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**DEPARTMENT OF DEFENSE
DESIGN CRITERIA STANDARD**

**SHIPBOARD GUIDED MISSILE LAUNCHING SYSTEM
SAFETY REQUIREMENTS, MINIMUM**



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DEPARTMENT OF DEFENSE

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SHIPBOARD GUIDED MISSILE LAUNCHING SYSTEM SAFETY REQUIREMENTS, MINIMUM

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2. Recommended corrections, additions, or deletions should be addressed to the Commanding Officer, Naval Ordnance Station, Standardization Division (502), Indian Head, Maryland 20640.

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1 SCOPE

1.1 This standard establishes the minimum safety requirements for ship-board guided missile launching systems. Special requirements which may be imposed on launching systems handling missiles containing nuclear war-heads or liquid fuels other than hydrocarbon fuels are not included.

1.2 Some of the requirements of this standard may not be applicable, feasible, or cost effective for certain types of launching systems. Waiver or exemption of my requirement for a particular launching system shall require approval of the Weapon System Explosives Safety Review Board.

1.3 Some of the requirements (5.1 and 5.10 for example) are necessarily general and will require more definition when applied to a specific launching system. These more definitive requirements will be included in the development specification for the launching system.

2 REFERENCED DOCUMENTS

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

Specifications

Military

MIL-E-2036 - Enclosures for Electric and Electronic Equipment, Naval Shipboard

MIL-P-23928 - Panels, Electrical, Power Distribution and Manual Transfer, Circuit Breaker Type (Naval Shipboard Use)

Standards

Military

MIL-STD-454 - Standard General Requirements for Electronic Equipment

MIL-STD-882 - System Safety Program for Systems and Associated Subsystems and Equipment: Requirements for

MIL-STD-1385 - Preclusion of Ordnance Hazards in Electro-magnetic Fields; General Requirements for

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MIL-STD-1472 - Human Engineering Design - Criteria for
Military Systems, Equipment and Facilities

MIL-STD-1522 - Standard General Requirements for Safe
Design and Operation of Pressurized Missile
and Space Systems

Other Publications

OD 30393- Design Principles and Practices for Controlling
Hazards of Electromagnetic Radiation to Ordnance
(HERO Design Guide)

NAVSHIPS 0902-002-5000- General Specifications for Ships of
the United States Navy

OR-11 - Development of Packaging, Handling, Storage and
Transportation Systems for Weapons

American Conference of Governmental - Documentation of the
Industrial Hygienists Threshold Limit Values

3 DEFINITIONS

3.1 Launching System. That portion of the missile system which stows, selects, handles, loads, aims, and fires or ejects the missile.

3.2 Launcher. That portion of the launching system which supports and holds the missile in position for firing or ejection.

3.3 Stowage Area. That portion of the launching system in which the missiles are normally stored. In some launching systems the launcher and stowage areas are one and the same.

3.4 Ejection System. A system for starting the missile in flight with energy external to the missile. The missile rocket motor is not ignited until the missile is some distance from the ship.

3.5 Deadman. A type of switch or control which requires a sustained force by the operator to maintain the equipment in the "ON" or operating state. Release of the control will immediately stop equipment operation or movement.

3.6 Wet Sprinkling System. A system which contains lines prefilled with water up to the sprinkling heads as opposed to a "dry" system which does not contain water beyond the main control valve until activated.

3.7 Umbrella Effect. The shielding effect caused by motors missiles which are physically located between the sprinkling heads and other

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units stowed in the same compartment. The units so shielded do not receive the full protective effects of the water in the event of fire or accidental initiation of an ordnance component.

3.8 Water Injection System. A system for injecting a high pressure water stream into the exhaust nozzle or exhaust stream of an inadvertently ignited rocket motor.

3.9 Waiver. A written authorization from the Naval Ordnance Systems Command specifically permits deviation from a mandatory regulation or instruction for a limited time pending correction of the deficiency.

3.10 Exemption. A written authorization from the Naval Ordnance System Command which specifically permits deviation from a mandatory regulation or instruction

4 GENERAL REQUIREMENTS

4.1 System Safety Program. A system safety program shall be initiated during the initial phase of the launching system program and shall continue throughout the life of the launching system. The safety program shall satisfy the requirements of MIL-STD-882.

4.2 Personnel and Equipment. Electrical and mechanical interlocks and safety devices shall be provided to prevent injury to personnel or damage to system equipment during normal operation and maintenance. Controls and circuits shall be arranged so that operation of any control or combination of controls in other than normal sequence shall not cause injury to personnel, operation of the equipment, or damage to any component. Power failure shall not initiate equipment or missile motion (e.g., through inadvertent release of latches), create any dangerous condition, or cause damage to the equipment or missiles. Interlocks shall be designed to place the equipment in the safest of the various possible alternate conditions in case of interlock or power failure.

4.3 Electromagnetic Radiation Exposure. Exposure of the launching system to the electromagnetic radiation environment defined in MIL-STD-1385 shall not cause initiation of any electro-explosive device in the launching system or result in malfunctioning of the launching system. Guidance for meeting this requirement is contained in OD 30393.

4.4 Human Engineering. The human engineering design safety criteria of MIL-STD-1472 shall be satisfied.

4.5 Continuity Checkout. There shall be no electrical continuity tests of electrical initiating elements of the missile warhead, rocket motor or self-destruct device while the missile is in the launching system.

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4.6 Safety Observer. A safety observer's station which provides an unobstructed view of the launcher area by direct or remote vision shall be provided. The safety observer shall have communications with the launching system control station and missile firing officer. The safety observer's station shall not expose the safety observer to the exhaust of a launched missile.

5 DETAILED REQUIREMENTS

5.1 Within the constraints of weight, space, and cost, the maximum feasible ballistic protection against gunfire, fragments, and shock resulting from enemy action shall be provided.

5.2 If a part of the launching system is used as a shipping container for the missile, it shall meet the requirements of OR-11, Appendix A.

5.3 Means shall be provided to prevent the chain ignition of rocket motors and warheads in case of inadvertent ignition of a rocket motor. Means considered shall include separation, restraint, venting, flame shields, fragment shields, wet sprinkling systems, water injection systems, and flame tight compartments.

5.4 The missile in the launching system shall be restrained to prevent movement in case of inadvertent ignition of the rocket motor or shipboard shock conditions.

5.5 Stowage area doors, hatches, and covers shall be flameproof and watertight. Interlocks shall be provided which assure that stowage area doors and hatches are closed during missile launching.

5.6 The missile exhaust shall be vented to the atmosphere in case of rocket motor ignition. Other missiles in the launching system and internal ship areas shall not be exposed to the missile exhaust.

5.7 A pressure relief system shall be provided for the stowage area which will effectively relieve abnormal stowage area pressures (resulting from Inadvertent ignition of a rocket motor) to a level that can be, withstood by the stowage area bulkheads.

5.8 The stowage area shall have a "wet" sprinkling system with both automatic and manual control. The design of the system shall minimize the "umbrella effect". A detection and alarm system shall provide indication of sprinkling system activation.

5.9 The stowage area shall have an internal automatic temperature control system. A detection and alarm system shall provide indication of overbearing conditions.

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5.10 The missile shall be protected against the expected environments of shock, vibration, gun blast, green water, salt spray and missile blast. The launching systems shall be designed to withstand these environments without sustaining damage.

5.11 A system shall be provided which restricts the launching of the missile to those zones within which the launched missile will safely clear all ship structure and installations by interrupting the firing circuit if the missile is pointing outside these zones.

5.12 Means shall be provided to remotely arm and disarm the rocket motor,

5.13 The launching system shall have the capability of being secured against access that would allow unauthorized firing of a missile,

5.14 Firing Circuit.

5.14.1 An inadvertent firing shall not be possible without the occurrence of at least three independent failures when there is no power to the firing circuit, and at least two independent failures when there is power to the firing circuit.

5.14.2 The firing circuit to the missile shall be interrupted until firing is imminent. Both the "hot" side and return side of the firing circuit shall be interrupted. Interlocks shall be provided in the firing circuit to insure proper missile/launching system prelaunch conditions are satisfied before firing is allowed.

5.14.3 Prior to completion of the firing circuit, the portion of the firing circuit nearest to the missile shall be electrically interrupted by an electro-mechanical device such as an open relay contact.

5.14.4 The firing circuit shall be electrically balanced: that is; the return shall not be via the chassis. The firing circuit "hot" and return sides shall be isolated from ground.

5.14.5 All firing circuit wiring shall be isolated from other wiring and cables in the system in accordance with OD 30393. This may be accomplished by shielding or by the physical separation of the wiring.

5.14.6 Filtering or other techniques shall be used to ensure that ship-board noise and spikes on the power lines due to start up or shut down of heavy equipment, etc. do not inadvertently trigger the firing circuit.

5.15 The launcher shall have a mechanism which requires adequate missile thrust build-up to clear the ship before the missile is released.

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5.36 Sufficient launching clearance shall be provided so that undesirable motion of the ship, launcher or missile will not result in unscheduled contact of the aft end of the missile and forward end of the launcher during launch.

5.17 Means shall be provided to jettison a missile from the launcher.

5.18 Means shall be provided to positively identify the type of missile at any position in the launching system at all times.

5.19 The design of the storage area and its equipment shall make minimum use of flammable materials. Where flammable materials are used, methods shall be employed to reduce the possibility of ignition and resulting hazards. Materials employed in the stowage area shall be selected so as to minimize the evolution of toxic gases in amounts dangerous to personnel when subjected to high temperatures.

5.20 An automatically-activated carbon dioxide extinguishing system shall be provided in unmanned electrical equipment areas. Manual controls for the extinguishing system shall also be provided. A detection and alarm system shall provide indication of extinguishing system activation. The launching system shall have the capability of reducing the concentration of carbon dioxide in a contaminated area below the threshold limit value specified in the American Conference of Government Industrial Hygienists-Documentation of the Threshold Limit Values within 15 minutes.

5.21 Auxiliary, hand-operated fire-fighting equipment shall be available for use in missile stowage and electrical equipment areas. Portable carbon dioxide, foam, or gas shall make up a portion of this equipment. Access for fighting fires in missile storage areas shall be provided.

5.22 Brakes and/or locks shall be provided to prevent unintended motion of the launcher or other moving equipment which can present a hazard to personnel.

5.23 "On-deck" control of the launcher shall be provided for maintenance, test and loading operations. "Deadman" type switch controls shall be provided.

5.24 Alarms shall be provided to warn personnel of impending launching system equipment movement and missile firing.

5.25 Sufficient working space shall be provided around and in the launching system for safe maintenance and repair.

5.26 A minimum 18-inch clearance shall be provided between the maximum rotating projection of the launcher structure and other ship's structure.

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5.27 The safety (personnel hazard) of electrical and electronic equipment shall be in accordance with MIL-STD-254, Requirement 1.

5.28 Electrical marked protection of equipment shall be in accordance with MIL-STD-454 , Requirement 8.

5.29 All DC control circuit voltages which control power circuits such as 440 VAC circuit breakers, or other DC circuits which run to the same junction box as power conductor, shall contain filters and be adequately shielded and insulated from the power circuit. Such practices as using insulation over the terminal in junction boxes or control boxes to prevent moisture from shorting 115 VAC or 440 VAC to DC circuits is recommended. Connections for different voltages shall be segregated, labeled and barricaded to prevent confusion, miswiring, shorting or personnel touching high voltage circuits while working on low voltage circuits.

5.30 All DC wiring runs through the same cable or conduit as AC wiring shall be adequately shielded to prevent induced voltages. AC and DC conductors may occupy the same raceway provided all conductors are sufficiently insulated to prevent breakdown from the highest voltage cable in that bundle.

5.31 The selection and installation of electric cables used in the launching system shall meet the requirements of NAVSHIPS 0902-001-5000, Section 304.

5.32 Circuit breaker type power distribution and manual transfer electrical panels used in the launching system shall meet the requirements of MIL-P-23928.

5.33 Equipment shall be provided with overtemperature and overpressure alarms, and with automatic power cutoff devices when overtemperature or overpressure conditions can cause unacceptable damage to equipment or danger to personnel.

5.34 Equipment shall be provided with "power-off" switches with removable handles or keylocks for protection of maintenance personnel.

5.35 Positive control of landing system equipment shall be maintained at all times.

5.36 The missile shall be positively latched in its handling, transfer, and stowage equipment at all these

5.37 Interlocks shall be provided to insure proper connection at transfer points before the missile is moved.

5.30 Guarded switches shall be provided for critical functions such as missile firing, jettisoning, and destruct.

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5.39 Liquid Fuel Missiles. The following three requirements apply only to launching systems for liquid fuel missiles.

5.39.1 If missiles stowed in the launching system contain fuel with a flash point of less than 130°F, electrical equipment in the stowage area shall be "explosion-proof" as defined in MIL-E-2036.

5.39.2 The missile stowage area shall contain detection equipment which will detect explosive; flammable, or toxic vapors resulting from fuel leakage. An alarm will be automatically activated to warn personnel of this condition.

5.39.3 Any explosive, flammable, or toxic vapors resulting from fuel leakage shall be contained within the stowage area without leakage into other shipboard areas. Means shall be provided to remove these vapors and leaked fuel from the missile stowage area.

5.40 Missile Ejection Systems. The following six requirements apply only to launching systems which have a missile ejection system.

5.40.1 The ejection system shall eject the missile a sufficient distance and in an appropriate direction that will prevent impact of the missile with the ship in case of missile rocket motor ignition failure.

5.40.2 If a sabot is used between the missile and ejection gases, the design of the sabot and the ejection technique shall minimize the hazards of the sabot striking the ship or personnel aboard the ship.

5.40.3 The missile shall be protected from ignition or damage by ejection system gases during ejection and in case of inadvertent activation of the ejection system.

5.40.4 Ejection system gases shall be vented to the atmosphere in case of inadvertent activation of the ejection system, and after missile ejection. Other missiles in the launching system and internal ship areas shall not be exposed to the ejection system gases. Launching system damage shall be prevented.

5.40.5 Mechanical interlock and/or gas venting or diverting devices shall be provided to prevent movement of the missile in case of inadvertent activation of the ejection system power source (e.g, gas generator, high pressure, etc.)

5.40.6 The initiation mechanism for the ejection system shall be interrupted until missile launch is imminent. Interlocks shall be provided in the ejection system initiation circuit to insure proper missile/launch system prelaunch conditions are satisfied before ejection is initiated.

5.41 The requirements of MIL-STD-1522 shall be used as a design guide in the design of pressure systems used in the ejection system or jettisoning system.

5.42 Gas generators used in the missile ejection system or jettisoning system shall satisfy the following two requirements.

5.42.1 Propellant formulations different from those previously accepted for service use shall not be used unless approved by the Naval Ordnance Systems Command. The following characteristics of the new formulation, as a minimum, shall be determined, and complete documentation on such determinations shall be available to the Naval Ordnance Systems command.

- a. Sensitivity to initiation by shock, vibration, impact and heat.
- b. Effects of aging and environmental extremes on sensitivity.
- c. Type and amount of toxic materials in original formulations and in reaction products.
- d. Detonability.
- e. Thermal stability.
- f. Chemical compatibility.

5.42.2 The minimum factor of safety for the pressure chamber of the gas generator shall be 1.25 times the maximum expected operating pressure of the propellant.

6 SAFETY TESTING

6.1 A safety test program shall be conducted to verify that the launching system can be operated safely. The primary objective of the test program shall be to:

6.1.1. Verify that unacceptable hazards are not created by exposure of the launching system to expected environments, nor during normal operation.

6.2.2 Verify that safety features of the launching system satisfactorily perform their intended function.

6.1.3 Demonstrate the effectiveness of the stowage area damage control system.

7 DOCUMENTATION

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7.1 All operating and maintenance manuals for the launching system shall contain information on existing hazards and pertinent safety procedures and precaution. Emergency procedures shall be included where applicable.

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