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MILITARY SPECIFICATION

ROCKET MOTOR, 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 auxiliary booster propulsion systems, hereinafter referred to as "booster." Although this specification applies to the complete auxiliary booster propulsion system, specific components and parts are addressed to a limited extent. Implicit within this specification are requirements for the shipping container design (see 6.1).

2. APPLICABLE DOCUMENTS

2.1 Government documents.

2.1.1 Specifications, standards, and handbooks. The following specifications, standards, and handbooks form a part 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 and Pretreatment of Ferrous Surfaces for Organic Coatings
TT-P-1757	Primer Coating, Zinc Chromate, Low-Moisture-Sensitivity

MILITARY

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

Beneficial comments (recommendations, additions, deletions) and any pertinent data which may be of use in improving this document should be addressed to: Commanding Officer, Naval Air Engineering Center, Systems Engineering and Standardization Department (SESD) Code 53, Lakehurst, NJ 08733-5100, by using the self-addressed Standardization Document Improvement Proposal (DD Form 1426) appearing at the end of this document or by letter.

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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-W-46132	Welding, Fusion, Electron Beam, Process for
MIL-H-46855	Human Engineering Requirements for Military Systems, Equipment and Facilities
MIL-M-63018	Manual, Technical: Nonnuclear Explosive Ordnance Disposal
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-I-85889	Igniter, Jet Assisted Take-Off (JATO) Propulsion System, General Development Specification for

STANDARDS

FEDERAL

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

MILITARY

DOD-STD-100	Engineering Drawing Practices
MIL-STD-129	Marking for Shipment and Storage
MIL-STD-130	Identification Marking of US Military Property
MIL-STD-143	Standards and Specifications, Order of Preference for the Selection of
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-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-1385	Preclusions of Ordnance Hazards in Electromagnetic Fields; General Requirements for
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, Equipments, 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

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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 documents 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

OPNAVINST 3401.3	Nuclear Survivability of Navy and Marine Corps Systems
NAVAIRINST 5100.7	Technical Guidelines for Naval Air Systems Command Safety Programs for Explosive Ordnance, Laser Systems and Lithium Batteries
NAVSEAINST 8010.5	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 OD44811	Safety and Performance Tests for Qualifications of Explosives
NAVSUP PUB 505	Packaging and Handling of Dangerous Material for Transportation 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.)

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2.2 Other publications. The following document forms a part of this specification to the extent specified here in. 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 Y14.5 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 cross-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 a booster 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 - Design Development. Phase I covers program initiation and all basic engineering efforts necessary to define a booster 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 all 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 qualification. 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 booster's expected life cycle environments. 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 booster design. Boosters 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 design requirements.

3.2.1 Design features.

3.2.1.1 Chamber factor of safety. The pressure vessel or chamber shall be designed to withstand the maximum expected operating pressure (MEOP) with a factor of safety (FS) defined by

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

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for deformation. The deformation criterion shall be that the cumulative effects of plastic, elastic, and thermal deformations do not adversely affect performance or safety. Chamber factor of safety shall be no less than 1.15. 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 (see 4.2.2.3, 4.3.2.1, 4.3.4.2, and 4.4.2.1)

3.2.1.2 **Closure seals.** The design shall incorporate closure seals to prevent foreign materials and moisture from entering the booster.

3.2.1.3 **Shorting of ignition leads.** The design shall incorporate a means of shorting the leads of the ignition system when the booster is in the shipping condition (see 6.3.1.1).

3.2.1.4 **Continuity measurement.** The booster design shall incorporate means for verifying continuity of the ignition circuit with low current ohmmeters (50 milliamperes maximum) typical of ordnance operations.

3.2.1.5 **Non-propulsivity.** The booster design shall incorporate features to reduce its thrust output when fired in the shipping configuration. The booster shall not exhibit a thrust, in any direction, greater than 5 percent of nominal thrust when fired (see 4.3.3.8) in its shipping configuration (see 6.3.1.1).

3.2.1.6 **Combustion stability.** The booster shall not exhibit resonant, unstable or irregular burning, or pressure oscillations.

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

3.2.1.8 **Reliability.** Selection of materials and design practices employed by the contractor shall promote high booster reliability.

3.2.1.8.1 **Design goal.** As a design goal, the probability of the booster meeting the performance requirements specified herein, during its service life, shall be no less than 0.99.

3.2.1.8.2 **Demonstrated.** Demonstrated reliability during Phase III shall be no less than 0.90 with a confidence of 90 percent (see 4.4.10).

3.2.1.9 **Maintenance-free design.** The booster shall be designed such that it requires no maintenance (other than touch-up of external paint) during its service life. To ensure a maintenance-free design, the contractor shall consider all expected life cycle environments (see 4.2.2.1).

3.2.1.10 **Ease of disassembly.** The booster shall be designed such that it can be easily disassembled. Special tooling required for disassembly shall be kept to a minimum. Large forces or torques shall not be required for disassembly. Disassembly shall pose no inordinate safety hazard.

3.2.1.11 **Conversion to operational condition.** The booster shall be designed such that it can easily be converted from the shipping condition (see 6.3.1.1) to the operational condition (see 6.3.1.2). Special tooling for conversion shall be kept to a minimum. Large forces or torques shall not be required for conversion. Conversion shall pose no inordinate safety hazard.

3.2.1.12 **Color.** The booster shall be painted olive drab or white overall, in accordance with NAVAIR 11-1-117. Inert units shall be distinctively identified as specified in 3.2.1.15.

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

3.2.1.14 **Marking.** Propulsive boosters shall be marked with a 3-inch wide brown band near the forward end of the unit. Inert units shall be marked with a 3-inch wide blue band and painted bronze in accordance with NAVAIR 11-1-117.

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3.2.1.15 Booster labeling data. The booster shall be labeled with identification data in accordance with Method III or IV, Type 3 of MIL-R-81128. As a minimum, the booster shall be labeled with the following identification data:

a. Nomenclature and MK/MOD number
b. Department of Transportation Classification
c. Operating temperature range
d. Storage temperature range
e. Manufacturer's name
f. Lot number
g. Propellant manufacture date (month/year)
h. Serial number
i. Special handling instructions and warnings

3.2.1.16 Igniter labeling data. The igniter shall be labeled in accordance with MIL-I-85889.

3.2.1.17 Booster igniter. The booster igniter shall incorporate a safe-arming mechanism and shall be designed in accordance with MIL-I-85889.

3.2.2 Design practices.

3.2.2.1 Design guidelines. The documents of table I shall be used for engineering design of the booster. Design practices 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-8611 MIL-W-46132

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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 **Threaded parts.** Duplicate parts, differing only in thread form, are prohibited.

3.2.2.4 **Standard tools and test equipment.** The booster 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 booster produced shall possess functional and physical characteristics necessary to provide equivalent performance, reliability, and maintainability. Each booster 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.

TABLE II. 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. Cadmium
d. Lead styphnate and lead azide
e. Asbestos
f. Proprietary materials

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

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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 documents.

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-1598
Fastening devices	MIL-STD-1754
Keys and pins	MIL-STD-1755
Retaining rings	MIL-STD-1756
Threaded inserts	MIL-STD-1758

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 4.4.3.12). A typical performance characterization is presented in 6.3.2. Values for additional parameters may be specified by the contracting activity, as required. An alternate performance characterization may be used by the contracting activity, as required.

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3.4 Environmental resistance requirements.

3.4.1 Transportation vibration. When in its shipping condition (see 6.3.1.1), the booster shall be capable of withstanding the vibration environment resulting from land, sea or air transport (see 4.3.3.1). The maximum expected transportation distance is 3000 miles, and the packaged booster is expected to be treated as secured cargo.

3.4.2 Thermal shock. When in its storage condition (see 6.3.1.3), the booster shall be capable of withstanding the thermally induced stresses resulting from transfer between the extreme temperature environments of its life cycle (see 4.3.3.2).

3.4.3 High temperature storage. When in its storage condition (see 6.3.1.3), the booster shall be capable of withstanding prolonged storage at the storage temperature upper limit (see 4.3.3.3).

3.4.4 Altitude. When in its shipping condition (see 6.3.1.1), the booster shall be capable of withstanding the reduced pressure environment resulting from transport in a cargo airplane (see 4.4.3.4).

3.4.5 Rain. When in its operational condition (see 6.3.1.2), the booster shall be capable of withstanding the blowing rain environment typical of a high intensity storm (see 4.3.3.4).

3.4.6 Salt fog. When in its operational condition (see 6.3.1.2), the booster shall be capable of withstanding the aqueous salt atmosphere typical of coastal regions (see 4.3.3.5).

3.4.7 Sand and dust. When in its operational condition (see 6.3.1.2), the booster shall be capable of withstanding the airborne dust environment associated with hot, dry regions of the earth (see 4.4.3.7).

3.4.8 Two-foot drop. When in its operational condition (see 6.3.1.2), the booster shall be capable of withstanding a drop of two feet onto a hard surface as typical of a handling mishap (see 4.3.3.6).

3.4.9 Four-foot drop. When in its shipping condition (see 6.3.1.1), the booster shall be capable of withstanding a drop of four feet onto a hard surface as typical of a transport mishap (see 4.4.3.9).

3.4.10 Fungus. When in its shipping condition (see 6.3.1.1), the booster shall withstand the attack of fungi typical of humid tropical regions of the earth (see 4.4.3.10).

3.4.11 Acceleration. When fired in the operational condition (see 6.3.1.2), the booster shall be capable of withstanding the forces induced by the acceleration typical of the service use environment (see 4.4.3.11).

3.4.12 Humidity. When in its operational condition (see 6.3.1.2), the booster shall be capable of withstanding the moist environment typical of warm, humid regions of the earth (see 4.3.3.7).

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.

3.5.2.1 Slow cook-off response. The booster shall satisfy the insensitive munitions criteria of NAVSEAINST 8010.5 for slow cook-off (see 4.4.4.2).

3.5.2.2 Fast cook-off response. The booster shall satisfy the insensitive munitions criteria of NAVSEAINST 8010.5 for fast cook-off (see 4.4.4.3).

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3.5.2.3 Bullet impact response. The booster shall satisfy the insenstive munitions criteria of NAVSEAINST 8010.5 for bullet impact (see 4.4.4.4).

3.5.2.4 Fragment impact response. The booster shall satisfy the insensitive munitions criteria of NAVSEAINST 8010.5 for fragment impact (see 4.4.4.5).

3.5.2.5 Sympathetic detonation sensitivity. The booster shall satisfy the insensitive munitions criteria of NAVSEAINST 8010.5 for sympathetic detonation (see 4.4.4.6).

3.5.2.6 Electromagnetic pulse vulnerability. The booster shall be assessed for electromagnetic pulse vulnerability in accordance with NAVSEAINST 8010.5 and OPNAVINST 3401.3 (see 4.4.7.1).

3.5.2.7 Sensitivity to electromagnetic radiation. The booster shall satisfy the insensitive munitions criteria of NAVSEAINST 8010.5 and MIL-STD-1385 for sensitivity to electromagnetic radiation (see 4.4.4.7).

3.5.2.8 Electrostatic discharge sensitivity. If the life cycle of the booster includes helicopter transport, the packaged booster shall exhibit no safety degradation when subjected to an electrostatic discharge typical of helicopter operations (see 4.4.4.8).

3.5.2.9 Forty-foot drop response. When environmentally conditioned and drop tested in accordance with DOD-STD-2105, the booster shall exhibit no explosive event and shall be safe for disposal (see 4.4.4.9).

3.5.3 Hazard classification. The booster shall be designed so that its response to the tests defined by NAVSEAINST 8020.8 are such that it qualifies for a DOD hazard class/division of 1.3 (see 4.4.5).

3.5.4 Interface compatibility. The booster shall conform to the mechanical and electrical interface criteria specified in the acquisition documents (see 4.4.6.1 and 6.2.1).

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

3.5.6 Shipping container. The contractor shall design and demonstrate a shipping container in consonance with the booster 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.

3.5.7 Workmanship. The workmanship displayed in fabrication and assembly shall ensure the ability of the booster 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 burrs, contamination, sharp edges, corrosion, cracks, dents, chipped paint, excessive wear, and foreign material.

4. QUALITY ASSURANCE PROVISIONS

4.1 Responsibility for inspection. Unless otherwise specified in the contract or 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.

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4.1.1 Responsibility for compliance. All items must meet all 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 authorize 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-to-day control of the booster development program and promote quality assurance in several areas:

a. Fabrication
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 verification tests. The contractor shall static fire a minimum of two boosters, incorporating all essential features of the design approach, to verify that the ballistic performance requirements are satisfied (see 3.3). The data collection system shall include high frequency pressure transducers to monitor combustion stability (see 3.2.1.7). Results of the ballistics verification tests shall be documented in the Design Development Report (see 4.2.3.5).

4.2.1.2 Propellant characterization tests. The contractor shall generate (unless already available) test data (nominals and acceptable tolerances) for each propellant characteristic listed below, and shall develop pass/fail criteria for the aging test of subparagraph h. Tests shall be conducted in accordance with the procedures of MIL-STD-2100. Results of propellant characterization tests shall be documented in the Design Development Report (see 4.2.3.5) and shall include:

a. Burning rates over the entire operating pressure range at nominally 300 psi intervals and at least 500 psi above the MEOP (see 4.2.2.5). Measurements shall be taken after conditioning to the following temperatures (±3° C): operating temperature lower limit (OTLL), 21° C, and operating temperature upper limit (OTUL).

b. Differential thermal analysis from 21° C to autoignition (heating rate of 1° C/minute).

c. Time to ignition (8 hour maximum) at 95° and 120° C for double-base propellant and at 175° and 200° C for other types of propellant.

d. Physical properties.

(1) Density
(2) Durometer A hardness
(3) Maximum tensile strength (OTLL, 21° C, OTUL)
(4) Tensile strength at break (OTLL, 21° C, OTUL)
(5) Elongation at maximum tensile strength (OTLL, 21° C, OTUL)
(6) Elongation at break (OTLL, 21° C, OTUL)

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(7) Modulus of elasticity (OTLL, 21° C, OTUL)
(8) Glass transition point
(9) Tensile strength (high strain rate) (OTLL, 21° C, OTUL)

e. Theoretical specific impulse (calculated).

f. Exhaust constituents (calculated) at nozzle and standard sea level temperature and pressure conditions.

g. Heat of explosion.

h. Aging tests (to demonstrate propellant characteristics and service life capability).

(1) High temperature aging at 60° C shall be conducted for 16 weeks, with an atmosphere of air and ambient relative humidity. Sampling and testing shall be conducted at 0, 2, 4, 8 and 16 weeks. Sample specimens shall be tested for physical properties, burning rates, and differential thermal analysis.

(2) Pass/fail criteria for the aging tests shall be based on the developer's propellant grain stress analysis (see 4.2.2.3) and internal ballistic analysis (see 4.2.2.5). Physcial properties after aging shall demonstrate a 1.50 factor of safety above the minimum required stress/strain requirements deduced from the stress analysis.

4.2.1.3 Propellant hazard tests. The contractor shall generate (unless already available) test data for each propellant hazard characteristic listed in table V. These test results shall be reported in the Design Development Report (see 4.2.3.5).

TABLE V. Propellant 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

4.2.1.4 Liner characterization tests. The contractor shall generate (unless already available) test data (nominals and acceptable tolerances) for each liner characteristic listed below and shall develop pass/fail criteria for the aging test of subparagraph j. Tests shall be conducted in accordance with the procedures of MIL-STD-2100. Results of the liner characterization tests shall be documented in the Design Development Report (see 4.2.3.5) and shall include:

a. Density
b. Durometer A hardness
c. Maximum tensile strength (OTLL, 21° C, OTUL)
d. Tensile strength at break (OTLL, 21° C, OTUL)
e. Elongation at maximum tensile strength (OTLL, 21° C, OTUL)
f. Elongation at break (OTLL, 21° C, OTUL)
g. Modulus of elasticity (OTLL, 21° C, OTUL)
h. Peel strength

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i. Liner bond strength to bonded surface at (OTLL, 21° C, OTUL) and strain rate of 20 mm/mm/minute to failure.
j. Aging study: High temperature aging at 60° C shall be conducted for 16 weeks, with an atmosphere of air and ambient relative humidity. Sampling and testing shall be conducted at 0, 2, 4, 8 and 16 weeks. Pass/fail criteria shall be based on the contractor's propellant grain stress analysis (see 4.2.2.3).

4.2.1.5 **Inhibitor (insulator) characterization tests.** The contractor shall generate (unless already available) test data (nominals and acceptable tolerances) for each inhibitor (insulator) characteristic listed below and shall develop pass/fail criteria for the aging test of subparagraph j. Tests shall be conducted in accordance with the procedures of MIL-STD-2100. Results of inhibitor (insulator) characterization tests shall be documented in the Design Development Report (see 4.2.3.5) and shall include:

a. Density
b. Durometer A hardness
c. Maximum tensile strength (OTLL, 21° C, OTUL)
d. Tensile strength at break (OTLL, 21° C, OTUL)
e. Elongation at maximum tensile strength (OTLL, 21° C, OTUL)
f. Elongation at break (OTLL, 21° C, OTUL)
g. Modulus of elasticity (OTLL, 21° C, OTUL)
h. Peel strength
i. Inhibitor (insulator) bond strength to bonded surface at (OTLL, 21° C, OTUL) and strain rate of 20 mm/mm/minute to failure.
j. Aging study: High temperature aging at 60° C shall be conducted for 16 weeks, with an atmosphere of air and ambient relative humidity. Sampling and testing shall be conducted at 0, 2, 4, 8 and 16 weeks. Pass/fail criteria shall be based on the contractor's propellant grain stress analysis (see 4.2.2.3).

4.2.1.6 **Component compatibility test.** The contractor shall conduct compatibility tests to determine the effects of interaction among energetic materials, adhesives, lubricants, 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 booster'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 4.2.3.5).

4.2.2 **Analyses.**

4.2.2.1 **Life cycle environmental profile.** When specified in the contract or order, the contractor shall conduct a life cycle environmental profile to determine the expected environments for the booster. Typically, the life cycle consists of the following sequence:

a. Manufacture
b. Packaged into shipping container
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 launch site
i. Attached to platform
j. Platform launch
k. Expended remains scrapped

However, any given booster may have a significantly different life cycle. Using the guidelines of MIL-STD-810 and MIL-STD-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:

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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; intermittency 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 booster.

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 profile shall be made available to the contracting activity for acceptance.

4.2.2.2 Environmental design criteria and test plan. When specified in the contract or order, the contractor shall devise a plan which defines the specific environmental design and test requirements and includes an environmental test plan for Phases II and III. 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 booster 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 booster and shall include a thorough stress analysis of the propellant grain. The stress analysis shall consider the stress and strain requirements of the propellant grain during post-cure cool down, temperature cycling, and ignition. 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 booster 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 may be severely degraded by excessive heat. Results of the thermal analysis shall be documented in the Design Development Report (see 4.2.3.5).

4.2.2.5 Ballistic analysis. The contractor shall conduct a ballistics analysis of the booster design to define expected performance. The contractor shall consider the effects of the operating temperature limits. Maximum expected operating pressure (MEOP) shall be calculated as part of the ballistics analysis. Results of the ballistics analysis shall be documented in the Design Development Report (see 4.2.3.5).

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4.2.2.6 Thrust alignment analysis. The contractor shall conduct a thrust alignment analysis to demonstrate that the booster design satisfies the thrust alignment requirements specified in the acquisition documents (see 6.2.1). Results of the thrust alignment analysis shall be documented in the Design Development Report (see 4.2.3.5).

4.2.2.7 Interface analysis. The contractor shall conduct an interface analysis of the booster design to demonstrate that it satisfies all mechanical and electrical interface requirements. Results of the interface analysis shall be documented in the Design Development Report (see 4.2.3.5).

4.2.2.8 Preliminary hazard analysis. When specified in the contract or order, the contractor shall prepare a preliminary hazard analysis in accordance with Task 202 of MIL-STD-882 with emphasis on ordnance hazards. 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 contract or 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 days prior to the Preliminary Design Review. He shall include provisions for the following:

a. Serialization of all hardware and energetic components down to the piece part levels.
b. 100 percent 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
h. Hydrostatic proof pressure testing of each pressure vessel.

4.2.3.4 Marginality of success evaluation plan. When specified in the contract or 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, nozzle throat diameter, seal integrity, ejecta
c. Comparison of actual versus predicted ballistic performance

The plan shall be made available to the contracting activity for acceptance in Phase I 30 days prior to static firing the first booster.

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4.2.3.5 Design Development Report. When specified in the contract or order, the contractor shall prepare a design development report which summarizes the results of all efforts conducted during Phase I. 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-1000. Tooling which controls the dimensions and geometry of the propellant grain shall be a part of the booster drawings. 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 contract or order, the contractor shall prepare a configuration management plan covering Phases II and III of the development program. The plan shall include tooling for manufacturing the propellant grain. Approval authority shall be as specified herein (see 4.3.7 and 4.4.9). 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 booster. 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 60 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 requirements. 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 minutes. When specified in the contract or 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 II - Design Verification.

4.3.1 Fabrication.

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4.3.1.1 Manufacture of environmental test items. The contractor shall manufacture 20 test units in accordance with the approved Level 2 drawings except that provisions for monitoring chamber pressure shall be incorporated.

4.3.1.2 Manufacture of inert test items. The contractor shall manufacture ten inert test items which replicate the mass properties of the live booster. These test units will be employed for handling and container tests.

4.3.2 Quality conformance of test items.

4.3.2.1 Hydrostatic proof pressure test. Prior to assembly, each booster chamber (and other components that constitute the pressure vessel) shall be subjected to an internal hydrostatic pressure of 1.15 times the maximum expected operating pressure (see 4.2.2.5). The pressure vessel shall demonstrate no permanent deformation as a result of hydrostatic proof pressure testing.

4.3.2.2 Radiographic inspection. After assembly, each test item shall be radiographically inspected in accordance with quality level 1 of MIL-STD-453. Any discrepancy including grain imperfection, defective material, missing or misplaced internal components shall be cause for rejection of the test item.

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

4.3.3 Environmental verification testing. The contractor shall demonstrate that the booster design is capable of withstanding the more severe service life stresses by subjecting test units to the series of environments outlined in table VI. Because an approved container design is typically not available in Phase II, all testing is to be done on the booster in its operational (see 6.3.1.2) or storage (see 6.3.1.3) condition.

TABLE VI. Environmental verification test matrix.

Test	Test temperature[1]	Requirement paragraph	Inspection method	Motor serial number[2]																	
				Environment												Baseline							
				1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
Vibration	STLL STUL	3.4.1	4.3.3.1	A	A																		
						A	A																
Thermal shock	Variable	3.4.2	4.3.3.2					A	A														
High temp. storage	STUL	3.4.3	4.3.3.3							A	A												
Two-foot drop	OTLL OTUL	3.4.8	4.3.3.6									A											
													A										
Humidity	Ambient	3.4.12	4.3.3.7	B		B																	
Rain	Ambient	3.4.5	4.3.3.4		B		B																
Salt fog	Ambient	3.4.6	4.3.3.5					B	B														
Non-Propulsivity	+70° F	—	4.3.3.8											A	A								
Ballistic performance	OTLL +70° F OTUL	—	4.3.3.9	C		C		C		C		C				A	A						
					C		C		C		C		C					A	A				
																				A	A		
Contingency	—	—	—																			A	A

[1]See life cycle environmental profile for description of temperatures.
[2]Letters denote test sequence.

4.3.3.1 Transportation vibration. The booster, in its storage condition (see 6.3.1.3), 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 514.3-1 through 514.3-3 of MIL-STD-810. Maximum expected transportation distance is 3000 miles. During vibration testing, the booster shall be contained in a temperature controlled chamber maintained at the specified temperature. Following this treatment, the booster shall be visually and radiographically inspected for evidence of degradation.

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4.3.3.2 Thermal shock. The booster, in its storage condition (see 6.3.1.3), shall be held in a conditioning chamber at the storage temperature upper limit (STUL) for the requisite thermal stabilization period. The booster shall than be moved to another chamber at the storage temperature lower limit (STLL) within 5 minutes. The booster 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 transfer. (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 booster shall then be removed and allowed to return to ambient temperature. Following this treatment, the booster shall be visually and radiographically inspected for evidence of degradation.

4.3.3.3 High temperature storage. The booster, in its storage condition (see 6.3.1.3), shall be placed in a conditioning chamber maintained at the STUL for a period of 6 weeks. Following this treatment, the booster shall be visually and radiographically inspected for evidence of degradation.

4.3.3.4 Rain. The booster, in its operational condition (see 6.3.1.2), shall be exposed to a rainfall environment in accordance with Procedure I - Blowing Rain, Method 506.2 of MIL-STD-810. The booster shall be conditioned to a temperature 18° F greater than the rain temperature prior to test. Rainfall rate shall be 4 inches per hour and wind velocity shall be 40 miles per hour. Test duration shall be 30 minutes. Following this treatment, the booster shall be visually and radiographically inspected for evidence of degradation.

4.3.3.5 Salt fog. The booster, in its operational condition (see 6.3.1.2), 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. Following this treatment, the booster shall be visually and radiographically inspected for evidence of degradation.

4.3.3.6 Two-foot drop. The booster, in its operational condition (see 6.3.1.2), shall be conditioned to the specified operating temperature limit and dropped horizontally onto a 2-inch thick steel plate (minimum Brinell hardness of 207) embedded in not less than 2 feet of concrete. Two feet, as measured from the lowest point of the test article, shall be the drop height. Following this treatment, the booster shall be visually and radiographically inspected for evidence of degradation.

4.3.3.7 Humidity. The booster, in its operational condition (see 6.3.1.2), shall be subjected to a high humidity environment in accordance with Procedure III - Aggravated, Method 507.2 of MIL-STD-810. The aggravated temperature-humidity cycle specified in figure 507.2-3 of MIL-STD-810 shall be repeated ten times for a total test duration of 240 hours. Following this treatment, the booster shall be visually and radiographically inspected for evidence of degradation.

4.3.3.8 Non-propulsivity. The booster shall be configured to be representative of its storage condition (see 6.3.1.3). It shall be attached to a multi-component thrust stand and ignited. Thrust shall be recorded and compared to predicted performance. Post-firing inspection shall be in accordance with the marginality of success evaluation plan (see 4.2.3.4).

4.3.3.9 Ballistic performance static firing. The booster, in its operational condition (see 6.3.1.2), shall be conditioned to the specified temperature. Within 10 minutes of removal from the conditioning chamber, the booster shall be attached to a thrust stand and static fired. The ignition current shall replicate that of the end use application. Chamber pressure and motor thrust shall be recorded. The static firing shall be filmed with high speed photography equipment (2000 frames per second minimum). For the baseline static firings, motors 13 through 18, the contractor shall include provisions for characterizing ejecta from the rocket motor. Post-firing inspection shall be performed in accordance with the marginality of success evaluation plan (see 4.2.3.4). Photographic prints shall be made available to the contracting activity when specified in the contract or order.

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4.3.4 Other tests.

4.3.4.1 Thermal stabilization test. The contractor shall instrument a booster with temperature sensing transducers. The booster may employ live propellant or inert propellant with similar thermal properties. The instrumented booster shall be placed in temperature conditioning chambers maintained at the operating or storage temperature limits, whichever is most extreme. The temperature history of the booster shall be recorded to establish the time required for the booster 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 4.3.6.6).

4.3.4.2 Hydroburst. The contractor shall fabricate two test units from hardware which represents the pressure vessel of the booster. The units shall be subjected to gradually increasing water pressure until failure. The mode of failure shall be noted and the hardware shall be photographed. Results shall be documented in the Design Verification Report (see 4.3.6.6).

4.3.5 Analyses.

4.3.5.1 Structural analysis. When specified in the contract or order, the contractor shall update the structural analysis based on the test results in Phase II. Failure pressure and mode of failure (from 4.3.4.2) shall be compared to theoretical prediction and inconsistencies shall be identified. The structural analysis shall be made available to the contracting activity for acceptance.

4.3.6 Documentation and reviews.

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

4.3.6.2 System safety 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.

4.3.6.3 Quality assurance plan. When specified in the contract or 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.

4.3.6.4 Configuration management plan. When specified in the contract or 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.

4.3.6.5 Radiographic inspection procedure. When specified in 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 MIL-STD-453 as a guideline. The contractor shall include the procedure along with sample films to the contracting activity for acceptance. Any subsequent change to the radiographic inspection procedure shall be acceptable to the contracting activity.

4.3.6.6 Explosive ordnance disposal procedures. When specified in the contract or order, the contractor shall prepare data required to identify, render safe, and dispose explosive ordnance per MIL-M-63018. The data shall be made available to the contracting activity for acceptance 30 days prior to the Critical Design Review.

4.3.6.7 Design verification report. When specified in the contract or order, the contractor shall prepare a design verification report which summarizes the results of all efforts conducted during Phase II. The design verification report 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 available for acceptance within 60 days following the Critical Design Review.

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4.3.6.8 Level 3 engineering drawings. When specified in the contract or order, the contractor shall prepare Level 3 engineering drawings and associated lists in accordance with DOD-D-1000. Tooling which controls the dimensions and geometry of the propellant grain shall be a part of the booster drawings. The contractor shall incorporate detailed classification of characteristics in accordance with DOD-STD-2101 into the drawings. Toleranc-ing shall be in accordance with ANSI Y14.5. The drawings shall be made available to the contracting activity no later than 30 days prior to the Critical Design Review.

4.3.6.9 Test readiness review. When specified in the contract or 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.

4.3.6.10 Nomenclature request. When specified in the contract or order, the contractor shall prepare a Nomenclature Assignment Request (NAVSEA 5030/1) 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.

4.3.6.11 Hazard classification test plan. When specified in the contract or order, the contractor shall evaluate the hazards of the booster and, based on anticipated reactivity, develop a test plan for determination of hazard classification as described in NAVSEAINST 8020.8. The plan may include replicate testing as follows:

a. Single package test
b. Stack test
c. External fire, stack test

In general, boosters will be:

a. DOD hazard class/division: 1.3
b. DOD compatibility group: C

Thus, the full range of NAVSEAINST 8020.8 tests may not be required to demonstrate the hazard characteristics of the packaged booster. The test plan shall be made available to the contracting activity no later than 30 days prior to the Critical Design Review.

4.3.6.12 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.

4.3.6.13 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.

4.3.6.14 Review minutes. When specified in the contract or 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 following the review. The final review minutes shall be distributed no later than 15 days after receipt of the contracting activity's comments.

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4.3.7 **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 booster 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.

4.4 **Phase III - Design Qualification.**

4.4.1 **Fabrication.**

4.4.1.1 **Manufacture of environmental test items.** The contractor shall manufacture 30 test units in accordance with the approved Level 3 drawings, except that provisions for monitoring chamber pressure shall be incorporated.

4.4.1.2 **Manufacture of hazard test items.** The contractor shall manufacture hazard test items in accordance with the approved Level 3 drawings. Special provisions for monitoring chamber pressure shall not be incorporated.

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 flight test items.** The contractor shall manufacture the requisite number of flight test items, as specified in the acquisition documents (see 6.2), in accordance with approved Level 3 drawings. Special provisions for monitoring chamber pressure shall not be incorporated.

4.4.1.5 **Manufacture of static display model.** The contractor shall manufacture a cut-away model of the booster. 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.

4.4.1.6 **Manufacture of containers.** The contractor shall manufacture a sufficient number of containers to perform Phase III test and evaluation.

4.4.2 **Quality conformance of test items.**

4.4.2.1 **Hydrostatic proof pressure testing.** Prior to assembly, each booster chamber (and other components that constitute the pressure vessel) shall be subjected to an internal hydrostatic pressure of 1.15 times the maximum expected operating pressure (see 4.2.2.5). The pressure vessel shall demonstrate no permanent deformation as a result of hydrostatic proof pressure testing.

4.4.2.2 **Radiographic inspection.** After assembly, each test item shall be radiographically inspected in accordance with quality level 1 of MIL-STD-453. Any discrepancy including grain imperfection, defective material, missing or misplaced internal components, shall be cause for rejection of the test item.

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

4.4.3 **Environmental qualification testing.** The contractor (or other activity designated by the contracting activity - see 6.2) shall demonstrate that the booster design is capable of withstanding all expected service life stresses by subjecting test units to the series of environments outlined in table VII.

TABLE VII. Environmental qualification test matrix.

Test	Test temp.[1]	Requirement paragraph	Inspection method	Motor serial number[2]																												
				Environment																	Baseline												
				1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30
Vibration	STLL	3.4.1	4.4.3.1	A								C	C																			
	STUL				A									C	C																	
Thermal shock	Variable	3.4.2	4.4.3.2			A	A					B	B	B	B																	
High temp. storage	STUL	3.4.3	4.4.3.3					A	A			A	A	A	A																	
Altitude	Ambient	3.4.4	4.4.3.4									D	D	D	D																	
Rain	Ambient	3.4.5	4.4.3.5									E	E	E	E																	
Salt fog	Ambient	3.4.6	4.4.3.6									F	F	F	F																	
Sand-dust	Ambient	3.4.7	4.4.3.7									G	G	G	G																	
Two-foot drop	OTLL	3.4.8	4.4.3.8							A		H		H																		
	OTUL										A		H		H																	
Four-foot drop	STLL	3.4.9	4.4.3.9	B		B		B																								
	STUL				B		B		B																							
Fungus	Ambient	3.4.10	4.4.3.10													A																
Acceleration	OTLL	3.4.11	4.4.3.11														A															
	+70° F																	A	A													
	OTUL																			A												
Ballistic Performance	OTLL	—	4.4.3.12	C		C		C		B		I		I							A	A	A	A								
	+70° F																								A	A	A	A				
	OTUL				C		C		C		B		I		I														A	A	A	A	
Contingency	—	—	—																													A

[1] See life cycle environmental profile for description of temperatures.
[2] Letters denote test sequence.

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4.4.3.1 Transportation vibration. The booster, in its shipping condition (see 6.3.1.1), shall be subjected to a vibration environment in accordance with Category 1 - Basic Transportation, Method 514.3 of MIL-STD-810. Test levels shall be as shown in figures 514.3-1 through 514.3-3 of MIL-STD-810. Maximum expected transportation distance is 3000 miles, and the packaged booster is to be treated as secured cargo. During vibration testing, the packaged booster shall be contained in a temperature controlled chamber maintained at the specified temperature. Following this treatment, the booster shall be visually and radiographically inspected for evidence of degradation.

4.4.3.2 Thermal shock. The booster, in its storage condition (see 6.3.1.3), shall be held in a conditioning chamber at the storage temperature upper limit (STUL) for the requisite thermal stabilization period. The booster shall then be moved to another chamber at the storage temperature lower limit (STLL) within 5 minutes. The booster 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 booster shall then be removed and allowed to return to ambient temperature. Following this treatment, the booster shall be visually and radiographically inspected for evidence of degradation.

4.4.3.3 High temperature storage. The booster, in its storage condition (see 6.3.1.3), shall be placed in a conditioning chamber maintained at the STUL for a period of 6 weeks. Following this treatment, the booster shall be visually and radiographically inspected for evidence of degradation.

4.4.3.4 Altitude. The booster, in its shipping condition (see 6.3.1.1), shall be subjected to a low pressure environment in accordance with Procedure I - Storage, Method 500.2 of MIL-STD-810. The packaged booster shall be held at an equivalent of 15,000 feet altitude for not less than one hour. Following this treatment, the booster shall be visually and radiographically inspected for evidence of degradation.

4.4.3.5 Rain. The booster, in its operational condition (see 6.3.1.2), shall be exposed to a rainfall environment in accordance with Procedure I - Blowing Rain, Method 506.2 of MIL-STD-810. The booster 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. Following this treatment, the booster shall be visually and radiographically inspected for evidence of degradation.

4.4.3.6 Salt fog. The booster, in its operational condition (see 6.3.1.2), 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. Following this treatment, the booster shall be visually and radiographically inspected for evidence of degradation.

4.4.3.7 Sand and dust. The booster, in its operational condition (see 6.3.1.2), 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 be at 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. Following this treatment, the booster shall be visually and radiographically inspected for evidence of degradation.

4.4.3.8 Two-foot drop. The booster, in its operational condition (see 6.3.1.2), 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 a minimum of 2 feet of concrete. Two feet, as measured from the lowest point of the test article, shall be the drop height. Drop attitudes shall be as specified in table VIII. Following this treatment, the booster shall be visually and radiographically inspected for evidence of degradation.

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TABLE VIII. Two-foot drop test attitudes.

Motor serial number	Test temperature (°F)	Drop attitude
7	OTLL	Horizontal
8	OTUL	Horizontal
9	OTLL	Nozzle end down
10	OTUL	Nozzle end down
11	OTLL	Forward end down
12	OTUL	Forward end down

4.4.3.9 Four-foot drop. The booster, in its shipping condition (see 6.3.1.1), shall be conditioned to the specified temperature. The test unit shall be subjected to a shock environment in accordance with Procedure IV - Transit Drop, Method 516.3 of MIL-STD-810. Four feet, as measured from the lowest point of the test article to the floor, shall be the drop height for shock testing. Drop attitudes shall be as specified in table IX. Following this treatment, the booster shall be visually and radiographically inspected for evidence of degradation.

TABLE IX. Four-foot drop test attitudes.

Motor serial number	Test temperature (°F)	Drop attitude	
		First drop	Second drop
1	STLL	Horizontal	Horizontal, bottom down
2	STUL	Horizontal	Horizontal, top down
3	STLL	Horizontal	Horizontal, side 1 down
4	STUL	Horizontal	Horizontal, side 2 down
5	STLL	Horizontal	Vertical, nozzle end down
6	STUL	Horizontal	Vertical, forward end down

4.4.3.10 Fungus. The booster, in its shipping condition (see 6.3.1.1), 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. Following this treatment, the booster shall be disassembled and examined for evidence of degradation.

4.4.3.11 Acceleration. The booster, in its operational condition (see 6.3.1.2), shall be conditioned to the specified temperature. Within 10 minutes after removal from the conditioning chamber, the booster shall be attached to a centrifuge and subjected to an acceleration environment in accordance with Procedure II - Operational Test (Centrifuge), Method 513.3 of MIL-STD-810. The booster's orientation on the centrifuge shall replicate the direction of the acceleration-induced forces typical of its end use application. Likewise, the magnitude of the acceleration shall replicate that of the end environment. The booster shall be ignited and chamber pressure shall be measured. Post-firing inspection shall be in accordance with the marginality of success evaluation plan (see 4.2.3.4).

4.4.3.12 Ballistic performance static firing. The booster, in its operational condition (see 6.3.1.2), shall be conditioned to the specified temperature. Within 10 minutes of removal from the conditioning chamber, the booster shall be attached to a thrust stand and static fired. The ignition current shall replicate that of the end use application. Chamber pressure and motor thrust shall be recorded. The static firing shall be filmed with high speed photography equipment (2000 frames per second minimum). Post-firing inspection shall be performed in accordance with the marginality of success evaluation plan (see 4.2.3.4). Photographic prints shall be made available to the contracting activity in accordance with the acquisition documents.

4.4.4 Hazard assessment tests. The contractor shall subject the booster to hazard assessment tests as outlined in table X. Before testing, the boosters shall be subjected to environmental treatments typical of the life cycle as approved by the contracting activity. Results shall be interpreted in accordance with the definitions of NAVSEAINST 8010.5 and reported in the Safety Test Report (see 4.4.8.6).

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TABLE X. Hazard assessment test matrix.

Test[1]	Requirement paragraph	Inspection method	Number of test items	Item condition
Baseline	—	4.4.4.1	1	Operational
Slow cook-off	3.5.2.1	4.4.4.2	2	Shipping
Fast cook-off	3.5.2.2	4.4.4.3	2	Operational
Bullet impact	3.5.2.3	4.4.4.4	2	Operational
Fragment impact	3.5.2.4	4.4.4.5	2	Operational
Sympathetic detonation	3.5.2.5	4.4.4.6	2	Shipping
HERO	3.5.2.7	4.4.4.7	1	Operational
Electrostatic discharge	3.5.2.8	4.4.4.8	1	Shipping
Forty-foot drop	3.5.2.9	4.4.4.9	3	Operational

[1]Environmental treatments prior to testing to be acceptable to the contracting activity.

4.4.4.1 **Baseline output test.** In accordance with NAVSEAINST 8010.5, the booster shall be subjected to an explosive charge to initiate the most violent reaction possible. Blast overpressure shall be recorded. Test procedures shall be acceptable to the contracting activity prior to the conduct of the test.

4.4.4.2 **Slow cook-off.** Two boosters shall be subjected to the slow cook-off test in accordance with DOD-STD-2105. Test instrumentation shall be in accordance with NAVSEAINST 8010.5.

4.4.4.3 **Fast cook-off.** Two boosters shall be subjected to the fast cook-off test in accordance with DOD-STD-2105 and MIL-STD-1648. Test instrumentation shall be in accordance with NAVSEAINST 8010.5. Both boosters shall be in the operational condition (see 6.3.1.2) since normally this condition will yield the most violent reaction. Testing in the shipping condition (see 6.3.1.1) shall be acceptable to the contracting activity.

4.4.4.4 **Bullet impact.** Two boosters shall be subjected to the bullet impact test in accordance with DOD-STD-2105. Test instrumentation shall be in accordance with NAVSEAINST 8010.5. Both boosters shall be in the operational condition (see 6.3.1.2).

4.4.4.5 **Fragment impact.** Two boosters shall be subjected to the fragment impact test in accordance with NAVSEAINST 8010.5. Both boosters shall be in the operational condition (see 6.3.1.2).

4.4.4.6 **Sympathetic detonation.** Two packaged boosters shall be arranged in a typical storage configuration. One booster shall be subjected to an explosive charge to initiate the most violent reaction possible. Blast overpressure shall be recorded and the test shall be recorded on film. The reaction of the second booster shall be assessed based on post-test inspection.

4.4.4.7 **HERO.** Hazards of electromagnetic radiation to ordnance (HERO) testing shall be conducted on the electromagnetic compatibility test item (see 4.4.1.3) in accordance with MIL-STD-1385. The booster shall be in the operational condition (see 6.3.1.2).

4.4.4.8 **Electrostatic discharge.** If the life cycle of the booster includes helicopter transport, electrostatic discharge (300 kilovolt) testing shall be conducted on the electromagnetic compatibility test item (see 4.4.1.3) in accordance with Procedure II, Test 126 of MIL-STD-331. The booster shall be in the shipping condition (see 6.3.1.1).

4.4.4.9 **Forty-foot drop.** Three boosters shall be subjected to forty-foot drop testing in accordance with DOD-STD-2105. The boosters shall be in the operational condition (see 6.3.1.2).

4.4.5 **Hazard classification tests.** The contractor shall conduct hazard classification tests in accordance with the approved test plan (see 4.3.6.10).

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4.4.6 Other tests.

4.4.6.1 Interface demonstration. The contractor shall install a booster on its designated platform(s) to demonstrate physical compatibility. The booster may be inert as long as all physical interface characteristics are maintained. The booster shall be electrically connected to the firing circuit to demonstrate physical compatibility of connectors. The installed booster shall be photographed for documentation purposes. Results of the interface demonstration shall be documented in the Design Qualification Report (see 4.4.8.5).

4.4.6.2 Center of mass measurement. The contractor shall measure the location of the center of mass for not less than ten tests items in the operational condition (see 6.3.1.2). Measurement results shall be documented in the Design Qualification Report (see 4.4.8.5).

4.4.7 Analyses.

4.4.7.1 Electromagnetic pulse analysis. When specified in the contract or 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 acceptance.

4.4.8 Documentation and reviews.

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

4.4.8.2 System safety 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 III. The revised system safety program plan shall be made available to the contracting activity for acceptance.

4.4.8.3 Quality assurance plan. When specified in the contract or 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.

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

4.4.8.5 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.

4.4.8.6 Safety test report. When specified in the contract or order, the contractor shall prepare a safety test report which documents the results of hazard assessment tests (see 4.4.4) and hazard classification tests (see 4.4.5). The report shall be made available to the contracting activity no later than 60 days prior to the Functional Configuration Audit.

4.4.8.7 Test readiness review. When specified in the contract or 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:

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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

4.4.8.8 **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.

4.4.8.9 **Hazard classification data package.** When specified in the contract or order, the contractor shall prepare a hazard classification data 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 (for example, NAVAIR Safety Office) to assign a final hazard classification to the booster.

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

4.4.8.10 **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 the necessary information to demonstrate that the booster 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.

4.4.8.11 **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 booster 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.

4.4.8.12 **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 booster. 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 booster end item. The fabrication specifications shall be made available to the contracting activity no later than 30 days prior to the Functional Configuration Audit.

4.4.8.13 **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.

4.4.8.14 **Functional Configuration Audit.** When specified in the contract or order and at the conclusion of the Phase III 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 III is complete.

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4.4.8.15 Review minutes. When specified in the contract or 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 contracting activity's comments.

4.4.9 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.

4.4.10 Reliability assessment.

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

4.4.10.2 Reliability growth curve. The reliability growth curve shall be updated throughout Phase III to assess the rocket motor demonstrated (pass/fail) reliability at 90 percent confidence.

5. PACKAGING

5.1 Preservation. Boosters shipped outside 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. Boosters 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 military air. Boosters 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 146, and 49 CFR 100-199.

5.3 Marking.

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

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

5.4 Transportation. Boosters shipped outside the contractor's facility shall be shipped by approved modes of transportation in accordance with 49 CFR 100-199.

5.5 Shipping configuration. Each booster shipped outside the contractor's facility shall be in the shipping condition (see 6.3.1.1).

6. NOTES

6.1 Intended use. The solid propellant rocket booster systems described herein are used to assist manned aircraft, targets and other airborne platforms during takeoff.

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6.2 Ordering data.

6.2.1 Acquisition requirements. Acquisition documents should specify the following:

a. Title, number and date of this specification
b. Title, number and date of the detailed item specification
c. Performance requirements (see 3.3)
d. Mechanical interface requirements (see 3.5.4)
e. Electrical interface requirements (see 3.5.4)
f. Container reusability requirements (see 3.5.6)
g. Thrust alignment requirements (see 4.2.2.6)
h. Number of flight test items and delivery destination (see 4.4.1.4)
i. Launch environment description (i.e., engine exhaust, thermal profile, vehicle acceleration profile, flight loads - see 4.2.2.3 and 4.2.2.4)
j. Provisions for any tests to be performed by someone other than the contractor (see 4.1)

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 27.410.6 (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
4.2.2.8	System Safety Hazard Analysis Report	DI-SAFT-80101
4.2.3.1, 4.3.6.1, 4.4.8.1	Program Plan	DI-A-1021
4.2.3.2, 4.3.6.2, 4.4.8.2	System Safety Program Plan	DI-SAFT-80100
4.2.3.3, 4.3.6.3, 4.4.8.3	Quality Program Plan	UDI-R-23743B
4.2.3.4	Verification, Demonstration and Evaluation Plan	DI-S-6170
4.2.3.5, 4.3.6.6, 4.4.8.5	Report, Design	DI-R-24039A
4.2.3.6, 4.3.6.7	Drawings, Engineering and Associated Lists	DI-E-7031
4.2.3.7, 4.3.6.4, 4.4.8.4	Software Configuration Management Plan	DI-MCCR-80009
4.2.3.8	Military Specification	DI-MISC-80001
4.2.3.9, 4.4.8.10	Characteristics and Performance Data	DI-E-3135
4.2.3.10, 4.4.8.11	Presentation Material	DI-A-3024A
4.2.3.11, 4.3.6.11, 4.4.8.13	Conference Agenda	DI-A-7088
4.2.3.12, 4.3.6.12	Design Review Data Package	DI-E-5423
4.2.3.13, 4.3.6.13, 4.4.8.15	Conference Minutes	DI-A-7089
4.3.3.9, 4.4.3.12	Still Photographs	DI-A-5019
4.3.5.1	Structural Design Criteria Report (Aircraft)	DI-S-30587
4.3.6.5	Test and Inspection Report	DI-E-1150
4.3.6.6	Explosive Ordnance Disposal Procedure	DI-M-3403B
4.3.6.8, 4.4.8.7	General Test Plan/Procedure	DI-T-3707A
4.3.6.9, 4.4.8.8	MK/MOD Nomenclature Assignment Request	DI-E-2000A
4.3.6.10, 4.4.8.9	Explosives Hazard Classification Data	DI-L-3311B
4.4.7.1	Report, Electromagnetic Pulses (EMP) Hardening	UDI-R-22551A
4.4.8.6	Safety Assessment Report	DI-SAFT-80102
4.4.8.12	Critical Item Product Fabrication Specification	DI-E-30132
4.4.8.14	Plan, Configuration Audit	DI-E-2036
4.4.9	Engineering Change Proposals (ECPs) and Requests for Deviations and Waivers (Long Form)	DI-E-2037

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(Data item descriptions related to this specification, and identified in Section 6 will be approved and listed as such in DOD 5010.12L, 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 Booster condition.

6.3.1.1 Shipping condition. The booster shall be in its non-propulsive configuration and packaged in its shipping container.

6.3.1.2 Operational condition. The booster shall be in its propulsive configuration and generally ready for its intended use.

6.3.1.3 Storage condition. The booster shall be in its non-propulsive configuration.

6.3.2 Performance parameters. Performance parameters are depicted in figure 1.

6.3.2.1 Ignition delay. Ignition delay is defined to be the time span from the application of firing current to the time the thrust achieves a value of T_1.

6.3.2.2 Burn time. Burn time is defined to be the time span from the thrust first achieving a value of T_1 to the time the thrust decreases to a value of T_3.

6.3.2.3 Tailoff. Tailoff is defined to be the time span from the thrust last having a value of T_2 to the time the thrust decreases to a value of T_3.

6.3.2.4 Total impulse. Total impulse is defined to be the integral of the thrust-time curve over the burn time.

6.3.2.5 Peak thrust. Peak thrust is the maximum thrust measured during the burn time.

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

6.5 Typical program schedule. A typical program schedule showing specification requirements is presented as figure 2.

6.6 Subject term (key word) listing.

Booster systems
JATO units
Motor, rocket
Propulsion systems, booster
Rocket motor

Preparing activity:
Navy-AS

(Project No. 1340-N 753)

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TABLE XI. Relationship of requirements to quality assurance provisions.

Requirement		Quality Assurance Provision(s)		
		Inspection	Analysis	Test
3.2.1.1	Chamber factor of safety		4.2.2.3	4.3.2.1, 4.3.4.2, 4.4.2.1
3.2.1.2	Closure seals	4.4.8.12		
3.2.1.3	Shorting of ignition leads	4.4.8.12		
3.2.1.4	Continuity measurement	4.4.8.12		
3.2.1.5	Non-propulsivity			4.3.3.8
3.2.1.6	Combustion stability	4.4.8.12		
3.2.1.7	Service life		4.2.2.1	4.3.3.3
3.2.1.8	Reliability		4.4.10.2	
3.2.1.9	Maintenance free design	4.4.8.12	4.2.2.1	
3.2.1.10	Ease of disassembly	4.4.8.12		
3.2.1.11	Conversion to operational condition	4.4.8.12		
3.2.1.12	Color	4.4.8.12		
3.2.1.13	Lettering color	4.4.8.12		
3.2.1.14	Marking	4.4.8.12		
3.2.1.15	Booster labeling data	4.4.8.12		
3.2.1.16	Igniter labeling data	4.4.8.12		
3.2.1.17	Booster igniter	4.4.8.12		
3.2.2.2	Interchangeability of parts	4.4.8.12		
3.2.2.3	Threaded parts	4.4.8.12		
3.2.2.4	Standard tools and test equipment	4.4.8.12		
3.2.2.5	Foreign object damage prevention	4.4.8.12		
3.2.2.6	Human engineering	4.4.8.12		
3.2.2.7	Interchangeability	4.4.8.12		
3.2.3.2	Prohibited materials	4.4.8.12		
3.2.3.3	Compatibility		4.2.2.1	4.2.1.6
3.2.4	Material finishes	4.4.8.12		
3.2.4.2	Prohibited finishes	4.4.8.12		
3.2.5	Fasteners	4.4.8.12		
3.2.5.2	Nonstandard fasteners	4.4.8.12		
3.3	Performance requirements			4.4.3.12
3.4.1	Transportation vibration			4.3.3.1, 4.4.3.1
3.4.2	Thermal shock			4.3.3.2, 4.4.3.2
3.4.3	High temperature storage			4.3.3.3, 4.4.3.3
3.4.4	Altitude			4.4.3.4
3.4.5	Rain			4.3.3.4, 4.4.3.5
3.4.6	Salt fog			4.3.3.5, 4.4.3.6
3.4.7	Sand and dust			4.4.3.7
3.4.8	Two-foot drop			4.3.3.6, 4.4.3.8
3.4.9	Four-foot drop			4.4.3.9
3.4.10	Fungus			4.4.3.10
3.4.11	Acceleration			4.4.3.11
3.4.12	Humidity			4.3.3.7
3.5.2.1	Slow cook-off response			4.4.4.2
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3.5.2.6	Electromagnetic pulse vulnerability		4.4.7.1	
3.5.2.7	Sensitivity to electromagnetic radiation			4.4.4.7
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3.5.4	Interface compatibility			4.4.6.1
3.5.5	Configuration management	4.3.7		
3.5.6	Shipping container	4.4.8.12		
3.5.7	Workmanship	4.4.8.12		

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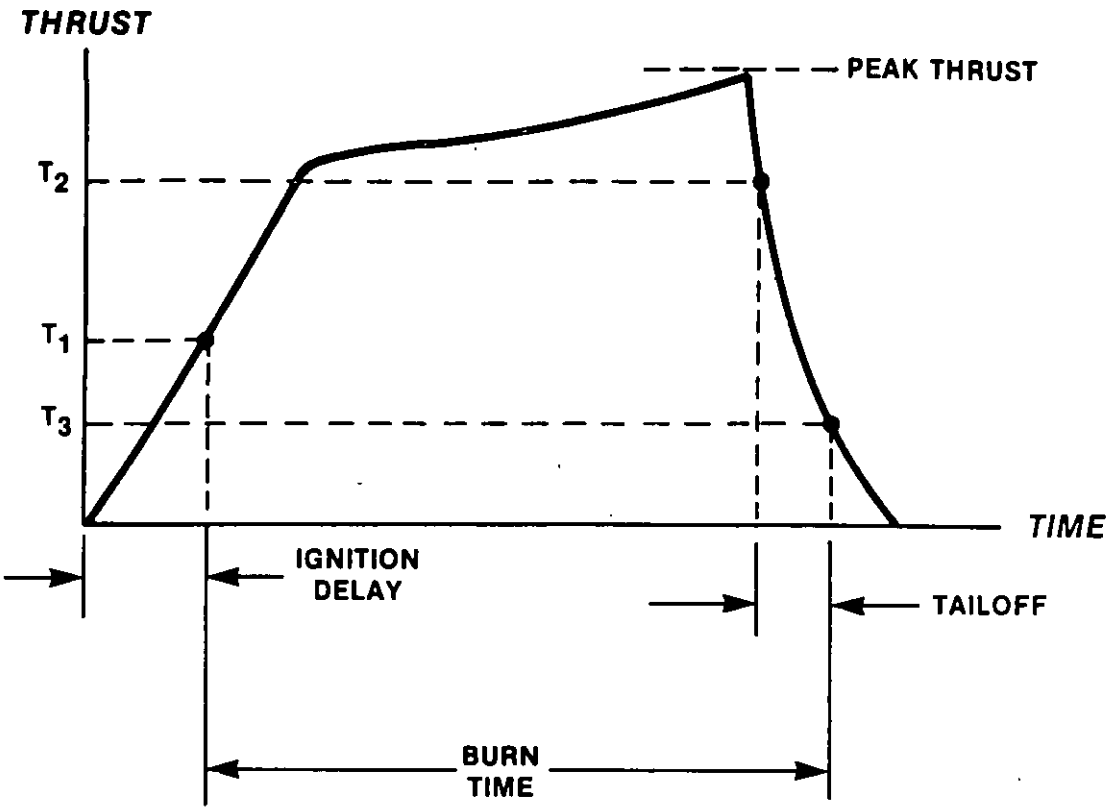

PARAMETER	REQUIREMENT FOR A CONDITIONING TEMPERATURE OF:		
	OTLL	70°F	OTUL
IGNITION DELAY			
BURN TIME			
TAILOFF			
TOTAL IMPULSE			
PEAK THRUST			

FIGURE 1. Summary of static firing performance.

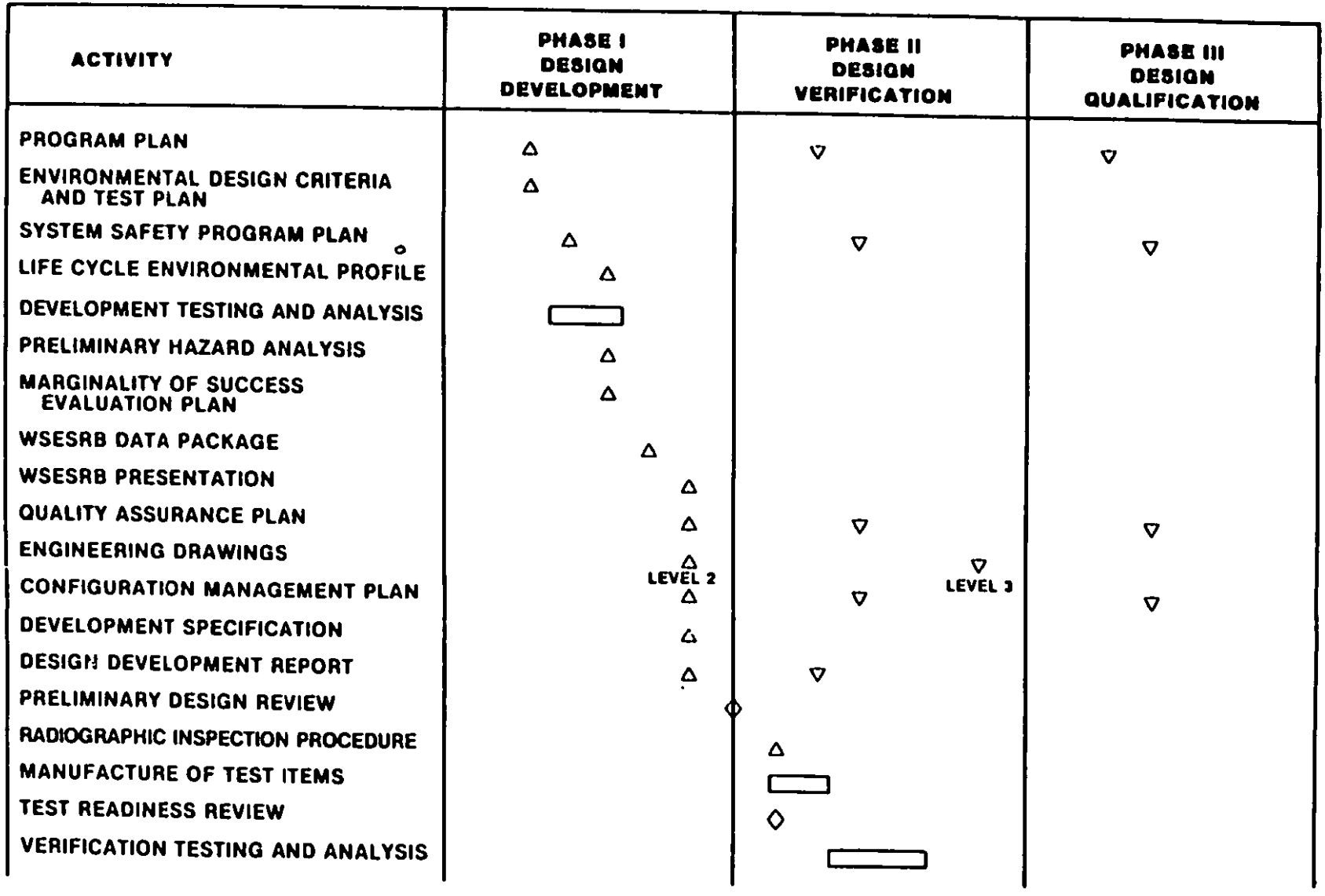

FIGURE 2. Typical program schedule.

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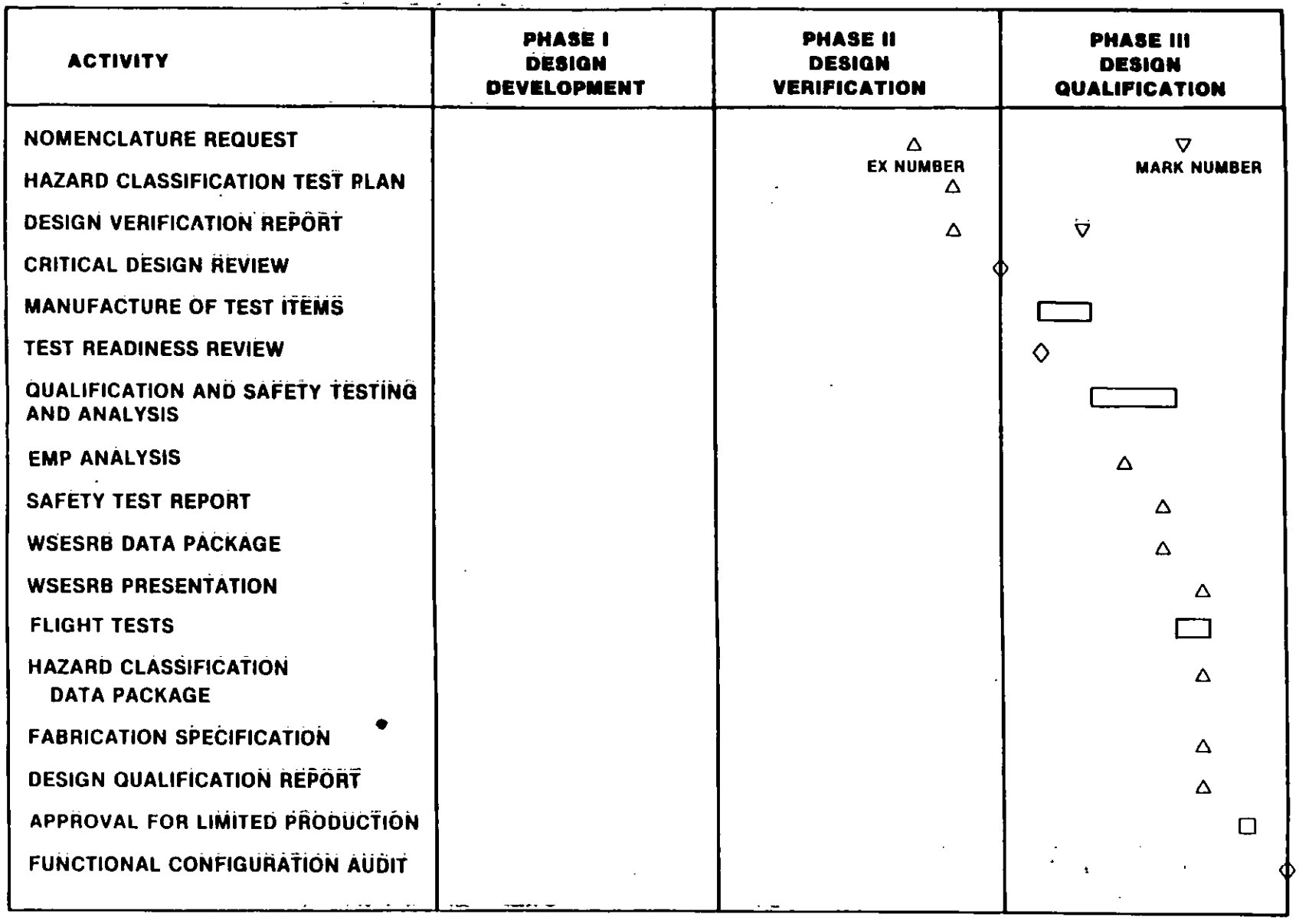

FIGURE 2. Typical program schedule - continued.

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	☐ VENDOR ☐ USER ☐ MANUFACTURER ☐ OTHER *(Specify)*: _____
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5. PROBLEM AREAS

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c. Reason/Rationale for Recommendation:

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