention	4.4.4.12		
3.2.1.7	Circuit redundancy	4.4.4.12		
3.2.1.8	Shorting of ignition leads	4.4.4.12		
3.2.1.9	Electrical insulation	4.4.4.5		
3.2.1.10	Initiator	4.4.4.5		
3.2.1.11	Maximum no-fire stimulus			4.4.2.2
3.2.1.12	Autoignition temperature			4.4.2.2
3.2.1.13	Continuity measurement	4.5.1.3		
3.2.1.14	Service life			4.5.2.3
3.2.1.15	Reliability		4.4.5.2	
3.2.1.16	Maintenance-free design	4.4.4.12		
3.2.1.17	Lettering color	4.4.4.12		
3.2.1.18	Igniter labeling data	4.4.4.12		
3.2.2.2	Interchangeability of parts	4.4.4.12		
3.2.2.3	Prohibition on similarly threaded parts	4.4.4.12		
3.2.2.4	Standard tools and test equipment	4.4.4.12		
3.2.2.5	Foreign object damage prevention	4.4.4.12		
3.2.2.6	Human engineering	4.4.4.12		
3.2.2.7	Workmanship	4.4.4.12		
3.2.2.8	Interchangeability	4.4.4.12		
3.2.3	Materials	4.4.4.12		
3.2.3.2	Prohibited materials	4.4.4.12		
3.2.3.3	Compatibility			4.2.1.3
3.2.4	Material finishes	4.4.4.12		
3.2.4.2	Prohibited finishes	4.4.4.12		
3.2.5	Fasteners	4.4.4.12		
3.2.5.2	Nonstandard fasteners	4.4.4.12		
3.3	Performance requirements			4.5.2.12
3.4.1	Transportation vibration			4.5.2.1
3.4.2	Thermal shock			4.5.2.2
3.4.3	High temperature storage			4.5.2.3
3.4.4	Altitude			4.5.2.4
3.4.5	Rain			4.5.2.5
3.4.6	Salt fog			4.5.2.6
3.4.7	Sand and dust			4.5.2.7
3.4.8	Six-foot drop			4.5.2.8
3.4.9	Fungus			4.5.2.9
3.4.10	Humidity			4.5.2.10
3.5.1	System safety program	4.4.4.2		
3.5.2.1	Hazard classification			4.4.2.2
3.5.2.2	Sensitivity			4.4.2.2
3.5.3	Configuration management	4.4.5		
3.5.4	Shipping container	4.4.4.12		

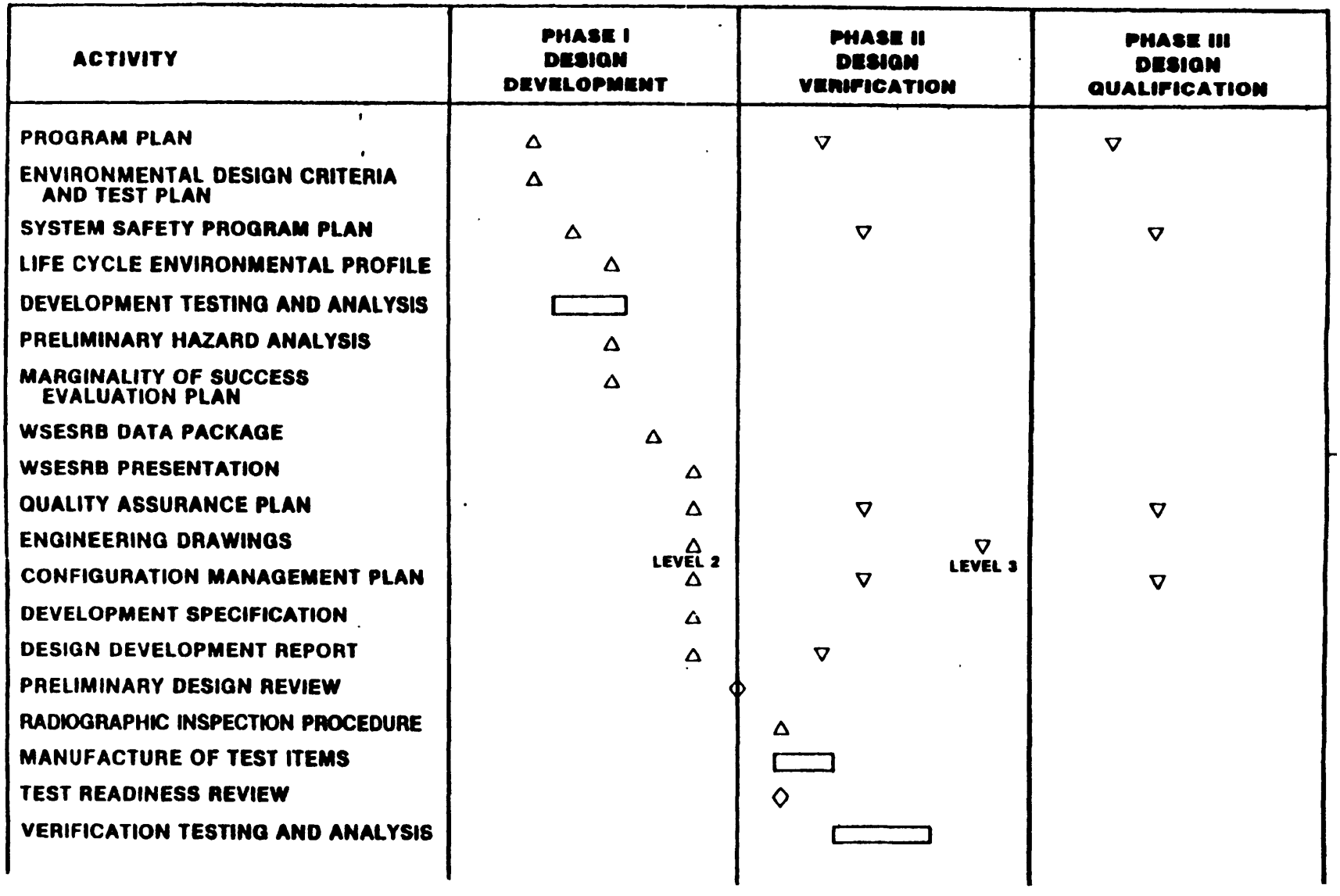

FIGURE 1. Typical program schedule.

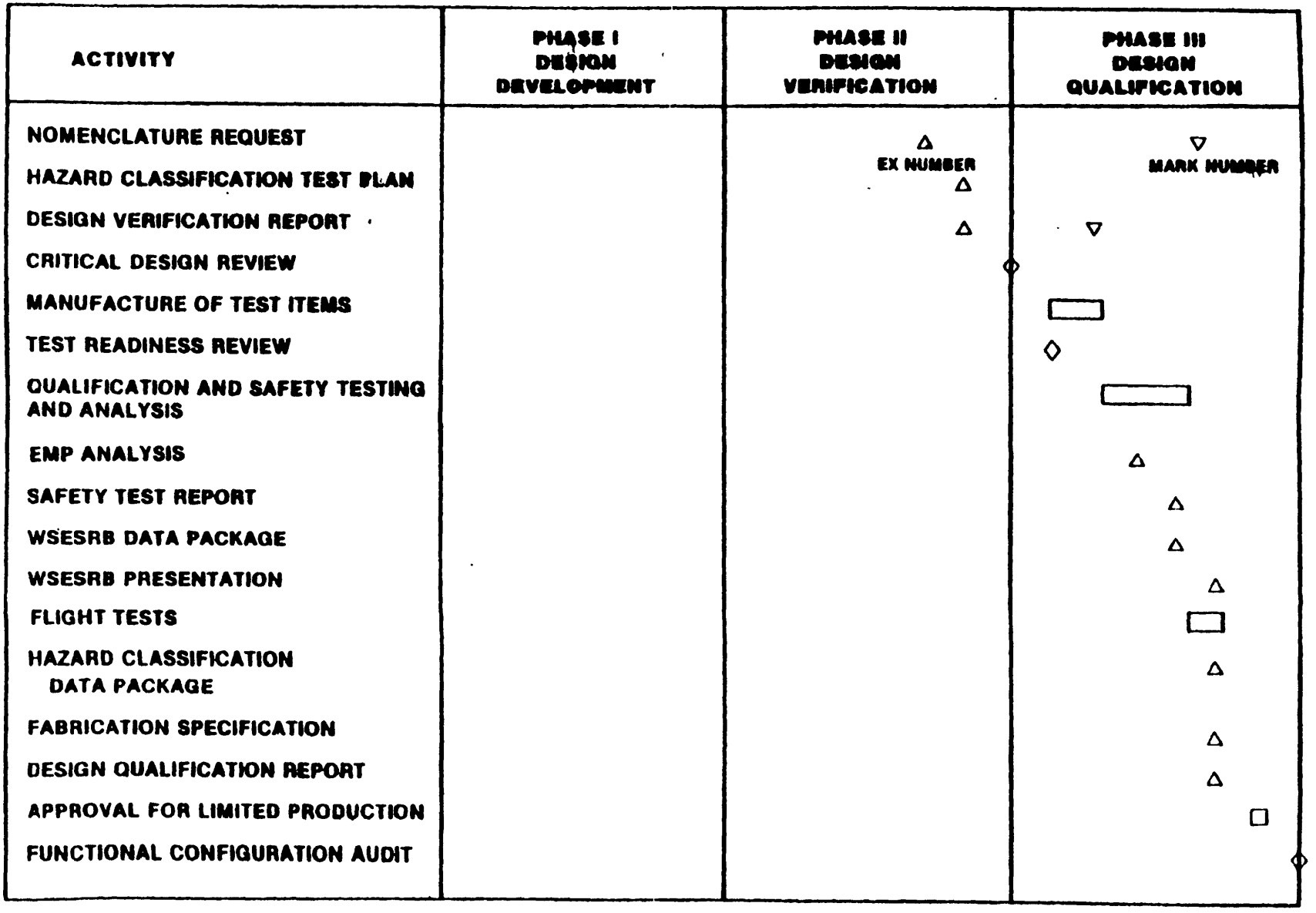

FIGURE 1. Typical program schedule - continued.

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	3.2.2.5	Foreign object damage prevention	7
MIL-STD-1251	3.2.5.1	Design guidelines	8
MIL-STD-1252	3.2.2.1	Design guidelines	6
MIL-STD-1472	3.2.2.1	Design guidelines	6
	3.2.2.6	Human engineering	7
MIL-STD-1515	3.2.5.1	Design guidelines	8
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