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MILITARY STANDARD

LAUNCHER, EJECTION, GUIDED MISSILE, AIRCRAFT, GENERAL DESIGN CRITERIA FOR

FSC 1440

DEPARTMENT OF DEFENSE
Washington, DC 20301

Launcher, Ejection, Guided Missile, Aircraft, General Design Criteria for

MIL-STD-2131(AS)

1. This Military Standard is approved for use by the Naval Air Systems Command, Department of the Navy, and is available for use by all Departments and Agencies of the Department of Defense.

2, 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, Engineering Specifications and Standards Department (ESSD), Code 93, Lakehurst, NJ 08733, 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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1. SCOPE

1.1 Scope. The purpose of this document is to provide guidelines for establishing general criteria for the design, development, construction, maintenance and testing of an ejection launcher. This standard is applicable to all missile suspension systems. However, it is assumed that all new missile developments will employ a 14-inch or 30-inch missile suspension system as defined in MIL-A-8591. The launcher shall provide for the carriage, service and power ejection release of an airborne guided missile with either a nuclear or conventional warhead from tactical aircraft in flight.

2. REFERENCED DOCUMENTS

2.1 Issues of Documents. The following documents of the issue in effect on date of invitation for bids or request for proposal, form a part of this standard to the extent specified herein.

SPECIFICATIONS

FEDERAL

L-P-383	Plastic Material, Polyester Resin, Glass Fiber Base, Low Pressure Laminated.
QQ-A-367	Aluminum Alloy Forgings.
QQ-P-416	Plating, Cadmium (electrodeposited).

MILITARY

DoD-D-1000	Drawings, Engineering and Associated Lists.
MIL-S-5002	Surface Treatments and Metallic Coatings for Metal Surfaces of Weapons Systems.
MIL-B-5087	Bonding, Electrical, and Lightning Protection, For Aerospace Systems.
MIL-W-5088	Wiring, Aircraft, Selection and Installation of.
MIL-C-5541	Chemical Films and Chemical Film Materials for Aluminum and Aluminum Alloys.
MIL-H-5606	Hydraulic Fluid, Petroleum Base, Aircraft, Missile and Ordnance.
MIL-C-6021	Casting, Classification and Inspection of.
MIL-S-6051	Electromagnetic Compatibility Requirements, Systems.
MIL-H-6088	Heat Treatment, Aluminum Alloys.
MIL-H-6875	Heat Treatment of Steels (Aircraft Practice) Process for.
MIL-F-7179	Finishes and Coatings, General Specification for Protection of Aerospace Weapons, Structures and Parts.

SPECIFICATIONS - Continued.

MILITARY

MIL-F-7190	Forgings, Steel, for Aircraft and Special Ordnance Applications.
MIL-T-7743	Testing, Store Suspension and Release Equipment, General Specification for.
MIL-B-7883	Brazing of Steels, Copper, Copper Alloys, Nickel Alloys, Aluminum and Aluminum Alloys.
MIL-I-8500	Interchangeability and Replaceability of Component Parts for Aerospace Vehicles.
MIL-A-8591	Airborne Stores, Associated Suspension Lugs, and Aircraft-Store Interface (Carriage Phase); General Design Criteria for.
MIL-A-8625	Anodic Coatings, for Aluminum and Aluminum Alloys.
MIL-A-8837	Coating, Cadmium (Vacuum Deposited).
MIL-L-8937	Lubricant, Solid Film, Heat Cured.
MIL-P-15024	Plates, Tags and Bands for Identification of Equipment.
MIL-F-18264	Finishes, Organic, Weapons System, Application and Control of.
MIL-N-18307	Nomenclature and Identification.
MIL-A-21180	Aluminum Alloy Castings, High Strength.
MIL-A-22771	Aluminum Alloy Forgings, Heat Treated.
MIL-C-38999	Connectors, Electrical, Circular, Miniature High Density, Quick Disconnect, Environment Resistant, Removable Crimp Contacts.
MIL-H-46855	Human Engineering Requirements for Military Systems, Equipment and Facilities.
MIL-H-81200	Heat Treatment of Titanium and Titanium Alloys.

SPECIFICATIONS - Continued.

MILITARY

MIL-D-81303	Design and Evaluation of Cartridges for Stores Suspension Equipment.
MIL-F-83142	Forging, Titanium Alloys, for Aircraft and Aerospace Applications.
MIL-C-85485	Cable, Electric, Filter Line, Radio Frequency Absorptive.

STANDARDS

MILITARY

MIL-STD-130	Identification Marking of U.S. Military Property.
MIL-STD-143	Standards and Specifications, Order of Precedence for the Selection of.
MIL-STD-454	Standard General Requirements for Electronic Equipment.
MIL-STD-461	Electromagnetic Compatibility.
MIL-STD-462	Electromagnetic Interference Characteristics, Measurement of.
MIL-STD-704	Aircraft Electric Power Characteristics.
MIL-STD-810	Environmental Test Methods.
MIL-STD-838	Lubrication of Military Equipment.
MIL-STD-882	System Safety Program Requirements.
MIL-STD-889	Dissimilar Metals.
MIL-STD-1385	Preclusion of Ordnance Hazards in Electromagnetic Fields, General Requirements for.
MIL-STD-1472	Human Engineering Design Criteria for Military Systems, Equipment and Facilities.
MIL-STD-1568	Materials and Processes for Corrosion Prevention and Control in Aerospace Weapons Systems.
MIL-STD-1587	Materials and Processes Requirements for Air Force Weapons Systems.
MIL-STD-1760	Aircraft/Store Electrical Interconnection System.
MIL-STD-2088	Bomb Rack Unit (BRU), Aircraft, General Design Criteria For.

HANDBOOKS

MILITARY

MIL-HDBK-5	Metallic Materials and Elements for Aerospace Vehicle Structures.
MIL-HDBK-235	Electromagnetic (Radiated) Environment Considerations for Design and Procurement of Electrical and Electronic Equipment, Subsystems and Systems-Part 1A.

PUBLICATIONS

MILITARY

MIL-BUL-147	Specifications and Standards of Non-Government Organizations Released for Flight Vehicle Construction.

NAVAL AIR SYSTEMS COMMAND

AR-43	Electromagnetic Compatibility Advisory Board; Requirement for.
SD-24	General Specification for Design and Construction of Aircraft Weapons Systems.
WR-62	Naval Weapons Requirements, Specifications and Standards; Use of.
19-15BD-6	Technical Manual, "Description, Operation and Maintenance Instruction with Illustrated Parts Breakdown for Single Hoist Ordnance Loading System (SHOLS)."
19-100-2	Airborne Weapons Handling Equipment (Shipboard).
19-100-1.1 (Vol 1) 19-100-1.2 (Vol 2)	Approved Handling Equipment for Weapons and Explosives, Volumes 1 and 2.

CHIEF OF NAVAL OPERATIONS

OPNAVINST 4790.2	Naval Aviation Maintenance Program.

AIR STANDARDIZATION COORDINATING COMMITTEE - AIR STANDARDS

AIR STD 20/16	Design Guide to Preclude Hazards of Electromagnetic Radiation to Airborne Weapon Systems.
AIR STD 20/18	Laboratory Tests for Stores Suspension Equipment.

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

2.2 Other publications. The following document(s) form a part of this standard to the extent specified herein. The issues of the documents which are indicated as DoD adopted shall be the issue listed in the current DoDISS and the supplement thereto, if applicable.

American National Standards Institute

ANSI B46.1 Surface Texture (Surface Roughness, Waviness and Lay).

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

Industry association specifications and standards are generally available for reference from libraries. They are also distributed among technical groups and using Federal agencies.

3. DEFINITIONS

3.1 Missile launcher. An item rigidly attached to an aircraft to carry, service, launch and jettison air-launched missiles.

3.2 Air-launched missile. A guided, self-propelled store designed to be launched from an airborne vehicle and whose target is either airborne, on the ground or under the water surface.

3.3 Ejection launcher. A launcher which provides an initial source of energy to adequately displace the missile from the aircraft prior to the initiation of the missile's self-propulsion system.

3.4 Rail launcher. A launcher containing rails on which the missile is carried, and along which the missile travels after initiation of the missile's self-propulsion system.

3.5 Launch. The intentional separation of the missile from the aircraft for normal employment of the missile.

3.6 Jettison. The intentional separation of the missile from the aircraft in a safed/unarmed condition.

3.7 Arming. The process of removing the safety devices and closing the signal paths necessary to allow firing of the missile motor or detonation of the missile warhead.

3.8 Safe separation. The parting of a missile from an aircraft without damage to, contact with or adverse effects on the aircraft, its launchers and other weapons.

3.9 Acceptable separation. Acceptable store separations satisfy not only safe separation criteria but also pertinent operational criteria to meet guidance control and trajectory requirements.

3.10 Cartridge hang fire. An abnormal delay between the instant of launcher firing signal and the explosion of the ejection cartridges.

3.11 Hung missile. A missile which does not separate from the launcher when the eject cycle is initiated.

3.12. Loading. The operation of installing missiles on the launcher and aircraft.

3.13 Suspension system. Launcher elements which engage the missile to react missile triaxial forces and moments, and generally consist of launcher hooks, support structure and sway braces.

3.14 Sway braces. Mechanical components of the launcher designed to provide missile restraint in roll and assist in counteracting other missile forces and moments.

3.15 Release system. Launcher elements which comprise a mechanism for latching and unlatching the launcher hooks from the missile support lugs.

3.16 Locking system. Elements of the launcher design that prevent inadvertent release or launch of the missile.

3.17 Umbilical. Normally a coolant line or an electrical harness which attaches to the missile with a quick disconnect fitting or plug. It is used to control or test missile equipment while the missile is attached to the launcher and aircraft.

3.18 Pylon. A pylon is a suspension device externally attachable on the wing or fuselage of an aircraft, with provisions for attaching aircraft stores.

4. GENERAL REQUIREMENTS

4.1 Launcher types. Rail launchers are generally used for missiles weighing less than 350 pounds, and can be used for missiles weighing up to 800 pounds. Ejection launchers can also be used for missiles weighing 350 to 800 pounds. Missiles weighing more than 800 pounds are assumed to be carried only on ejection launchers.

4.2 Selection of materials, specifications, standards and drawings. The selection of materials, standard parts, processes, corrosion protection, and design features significant in corrosion behavior shall be in accordance with the requirements of Design Specification SD-24, MIL-STD-1568 and MIL-STD-1587.

4.2.1 Materials. Materials shall conform to applicable specifications, be compatible with environmental and service conditions (see 4.3.10), and shall be as specified herein and on applicable drawings. Design shall make maximum use of standard (MS, AN, MIL-STD, etc) parts, materials and processes, rather than special or peculiar items. Materials which are not covered by government specifications or which are not specifically described herein, shall be of the best quality, suitable for the purpose intended. Particular care shall be given to close fitting parts in the choice of both materials and corrosion prevention method. Materials shall be selected such that wet lubricants or preservatives are not required, and the use of dry lubricants is minimized.

4.2.1.1 Metal parts. All metal parts shall be of the corrosion resistant type or treated in a manner to render them resistant to corrosion. Type AISI 431 corrosion-resistant steel shall not be used. Unless suitably protected against electrolytic corrosion, dissimilar metals, as defined in MIL-STD-889, shall not be used in contact with each other. General design information governing usage of metals is furnished in MIL-HDBK-5.

4.2.1.1.1 Heat treatment. Heat treatment of aluminum, steel and titanium parts shall be in accordance with MIL-H-6088, MIL-H-6875, and MIL-H-81200 respectively.

4.2.1.1.2 Castings. Castings used in the launcher shall conform with the requirements of MIL-C-6021 with appropriate class, grade and critical area notations. In addition, aluminum alloy castings, used in critical strength applications, shall conform to the requirements of MIL-A-21180.

4.2.1.1.3 Forgings. Forgings used in the launcher shall conform to the requirements of MIL-F-7190, MIL-F-83142, or QQ-A-367 with appropriate grade and grain flow notations. Forgings used in critical strength applications shall conform to the requirements of MIL-F-7190 Grade A or MIL-A-22771.

4.2.1.2 Non-metallic components. Non-metallic components shall be designed for minimum deterioration caused by abrasion, exposure to sunlight, microorganisms, moisture, temperature extremes, fuel, hydraulic and lubricating oil, grease, and salt spray. Protection shall be provided for those non-metallic components for which strength degradation associated with abrasion, load or exposure-induced deterioration can endanger or jeopardize the function of the launcher.

4.2.1.2.1 Reinforced plastic construction. Reinforced plastic materials if required, shall be as specified for Type I materials in L-P-383 and shall be of such character and quality as to be capable of withstanding all service conditions, as herein specified, without degrading the performance of the component of the launcher.

4.2.1.3 Lubrication. Lubricants and lubrication practices shall conform to the requirements of MIL-STD-838 and MIL-L-8937 as applicable. Lubricants shall function satisfactorily throughout the temperature range from minus 70°F to plus 280°F. Choice of lubricants shall (a) be compatible with non-metallic components, (b) not damage finishes adjacent to location of lubricant application, (c) eliminate the need for frequent lubrication by field maintenance activities, and (d) be non-reactive with the environment. If lubrication is required, choice of lubricants and practices shall be such that lubrication need be accomplished only during post-deployment intermediate-level maintenance (see 4.3.11.4.2).

4.2.1.4 Hydraulic fluids. Hydraulic fluids used in the launcher shall be in accordance with MIL-H-5606.

4.2.1.5 Fungus-proof materials. To the greatest extent practicable, the materials used in the launcher shall be non-nutrients for fungi.

4.2.1.6 Potting compounds. Potting compounds employed in the launcher shall comply with Requirement 47 of MIL-STD-454.

4.2.1.7 Corrosion protection. Corrosion protective practices employed in the manufacture of the launcher shall be in accordance with the MIL-F-7179 requirements for exterior surfaces. Design of the launcher shall make use of materials which preclude corrosion susceptibility under service environmental conditions without a requirement for hermetic sealing.

4.2.1.8 Finishes. Protective coatings and finishes shall not crack, chip, or scale during normal service, or in the herein specified extremes of environmental conditions. Surface treatments, coatings and finishes shall conform to MIL-S-5002, or surface treatments specified herein. General guidance in the application and control of organic finishes is provided in MIL-F-18264.

4.2.1.8.1 Anodizing. All non-fatigue critical aluminum and aluminum alloy parts, not subject to wear, shall have Type II anodic coatings in accordance with MIL-A-8625. Aluminum and aluminum alloy parts subject to wear shall have Type III anodic coatings in accordance with MIL-A-8625.

4.2.1.8.2 Chemical surface treatment. For aluminum and aluminum alloy parts not subject to wear, abrasion or erosion, chemical conversion surface treatment in accordance with MIL-C-5541 may be used in lieu of anodizing.

4.2.1.8.3 Plating. Plating shall be avoided where possible. When required, plating of steel surfaces shall be in accordance with the requirements of MIL-S-5002. Steel parts, not subject to wear, in contact with aluminum or aluminum alloys shall be cadmium plated in accordance with QQ-P-416, Type II, Class I, or MIL-A-8837, Type II, Class 1.

4.2.1.9 Electrical connectors. Connectors shall be "scoop proof" to prevent accidental shorting of or damage to contacts during mating of the plug and receptacle. The connectors shall contain positive mating features to indicate completed connection and to prevent any possibility of mismating. Connectors shall contain peripheral grounding fingers that connect the two mating halves of the connector before pin and socket contacts make connection. The connector shall also contain provisions for terminating shield braid for electromagnetic interference (EMI) protection. The aircraft, weapon and launcher sides of the electrical connection shall contain socket-type contacts, and the electrical harness shall contain pin-type contacts. If there is no electrical harness, then the aircraft or launcher side of the electrical connection shall contain socket-type contacts, and the weapon side shall contain pin-type contacts. Electrical connector selection shall be made utilizing MIL-C-38999, to the series identified in MIL-STD-1760. Soldered or brazed electrical connections shall not be used in electrical connectors.

4.2.1.10 Wiring. All electrical wiring shall be in accordance with MIL-W-5088 and MIL-C-85485.

4.2.1.11 Soldered or brazed connections. The soldering of contacts shall be in accordance with MIL-STD-454 requirement 5. When a brazing process is used, it shall be in accordance with MIL-B-7883.

4.2.2 Specifications and standards. Specifications and standards for necessary commodities and services not specified herein shall be selected in accordance with MIL-STD-143 and WR 62. A partial listing of approved MIL-STD-143 Group II non-government organization specifications and standards is furnished in MIL-BUL-147.

4.2.3 Drawings. Drawing requirements shall be specified by the procuring activity in accordance with DoD-D-1000 instructions.

4.3 General design requirements.

4.3.1 Performance. The launcher shall provide for safe and reliable captive carriage, service, ejection launch and jettison of a specified missile configuration installed on tactical aircraft. The launcher shall be capable of processing aircraft power and aircraft/missile signals essential to missile system operation and test. Launcher design shall permit quick and reliable loading and downloading of the missile to the launcher, and of the launcher to the aircraft, and provide easy access for maintenance and servicing. The launcher shall sustain specified design loads and environments which shall not adversely affect the launcher operation.

4.3.2 Design factors of safety. The launcher yield factor of safety shall be 1.15 times the design limit load. Design limit loads are the maximum actual loads that may be expected to occur in service. No permanent deformation shall be allowed after application of design yield loads. The launcher ultimate factor of safety shall be 1.5 times the design limit load. Failure of the launcher upon application of the ultimate load shall be defined as:

a. Separation of the missile from the launcher, or failure of the launcher to retain its missile in normal carriage position.

b. Separation of the launcher from the aircraft.

Other structural breakage or permanent deformation of the launcher does not constitute failure at the ultimate load level. In addition, all castings used shall have a minimum margin of safety of 0.33, all fittings and forgings shall have a minimum margin of safety of 0.20. Allowable yield and ultimate loads shall include the effects of thermal environments.

4.3.2.1 Pressure systems. Components of the pressure system shall be designed to a proof pressure of 2.0 and burst pressure of 2.5 times the operational peak pressure of that system. A lock shut firing incident shall not cause: (a) missile release; (b) hazard to personnel; (c) structural damage.

4.3.3 Structural loads requirements. Load analyses and tests shall be conducted to determine launcher design loads for the following conditions.

4.3.3.1 Take-off and landing loads. The launcher shall withstand the maximum loads imposed by catapult take-off and arrested landing in accordance with MIL-A-8591. Applicable inertial acceleration limits and loads shall be developed.

4.3.3.2 Captive flight loads. The launcher shall be designed for the maximum aerodynamic and inertial loads acting on the missile and launcher throughout the captive flight mach-altitude envelope of the aircraft (minimum store configuration). The design captive flight envelope and the inertial acceleration levels of the most severe aircraft/weapon station shall be used to develop worst-case launcher design loads in accordance with MIL-A-8591.

4.3.3.3 Launch loads. The launcher shall be designed for the maximum aerodynamic and inertial loads acting on the missile and launcher throughout the specified launch mach-altitude envelope of the aircraft (minimum store configuration). Combined launcher loads shall include launcher ejector forces and the structural dynamic interactions which occur at missile separation.

4.3.3.4 Jettison loads. The launcher shall be designed to withstand the combined effect of maximum ejection forces and the aerodynamic and inertial forces acting on the missile/launcher combination over the specified jettison envelope.

4.3.3.5 Cyclic loads. The launcher shall be capable of withstanding the cyclic application of combined limit loads imposed upon it over the course of its specified life. The cyclic load spectra shall include the effects of specified environments and a minimum of 500 launches.

4.3.4 Stress analysis. A stress analysis shall be accomplished using the loads generated in accordance with 4.3.2 and 4.3.3. Margins of safety shall be verified by static tests and cyclic load tests of 4.3.3.5 as required by the procuring activity.

4.3.5 Service life. The launcher design objective shall be to meet or exceed an economically maintainable service life of 10 years exclusive of shelf life and based on anticipated aircraft mission profiles. An economically maintainable service life is exceeded when the cost to repair the launcher is more than one half the replacement cost. In terms of missile release, the launcher shall have a minimum design service life of 500 missile ejections prior to major overhaul.

4.3.6 Reliability. Mission reliability for a launcher shall be a minimum of 0.99 at 90 percent confidence level. Mission reliability is defined as the probability that the launcher shall successfully eject missiles within specified mission parameters. Shelf life of the launcher and all components shall be a minimum of five years, and shall be refurbishable following the minimum shelf life specified. A maximum number of parts (subject to approval by the procuring agency) shall have a shelf life which is at least ten times the service life of the launcher, and a service life which is greater than that of the launcher.

4.3.7 Interfaces.

4.3.7.1 Launcher to aircraft interface. The launcher to aircraft interface is dependent on aircraft or pylon design for location of the launcher and the structural interface requirements. Launcher mounting shall be such as to minimize degradation of aircraft/missile performance, weight and drag, and shall utilize optimum load paths. Launcher design shall be tailored to existing aircraft support structure and shall not require special adaptors, and shall provide ease of installation and removal. When a launcher is required to satisfy different aircraft weapon stations which differ in primary support provisions, missile orientation or clearance requirements, or when the launcher is required to be used in combination with a bomb rack, the use of special adaptors may be permitted to avoid major aircraft modifications and to enhance system versatility. Physical interfaces between the launcher and aircraft shall be defined in terms of dimensions and tolerances and shall address each applicable aircraft weapon station. Functional interfaces shall include the support, service, missile control and fire control system functions. Electrical interfaces shall include aircraft supplied power and logic and control signals to and from the captive missile. Appropriate grounding and shielding shall be provided. All interface requirements shall comply with applicable aircraft/missile interface specifications.

4.3.7.2 Launcher to missile interface. Interfaces between the launcher and the missile shall include missile support, sway bracing, and pre-launch, ejection and service functions. Location of launcher ejectors, arming units, sway braces and suspension hooks shall be such as to optimize missile carry and separation performance and minimize missile stresses and weight. Physical interfaces including service umbilicals and safe-arm mechanisms shall be specified in terms of dimensions and tolerances under both static and dynamic conditions. Electrical interfaces shall specify missile power, and logic and control signal requirements. Appropriate grounding and shielding shall be provided. All interface requirements shall comply with applicable aircraft/missile interface specifications.

4.3.7.3 Launcher to support equipment interface. The functional and physical interfaces between the launcher and all applicable support equipment (SE) shall be specified and shall include any government furnished equipment (GFE) or contractor furnished equipment (CFE) used for handling, transporting, aircraft loading, cleaning, ground testing and servicing, and shipboard storage of the launcher.

4.3.7.4 Electrical grounding interface. The grounding system design shall provide compatibility with the grounding system within the aircraft and all other equipment to be used with or which interfaces with the launcher. The grounding system shall be in accordance with 5.11.5.

4.3.7.4.1 Launcher to aircraft structure grounding. The launcher structure shall be electrically grounded to the aircraft through the physical, mechanical interface of the two structures. The preparation of the conducting path and choice of mating surfaces composition, material and electrical characteristics shall be submitted by the contractor to the procuring activity for approval.

4.3.7.4.2 Launcher internal ground interface. Safety grounds shall be provided integral with the harness and connectors. The launcher shall be grounded in a manner which will prevent ground loops and ground returns common to signal and power circuits and will provide effective shielding for signal circuits, minimize electromagnetic interference (EMI), and protect personnel from electrical hazards.

4.3.8 Physical characteristics. The physical characteristics of the launcher shall be such as to satisfy all functional requirements. Major components of the launcher shall include as a minimum basic structure, ejector system, support and snubbing assemblies, latching and locking mechanisms, umbilical mechanisms, harnesses and rocket-motor firing circuits.

4.3.8.1 Launcher weight. The launcher shall be designed for minimum weight consistent with functional requirements, physical interface requirements and ease of handling during installation and maintenance, to the limits defined in the applicable detailed specification.

4.3.8.2 Launcher drag. The launcher shall be designed for minimum drag consistent with functional requirements, physical interface requirements and ease of handling during installation and maintenance, to the limits defined in the applicable detailed specification.

4.3.8.3 Launcher radar cross section (RCS). The launcher shall be designed for minimum radar cross section consistent with functional requirements, physical interface requirements and ease of handling during installation and maintenance, to the limits defined in the applicable detailed specification.

4.3.8.4 Dimensions and tolerances. Launcher dimensions shall be minimum consistent with functional requirements and physical interface requirements. Unless otherwise specified, dimension tolerances shall be in accordance with DoD-D-1000.

4.3.8.5 Clearances. Launcher clearances shall be such that deflections of launcher elements during operational usage shall not adversely affect launcher, missile or aircraft performance and safety.

4.3.8.6 Launcher installation alignment. The launcher design shall provide for a combined missile/launcher installation that maintains missile alignment tolerances within those specified for prelaunch alignment of the missile and aircraft reference axes.

4.3.8.7 Umbilical alignment. For blind installations, the launcher shall provide for alignment of the launcher-to-missile umbilical connector when the missile engages the launcher such that proper mechanical and electrical mating is achieved.

4.3.8.8 Service access. The launcher design shall provide adequate access for servicing of the launcher and removal of foreign deposits. The design shall permit removal of all launcher power supplies and electronic assemblies and harnesses for repair.

4.3.8.9 Test access. The launcher design shall provide access and provisions for test of the launcher, and shall meet the requirements of 5.11.

4.3.8.10 Drain provisions. Drain holes shall be provided as required to prevent collection and entrapment of water or other fluids. Where it is impractical to provide drain holes, cavities shall be sealed to prevent fluid penetration.

4.3.9 Human engineering. In addition to complying with MIL-STD-1472 and MIL-H-46855, the following additional requirements shall be incorporated in the design:

a. The anthropometric percentile range for armament groundcrew shall be as specified by the procuring activity.

b. An unloaded launcher shall be capable of being handled, serviced and transported outside of its aircraft installation without any requirement for ancillary equipment (ie, carriers, bolts, crates, etc).

c. Any positional indication and instructions located externally shall be flush with the general outside surface.

d. All normal launcher functional operations shall be performed without the use of special tools.

e. All normal functional operations and indications (ie, cartridge installation, latching, loading, locking, stray voltage checks, etc) shall be available from both sides of the launcher.

f. No components shall be accessible externally which would allow accidental or inadvertent firing or operation of the launcher.

g. All operation of the launcher shall require no more than two persons at any one time.

h. It shall be possible to install the cartridges with the missile in position on the launcher.

i. Criteria shall be applied to the design to (1) assure that the equipment shall be efficiently, safely, and reliably maintained and operated; (2) assure that adequate handling provisions have been included; (3) minimize human error type failures; (4) assure that design features shall not constitute a hazard to personnel.

j. Early design effort shall include identification of human factor variables which are most likely to require detailed study for research during later design stages: ie, human performance requirements which may exceed human capabilities, degrade system objective, reflect possible unsafe practices or may be prone to human error.

k. Access with sufficient internal space shall be provided for servicing, adjusting, etc.

l. The design of the launcher shall be such that there are no protrusions or critically located components that could easily be damaged by normal handling or normal operation of the launcher outside of a shipping container.

4.3.10 Environmental and service conditions. The launcher shall function properly under any and all combinations of environment experienced during launcher storage, ground operation and captive flight. The conditions specified herein shall be in accordance with the climatic criteria of MIL-STD-810 and MIL-T-7743 as modified by the operational service environments of ground operation and captive flight. and shall include:

a. Altitude: From sea level to 70,000 feet

b. Temperature: Captive flight mission profiles shall be developed to establish maximum time-temperature profiles. Low temperature conditions shall include worst case storage conditions and captive flight loiter cases, if applicable.

c. Humidity: Under all conditions of service and storage.

d. Dynamic Stresses: Under all conditions of vibration and shock that are present in a loaded and unloaded launcher during aircraft service operations.

e. Static Stresses: Under all conditions of high-g, static loads, ejector system pressure, and lock shut firing that are present in a loaded and unloaded launcher during aircraft service operations.

f. Contaminants: Under all conditions of service or storage.

4.3.11 Maintainability. Except for cleaning, the launcher shall not require maintenance at the organizational level, other than for replacement of consumable items and related services. The launcher shall be designed with sufficient simplicity to permit replacement of consumable items, adjustment and repair, and with component accessibility which requires a minimum of maintenance effort and facilities at all maintenance levels. The design shall provide for ease of assembly and disassembly with a minimal need for removal of hardware and special tools, test facilities and other support equipment for servicing. The use of modular assemblies shall be maximized for ease of replacement with minimum requirements for special skills. The shop-replaceable assembly (SRA) concept shall be employed.

4.3.11.1 Maximum maintenance time. Design shall provide for:

a. With launcher removed from the aircraft a mean time to repair (MTTR) the launcher of one hour and a two hour maximum to include fault isolation to the component level, replacement of the failed component and checkout.

b. The launcher shall be designed to require a minimum number of maintenance hours.

4.3.11.2 Ejector system maintainability. If impulse cartridges are used as release and ejection energy sources, design shall provide for:

a. Internal cleaning without removal of launcher assembly from the aircraft and without the use of peculiar support equipment. Launcher breech component removal shall be minimized to facilitate cleaning at the operational level.

b. Breech installation and removal with a minimum of maintenance effort.

c. A positive means other than removal of the breech cap or movement of electrical connection to indicate cartridge installation.

d. A means other than removal of the breech cap or movement of the electrical connection to indicate an expended cartridge.

4.3.11.3 Ejector system maximum maintenance time. The total servicing time for cleaning an ejector system shall be 0.33 manhours (20 man minutes) maximum. Total time required for removal and installation of expendable items shall be a maximum of 0.004 manhours (15 man seconds) for each energy source.

4.3.11.4 Maintenance plan. The launcher shall be designed to be maintained at only the organizational and intermediate levels of maintenance in accordance with the policy, requirements, and procedures established in OPNAVINST 4790.2 of the Naval Maintenance Program. These two levels provide for a separation of the various maintenance tasks according to complexity, depth, facility, equipment requirements and personnel skills. The launcher shall be maintained at activities both ashore and afloat.

4.3.11.4.1 Organizational maintenance. Maintenance tasks performed at this level shall be confined primarily to servicing and checkout of the launcher and shall be performed on a scheduled basis.

4.3.11.4.1.1 Organizational maintenance tasks. Maintenance at this level shall consist of the following:

a. Preflight and postflight operations such as visual inspection, cleaning, servicing and checkout. Ejector system shall not require cleaning or servicing between phased maintenance actions regardless of the number of firings.

b. Troubleshooting and testing conducted with launcher mounted to aircraft.

c. Removal and replacement of designated components without requirement for alignment and adjustment.

4.3.11.4.2 Intermediate maintenance. Maintenance tasks performed at this level shall be confined to support of organizational activities.

4.3.11.4.2.1 Intermediate maintenance tasks. The requirement for intermediate maintenance and inspection shall be minimized. Intermediate maintenance tasks shall consist of the following:

a. Inspection: Visual and dimensional inspections to determine corrosion damage and other defects reported by the organizational maintenance activity that would prevent reuse.

b. Repair by adjustment, servicing, and replacement of components, assemblies, and subassemblies not within the capabilities of organizational maintenance.

c. Checkout: Electrical and functional.

4.3.11.4.3 Depot maintenance. Normal repair shall be limited to intermediate level. Only unscheduled items beyond capability of maintenance at the intermediate level will be repaired at the depot level. Depot level maintenance consists of repair, rebuilding of parts, assemblies, subassemblies, and end items, and condemnation.

4.3.11.4.3.1 Depot maintenance tasks. No scheduled depot maintenance actions are required.

4.4 Interchangeability. All parts having the same part number shall be in accordance with MIL-I-8500. All parts having the same part number shall be functionally and dimensionally interchangeable regardless of manufacturer. The item identification, manufacturer's part number, and part number requirements of DoD-D-1000 shall govern the part numbers and changes thereto.

4.5 Identification and marking. Identification marking shall be in accordance with MIL-STD-130. Nameplates for equipment identification shall be in accordance with MIL-P-15024, Size 3, Type A (c) or H, Style III and MIL-N-18307, and shall have space available for future marking of technical directives. All parts shall be marked with part number and, if applicable, lot number and serial numbers. Specifications on engineering drawings shall provide for part marking and shall indicate location of marking for accessibility.

4.6 Recycled, virgin and reclaimed materials. There is no exclusion to the use of recycled or reclaimed materials and no mandate for the use of virgin materials as long as it meets the requirements of this standard.

5. DETAILED REQUIREMENTS

5.1 Loading of missiles. The launcher/missile interface shall be designed with adequate space provisions to allow safe, rapid loading and off-loading of all operationally configured missiles with a minimum of personnel, no peculiar equipment or tools required. The distance from the bottom of the launcher to the top of the missile shall conform to MIL-A-8591. This interface shall provide good visibility and easy access of all controls, connections switches and devices that relate to missile loading/off-loading operations and positive visual determination of status of missile installation. Consideration shall be given to providing release openings for the use of hoisting equipment in the double-reeved configuration. If the hoist is attached to the launcher, the standoff capability of the hoist shall be considered. The launcher structure shall be sufficiently strong to react loads from the trolleys. If a missile uses hoisting equipment, single-hoisting-point lift (single-reeved) or double-reeved configurations shall be used with suitable missile attaching hardware. Consideration shall be given to missile handling equipment installation (including manual loading equipment) and hook-lug entry angle during loading/off-loading operations. Launcher geometry shall provide for the proper application of existing non-permanent hoisting adapters, hoisting devices including manual loading equipment, and loading carts or trucks as specified herein. All loading/off-loading or related equipment attach or installation points shall be clearly marked and identified as to proper usage. Launcher/missile interface shall be compatible with the controls, load application range, and operational requirements of current U.S. Navy inventory support equipment (SE). In addition, the interface shall provide compatibility with manual loading equipment such that missiles can be loaded rapidly and safely with a minimum of personnel and without peculiar tools or equipment. All connections/disconnections, ie, arming and electrical connections, cartridge installation, motor ignition circuit connections and safety interlock functions required during this sequence of events shall be accomplished after the missile is structurally attached to the launcher without releasing the missile attachment even if the launcher is inadvertently fired. Alignment and contact between essential mating elements of the missile and launcher shall automatically accommodate a missile mispositioning of ±1 inch horizontally, ±1.0° in roll attitude and ±4° in pitch attitude or any combination thereof and accomplish required interfacing. The time required to complete all the steps necessary to reload the launcher shall be kept to a minimum with a design objective of not more than 5 minutes. The launcher shall provide for proper application of existing non-permanent hoisting adapters, hoisting devices including manual loading equipment, and loading carts or trucks, as specified in the following documents:

1. NAVAIR 19-15BD-6

2. NAVAIR 19-100-2

3. NAVAIR 19-100-1.1 (Volume 1) and 19-100-1.2 (Volume 2)

All loading and off-loading or related equipment attachment or installation points shall be clearly marked and identified for proper usage. For Navy aircraft applications, any launcher loading attachments or hoisting components shall be capable of withstanding a vertical limit loading of 2.67 g and carrier roll rates of ±20 degrees with a 17-second period and pitch of ±3 degrees with an 8-second period. The launcher/missile interface shall be compatible with the controls, load application range, and operational requirements of current applicable U.S. inventory support equipment including the Single Hoist Ordnance Loading System (SHOLS).

5.1.1 Support equipment. The launcher shall be designed so as to be capable of being installed, tested, serviced and maintained using standard support equipment (SE) and hand tools. Use of common hand tools shall be maximized. Special SE shall be identified for the above functions only when required and approved by NAVAIR. All standard and special SE shall be identified and grouped by maintenance level (Organizational and Intermediate) according to the recommended maintenance actions.

5.2 Launcher structure. The launcher shall be capable of withstanding missile captive flight and ejection loads and moments and shall transmit these from missile attach points to the aircraft through the shortest possible load paths. The launcher shall provide restraint to the captive missile against aerodynamic and inertia loads produced in the vertical, lateral and longitudinal axes and shall, if required, incorporate simplified anti-sway devices to prevent relative motion between the missile and the launcher. The structure shall be rigid enough to maintain the alignment requirements of 5.2.1.

5.2.1 Launcher interface alignment. The launcher shall provide boresight alignment of the missile consistent with aircraft/missile guidance requirements and as specified in the detailed specification. As a guideline, the misalignment of the missile and aircraft reference lines for each of the pitch, roll and yaw axes shall not exceed ± 0.002 radian maximum (3σ).

5.3 Suspension and release system. The launcher suspension and release system shall provide positive, locked retention of the missile and shall release the missile only upon deliberate ejection command or by proper manual release procedures. The launcher suspension system shall be designed to mate with available missile support lugs and to satisfy installation geometry requirements imposed by the aircraft weapon station.

5.3.1 Latch mechanism design. The latch mechanism shall not use a latching arrangement which depends only on an over-center feature to restrain the suspension hooks, but shall incorporate a locking sear for positive restraint under all functional static and dynamic hook-load conditions. Release of the sear shall be possible only by operation of the release mechanism as in 5.3.2. Suspension provisions shall be designed so that the launcher support hooks are either latched or unlatched with no in-between position. After a missile has been released, the latching system shall be in a position to engage and latch the next loaded missile without additional actions by the loading crew.

5.3.1.1 Independent self-latching. The suspension provisions shall permit automatic, independent self-latching of the launcher hooks upon insertion of the missile lugs from below. If missile positioning and engagement restrictions prohibit the above, then none of the suspension elements shall latch until the missile is properly positioned beneath the launcher, and thereafter, all elements shall latch simultaneously upon upward pressure by the missile.

5.3.1.2 Manual latching. If a self-latching suspension arrangement suitable for service use is not attainable, manual means for latching both suspension sets simultaneously shall be provided. The method for manual latching shall be accessible from both sides of the launcher. The suspension sets shall be released only by actuation of the ejection system or manual release as in 5.3.2.1.

5.3.1.3 Dependent unlatching. Independent self-latching, if provided, shall not preclude the requirement for a dependent, simultaneous unlatching of both latch mechanisms as in 5.3.2. Dependent unlatching is a prerequisite for safely separating the missile.

5.3.2. Release mechanism. The release mechanism shall be so designed that motion of the hook unlatching mechanism shall be initiated before the ejector mechanism is powered. The hooks shall unlatch simultaneously and powered displacement or release of all elements shall occur within 1 millisecond of each other.

5.3.2.1 Manual release. The launcher shall incorporate provisions for manually releasing the missile from either side of the launcher with a standard wrench (typically 3/8 inch square drive) during ground servicing.

5.3.3 Electromechanical safety interlock. The launcher shall contain an electromechanical safety interlock to prevent release of the suspension hooks and to interrupt the means of initiating release power to the launcher. The interlock shall be positioned in the launcher such that its location and function give maximum advantage in preventing inadvertent release as a result of any single-point mechanical or electrical failure during ground or flight operations. The interlock shall provide remote indication of status. The interlock shall be operable by one person locally without power and shall be capable of full manual operation within a maximum of 10 seconds either way (lock or unlock). The launcher local interlock position indicator shall be mechanically linked to the interlock, be visible from a distance of 15 feet during daylight hours, be capable of indication by touch, but be incapable of indicating a locked condition with either vertical support disengaged.

The design shall insure that the interlock can only be applied when the launcher hooks are fully latched. Power for remote interlock operation shall come from a normal aircraft energy source, and normal power operation of the interlock shall not take more than 10 seconds. The interlock design shall so function to (1) fail locked and (2) unlock at master arm command and relock or lock upon removal of master arm command. The design shall not require the use of manually insertable or removable parts to accomplish the interlock function. There shall be no more than one interlock system per launcher unit. Unlocking of the interlock shall not release the launcher support hooks nor provide release initiation power. The complete interlock system shall be totally contained within the structure of the launcher. For emergency jettison, means shall be provided to remove all mechanical and electrical vertical support safety interlock functions. Emergency jettison action shall require the simultaneous release of all store locks and supports in less than 0.50 seconds. The removal of the interlock shall simultaneously accomplish all of the mechanical and electrical unlocking functions of the vertical support safety interlock system. The operation of the removal system shall not release the missile. The removal system shall have the capability of remote indication of status and operation. The power for the removal system operation shall come from a source that is separated from and is controlled independently of the primary safety interlock. The removal system design and functional requirements shall consider and be compatible with all operational modes and environments consistent with the aircraft mission requirements

5.4 Missile sensing. The launcher shall provide for a missile present/gone indication capability. The sensing device shall have the capability for remote missile status indication. Missile sensing shall assure that a hang fire or a hung missile retained by partial support provisioning is sensed as a missile present. The sensing device shall provide, by logic signal to aircraft control system or otherwise, the capability to deactivate all release and control signals to the launcher when no missile is present, except it shall not affect mechanical operations. Included shall be the capability for release and control-system check-out and testing other circuitry present without directly overriding the sensing device. The launcher sensing device shall be protected from damage at all times. Normally a missile launcher accepts missile present/gone signals through the missile umbilical connector and transmits the signal to the aircraft through the aircraft interface connector.

5.5 Umbilical system. The launcher shall have provisions for an integral electrical umbilical system which mates with the missile and aircraft electrical connectors and transmits electrical signals to and from the aircraft and missile. Mating of the missile/launcher electrical connectors shall be manually or automatically accomplished, but either shall be possible after and while the missile is latched to the launcher. Connectors shall comply with applicable portions of 4.2.1.9. The launcher half of the electrical umbilical shall be protected such that when the launcher is not loaded with a missile, foreign substance contamination and possible electric shock to personnel are prevented.

5.6 Sway braces. Automatic or semi-automatic sway bracing of the missile shall be provided by the launcher during or immediately after hook/lug engagement. Adjustment of sway braces after missile engagement shall require no more than operator finger tight adjustment. When missile design permits, sway braces shall be located symmetrically about the missile and within areas of missile reinforced structure. Sway brace design shall not allow excessive loads to be applied to the missile or prevent missile release. After all sway braces have been activated, the missile shall be held securely in all three axes until separation of the missile. After release of the store, the sway braces shall reset for accepting the next missile. The sway braces shall not require any scheduled maintenance nor be susceptible to damage in the operational environment.

5.7 Signal management system. The system shall be capable of modifying all signals from external sources to supply the type and quantity required by the applicable missiles during ground operation and checkout, captive flight, and launching sequence. The system shall have appropriate short circuit and overload protection, and shall meet performance requirements under all applicable environments.

5.8 Fuzing and arming control. The launcher shall contain provisions for mechanically or electrically initiating the missile's electromechanical arming system for arming the missile motor and missile warhead.

5.8.1 Motor ignition provisions. If the design is such that the missile motor is normally ignited by aircraft power, the launcher shall provide a proximity switch device at a location suitable for connecting a motor ignition cable to the missile motor ignition plug. The electrical current shall be applied as late as possible near the end of the ejection stroke but shall not be applied until the missile has definitely separated from the captive flight position. Characteristics of the motor ignition switch device shall be consistent with motor electrical power requirements and high reliability and operational life. In the event the missile motor is ignited by missile power after ejection, the launcher electrical umbilical shall be capable of providing the necessary logic signals during the launch cycle.

5.8.2 Warhead arming provisions. The launcher design shall transmit to the missile any electrical or mechanical signals necessary to initiate the missile's peculiar fuze arming sequence.

5.9 Launcher ejection system. The launcher ejection system shall provide safe and acceptable missile separation throughout the missile launch envelope. The ejection system shall provide the acceleration, pitch rate and pitch attitude levels specified for the missile/aircraft combination to accomplish safe and adequate separation. Acceptable ejection shall be possible at all aircraft attitudes and maneuver limits specified by the government procuring activity.

5.9.1 Cartridge initiation. If explosive cartridges are used as the launcher ejection energy source, the ejection system shall be initiated remotely by two independent aircraft electrical sources. Independent initiation pulses shall be delivered through separate wiring to at least two installed cartridges. The ejection system shall be wired to provide simultaneous initiation of the impulse cartridges from either source as detailed in figure 1. Capability shall be provided to guarantee the sympathetic firing (ignition of one cartridge shall ignite the other) of either impulse cartridge by the other without sacrificing ejector performance.

5.9.2 Cartridges. If cartridges are employed in the ejector system, the cartridges and ejector system shall be designed, but not limited to, the following requirements:

a. The ejector system shall be actuated by the initiation of at least two cartridges of the same type. The types of cartridges to be utilized shall be CCU-43/B, CCU-44/B and CCU-45/B.

b. When the ejector system is actuated by more than two cartridges, a suitable combination of the three types of cartridges shall be used.

c. Cartridge interface and utilization shall comply with MIL-D-81303. (Cartridge geometry is specified in MIL-D-81303.)

d. Cartridge power sources shall provide a minimum of 3 amperes at 28 volts dc and meet the requirements in MIL-STD-704. The average cartridge functioning time versus the applied current data for the CCU-43/B, CCU-44/B, or CCU-45/B cartridges are as specified in figure 2.

5.9.3 Cartridge electrode contact pin. The cartridge electrode contact pin configuration and characteristics shall be as follows:

a. Shank diameter of 0.092 ±.002 inch.

b. Point of 90 degrees included angle with 0.005 inch diameter maximum flat.

c. Rockwell hardness C 59-62.

5.9.4 Cartridge breech. The diameter of the cartridge breech (or cartridge holder if used) shall be a straight bore of 1.081 + .003 - .000 inches over its full length. Any taper existing within these limits shall be uniform over the full length of the breech or cartridge holder, with the maximum diameter occurring at the end adjacent to the cartridge flange. The surface roughness on the cartridge breech shall be a minimum of 32 microinches, root mean square (rms) measured in accordance with ANSI B46.1. Cartridge breech design shall be such as to provide cartridge firing pressure in the range of 3,000 to 25,000 psi, with suitable confinement of the cartridge main charge propellant for reproducible performance. Means shall be provided at the end of the ejector piston cycle to safely vent the remaining pressurized gas. To comply with a 0.008 manhour (30 man second) cartridge removal and installation time, provisions shall be made for quick installation of cartridges, rapid cap insertion and positive integral extraction of expended cartridges to facilitate unaided manual cartridge removal. System design shall provide for:

a. Internal cleaning without removal of end assembly from the aircraft and without the use of special support equipment.

b. A means other than removal of components or movement of electrical connections to indicate cartridge installation.

c. A means other than removal to indicate an expended cartridge.

d. Breech cleaning shall not be required between phased maintenance actions regardless of the number of firings.

e. Electrode contact pin to breech cartridge bore true positioning of 0.015 inch diameter.

f. Full support of cartridge base upon installation and during firing.

g. Electrode contact pin/cartridge electrode contact force ranging from 40 lbf to 100 lbf.

h. Preclude shorting to ground of electrode upon cartridge installation.

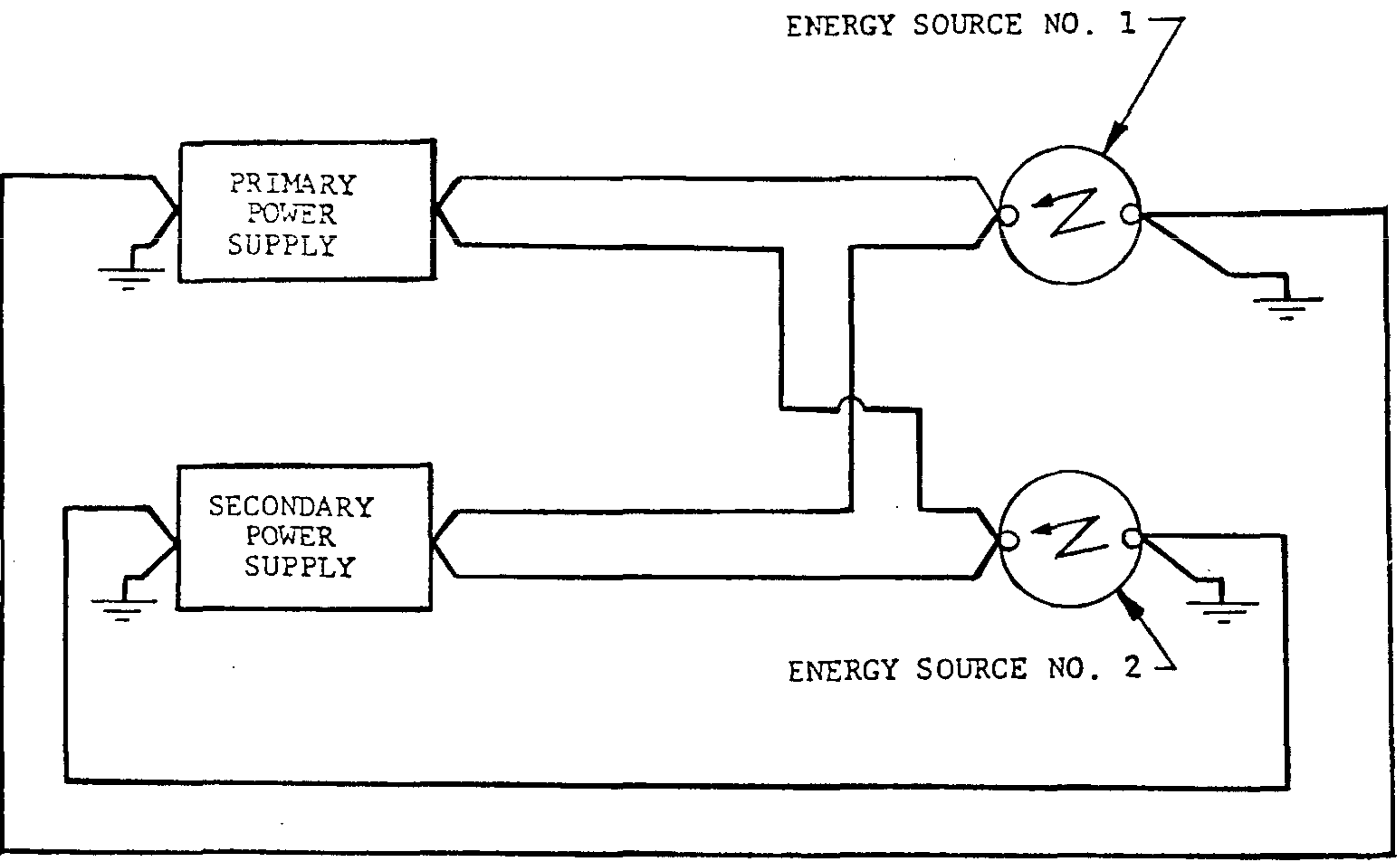

FIGURE 1. Wiring schematic to achieve primary and secondary release.

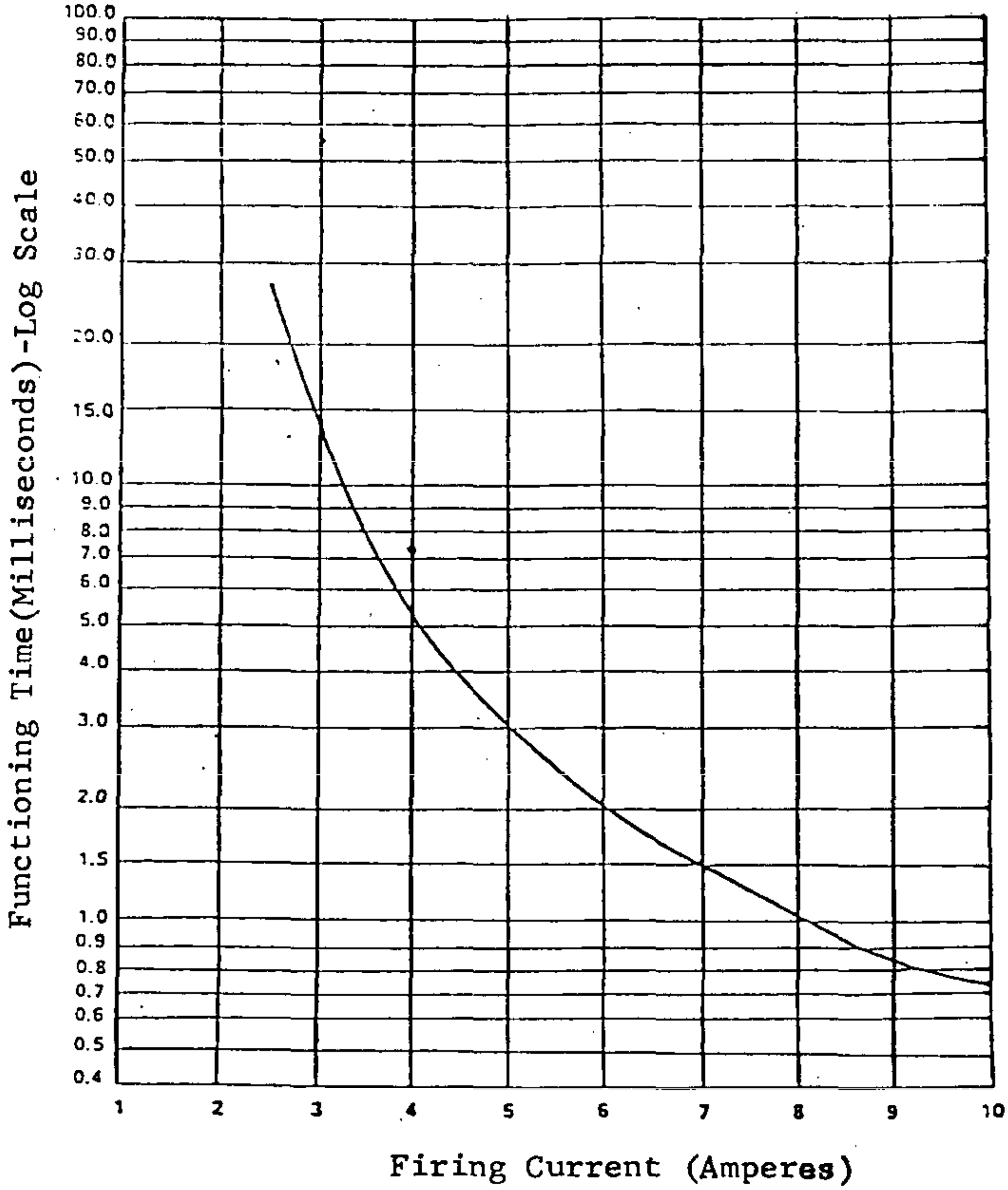

FIGURE 2. CCU-43/B, CCU-44/B, CCU-45/B cartridge functioning time vs applied current.

5.9.5 Launcher to aircraft reaction. To the maximum extent possible, the launcher design shall limit the reaction force on the aircraft resulting from launcher ejection of a missile to meet a goal of not greater than 1.0 g for every foot per second of end-of-stroke missile ejection velocity.

5.9.6 Separation performance requirements. If the launcher performance requirements for the specific missile/aircraft combinations are not available, the initial launcher design shall provide for ejector end-of-stroke velocity and missile angular rates to assure safe missile separation from the aircraft. End-of-stroke velocities ranging from 16 to 30 feet per second may be required to achieve safe separation. The launcher design shall provide for simple adjustment of any missile angular control required for safe separation.

5.9.7 Ejection pistons. The ejection pistons shall remain in contact with the missile during captive flight and shall remain in contact with the missile throughout the ejection stroke. After missile ejection, the ejection pistons shall automatically retreat within the launcher structure to permit acceptance of the next missile.

5.10 Safety in design. For adequate launcher design an active safety program shall be implemented and specific requirements introduced into the launcher design and development.

5.10.1 Launcher safety program. Launcher safety shall be achieved through pre-engineering safety analyses and evaluation of design concepts. This effort is required to provide surveillance, control and visibility to insure that no design creates a condition that can cause personnel injury.

5.10.1.1 Safety program functions. The safety program shall contain the following MIL-STD-882 requirements, as a minimum:

a. Provide for qualitative systems analyses to identify potential hazards. Close attention shall be given to those design features and characteristics that have created safety related problems on previous systems.

b. Submit Periodic Safety Program Status Reports identifying all hazard levels, including probability of occurrence. Probabilities may be based on MTBF data and past failure histories. If a corrective safety program has been identified and is to be corrected within the scope of the contract, the corrective action also shall be included in these reports.

c. Safety program personnel shall participate in all design reviews as part of the overall safety effort.

d. The safety program objectives are:

(1) Eliminate all catastrophic and critical hazard levels and provide control of all marginal hazard levels commensurate with mission objectives. To select an optional corrective action and to determine whether to implement the corrective action, a tradeoff study shall be conducted. Final implementation shall be acceptable to the procuring activity.

(2) Insure the subassemblies or components cannot be misassembled or misinstalled.

5.10.1.2 Failure mode effects analysis. During the launcher development process, the launcher assembly shall be analyzed for possible failure modes resulting from anticipated environmental, handling, and load conditions. This analysis shall evaluate the likelihood of occurrence of identified failure modes. For each failure mode identified, a determination shall be made of the effect of the part, circuit, or unit in question and of the ultimate significance of this effect relative to overall system safety. This analysis shall include a discussion of the factors inherent in the design or the quality program that will minimize the likelihood of occurrence of those failures having the most significant effect on system safety. Periodically throughout the launcher development process, this analysis shall be updated as design configuration and load conditions change. Periodically throughout the development process, this analysis shall be reviewed for approval.

5.10.1.3 Specific design safety. The following specific safety features shall be considered in design:

5.10.1.3.1 Safety interlock. A safety interlock shall be furnished on the launcher which meets the requirements of 5.3.3 and 5.10.

5.10.1.3.2 Inadvertent release. To the maximum extent possible, inadvertent release or arming of a missile shall not occur due to the failure or malfunction of one single component of the launcher, and inadvertent motor firing shall not result in missile release.

5.10.1.3.3 Locked shut functioning. In a locked shut functioning of the launcher, energy dissipation shall not be accomplished in any manner which could lead to personnel hazard, structural damage, or both.

5.10.1.3.4 Driven items. Except for the ejector pistons, no driven items shall be externally exposed.

5.10.1.3.5 Impulse cartridges. Impulse cartridge venting into the following areas is unacceptable:

a. Into an area where direct exposure to hot gas exhaust by personnel performing normal duties would occur.

b. Internally in any vicinity where venting would cause degradation of the launcher (ie, electrical wiring, mechanical equipment).

5.11 Electromagnetic environmental effects (E^3). The requirement for control of electromagnetic environmental effects shall be as specified in 5.11.1 through 5.11.9.

5.11.1 Electromagnetic compatibility program (EMCP). A system EMCP in accordance with the requirements of MIL-E-6051 shall be applied to the launcher system and launcher system/aircraft, SE and GFE Interfaces. This program shall be supported by an Electromagnetic Compatibility Advisory Board (EMCAB) established in accordance with the requirements of AR-43 for compliance with MIL-E-6051. The specifics for the Electromagnetic Compatibility Program Effort are provided in the Electromagnetic Compatibility Program Plan.

5.11.2 Electromagnetic compatibility (EMC). The launcher electrical system shall meet the requirements of MIL-E-6051 and MIL-STD-461 Class Alb using the test methods described in MIL-STD-462 (Notice 2). The following MIL-STD-461 tests are applicable: CE01, CE03, CE07, CS01, CS02, CS06, RE01, RE02, RS01, RS02, and RS03 or in accordance with the EMCP.

5.11.3 Electromagnetic vulnerability (EMV). The launcher electrical system shall meet the EMV requirements of MIL-E-6051 when subjected to the EMV environment of MIL-STD-461, as modified by table I and where applicable, MIL-HDBK-235.

5.11.4 Lightning protection. The launcher system shall meet the requirements of the EMCP to provide compliance, where applicable, with the requirements of MIL-E-6051 and MIL-B-5087.

5.11.5 Bonding and grounding. The launcher system shall meet the requirements of the EMCP to provide compliance, where applicable, with the requirements of MIL-E-6051 and MIL-B-5087.

5.11.6 Wiring and cabling. The launcher system shall meet the requirements of the EMCP to provide compliance, where applicable, with the requirements of MIL-E-6051.

5.11.7 Static electricity. The launcher system shall meet the requirements of the EMCP to provide compliance, where applicable, with the requirements of MIL-E-6051.

5.11.8 Hazards of electromagnetic radiation to ordnance (HERO). The launcher system shall meet the HERO requirements of MIL-STD-1385 and MIL-E-6051.

5.11.9 Coupling factor (CF). The launcher shall be considered a potential coupling device which may provide entry for excessive radio frequency (RF) energy from the external environment, through the launcher into the remainder of the weapon system and possibly the entire aircraft system. The launcher shall utilize sufficient shielding, filtering or such other electromagnetic interference suppression techniques as shall be required to ensure that the external electromagnetic environment shall not be coupled through the launcher. The external electromagnetic environment is as defined in MIL-STD-461 as modified by table I and, where applicable, MIL-HDBK-235. The radio frequency levels conducted from the launcher shall not be greater than those cited in MIL-STD-461, CE03. The CE03 limits shall be extended from 50 MHz to 100 MHz with no change and relaxed at 6 decibels (db)/octave above 100 megahertz (MHz).

TABLE I. External electromagnetic environment (EME).

Frequency (MHz)	Field intensity VRMS/M 1/	Field intensity VRMS/M 2/	PRF (pulses per sec)	Modulation pulse width (microsecond)
0.014-1.5		10	CW	-------
1.5-30		200	*	-------
30-200		200	CW	-------
200-225		200	180-200	4-200
225-400		100	CW	-------
400-450		200	300	0.6-60
450-840		200	CW	-------
840-970		200	450-500	1.2-1.3
970-1215		200	CW/100-800	0.3-1.5
1215-1365		200	140-3000	1-5
1365-2700		200	CW	-------
2700-3700		200	200-3000	0.1-40
3700-5400		200	10000	0.1
5400-5900		200	425-500	0.3-3
5900-8500		200	CW/1-10,000	0.01-26
8500-10000		200	200-2000	0.2-10
10000-10680		200	CW/1-10,000	0.01-26
10680-13200		20	CW	-------
13200-14400		200	60,000	0.1-0.4
14400-15400		20	CW	--------

TABLE I. External electromagnetic environment (EME) - Continued.

Frequency (MHz)	Field intensity VRMS/M 1/	Field intensity VRMS/M 2/	PRF (pulses per sec)	Modulation pulse width (microsecond)
15400-16300		200	3000	0.3
16300-16600		200	1500	0.5
33000-33400		200	2000	0.2

1/ Navy EME Test Levels, see EMCP or MIL-HDBK-235 if applicable.
2/ Minimum launcher EME specification requirements.

Legend:

CW - Continuous Wave
PRF - Pulse-Repetition Frequency
VRMS/M - Volts, Root Mean Square per Meter

* On/Off keying A1 modulation must be used at a 25 percent duty cycle.

5.12 International standardization agreements. Certain provisions of this document are the subject of international standardization agreements. When change notice, revision, or cancellation of the document is proposed which will affect or violate the international agreement concerned, the preparing activity shall take appropriate reconciliation action through international standardization channels, including departmental standardization offices, if required. Table II identifies the paragraphs containing the requirements for the international standardization agreements.

TABLE II. Paragraphs containing international standardization agreements.

Paragraph	Paragraph title	International standardization
4.3.10	Environmental and service conditions	AIR STD 20/18
5.11.8	Hazards of electromagnetic radiation to ordnance (HERO)	AIR STD 20/16

Custodians
Navy - AS

Preparing Activity:
Navy - AS
Project No. 1440-N064

Applicable International Organizations:
North Atlantic Treaty Organization (NATO)
Air Standardization Coordinating Committee (ASCC)

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STANDARDIZATION DOCUMENT IMPROVEMENT PROPOSAL

(See Instructions – Reverse Side)

1. DOCUMENT NUMBER	2. DOCUMENT TITLE
MIL-STD-2131 (AS)	LAUNCHER, EJECTION, GUIDED MISSILE, AIRCRAFT, GENERAL DESIGN CRITERIA

3a. NAME OF SUBMITTING ORGANIZATION

b. ADDRESS *(Street, City, State, ZIP Code)*

4. TYPE OF ORGANIZATION *(Mark one)*

☐ VENDOR

☐ USER

☐ MANUFACTURER

☐ OTHER *(Specify)*: ____

5. PROBLEM AREAS

a. Paragraph Number and Wording:

b. Recommended Wording:

c. Reason/Rationale for Recommendation:

6. REMARKS

7a. NAME OF SUBMITTER *(Last, First, MI)* – Optional

b. WORK TELEPHONE NUMBER *(Include Area Code)* – Optional

c. MAILING ADDRESS *(Street, City, State, ZIP Code)* – Optional

8. DATE OF SUBMISSION *(YYMMDD)*

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