

INCH-POUND

MIL-E-24762(SH)  
28 May 1991

## MILITARY SPECIFICATION

ENCLOSURES FOR ELECTRONIC EQUIPMENT, SURVIVABLE,  
NAVAL SHIPBOARD USE

This specification is approved for use by the Naval Sea 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 Scope This specification establishes the design, development performance, and test requirements for survivable electronic enclosures for shipboard-survivable electronic systems and equipment. Only one classification of enclosure is covered by this specification.

## 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 document to the extent specified herein. Unless otherwise specified, the issues of these documents are those listed in the issue of the Department of Defense Index of Specifications and Standards (DODISS) and supplement thereto, cited in the solicitation (see 6.2).

## SPECIFICATIONS

## FEDERAL

PPP-F-320 - Fiberboard. Corrugated and Solid, Sheet Stock (Container Grade) and Cut Shapes

## MILITARY

MIL-R-900 - Rubber Gasket Material, 45 Durometer Hardness.  
MIL-S-901 - Shock Tests, H I (High-Impact); Shipboard Machinery, Equipment and Systems, Requirements for

Beneficial ~~comments~~ (recommendations, additions, deletions) and any pertinent data which may be of use in improving this document should be addressed to: Commander, Naval Sea Systems Command, SEA 5523, Department of the Navy, Washington, DC 20362-5101 by using the self-addressed Standardization Document Improvement Proposal (DD Form 1426) appearing at the end of this document or by letter.

AMSC N/A

FSC 59GP

DISTRIBUTION STATEMENT A. Approved for public release; distribution is unlimited.

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- MIL-S-1222 - Studs, Bolts, Hex Cap Screws, Socket Head Cap Screws and Nuts
- MIL-E-2036 - Enclosures for Electric and Electronic Equipment.
- MIL-E-16400 - Electronic, Interior Communications and Navigation Equipment, Naval Ship and Shore: General Specification for.
- MIL-E-17555 - Electronic and Electrical Equipment, Accessories and Provisioned Items (Repair Parts), Packaging of
- MIL-L-19140 - Lumber and Plywood, Fire Retardant Treated
- MIL-W-21965 - Water Cooling of Shipboard Electronic Equipment General Specification for

## STANDARDS

## MILITARY

- MIL-STD-108 - Definitions of and Basic Requirements for Enclosures for Electric and Electronic Equipment
- MIL-STD-167-1 - Mechanical Vibrations of Shipboard Equipment (Type I - Environmental and Type II - Internally Excited)
- MIL-STD-202 - Test Methods for Electronic and Electrical Component Parts.
- MIL-STD-454 - Standard General Requirements for Electronic Equipment
- MIL-STD-461 - Electromagnetic Emission and Susceptibility Requirements for the Control of Electromagnetic Interference
- MIL-STD-470 - Maintainability Program for Systems and Equipment
- MIL-STD-740-1 - Airborne Sound Measurements and Acceptance Criteria of Shipboard Equipment.
- MIL-STD-810 - Environmental Test Methods and Engineering Guidelines
- MIL-STD-1310 - Shipboard Bonding, Grounding, and Other Techniques for Electromagnetic Compatibility and Safety.
- MIL-STD-1399 - Interface Standard for Shipboard Systems.
- MIL-STD-1399, Section 300 - Interface Standard for Shipboard Systems Electric Power, Alternating Current. (Metric)
- DOD-STD-1399, Section 304 - Interface Standard for Shipboard Systems Electrical Cables and Connectors.
- DOD-STD-1399, Section 532 - Interface Standard for Shipboard Systems Cooling Water for Support of Electronic Equipment. (Metric)
- MIL-STD-1686 - Electrostatic Discharge Control Program for Protection of Electrical and Electronic Parts, Assemblies and Equipment (Excluding Electrically Initiated Explosive Devices) (Metric)

## HANDBOOK

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- DOD-HDBK-263 - Electrostatic Discharge Control Handbook for Protection of Electrical and Electronic Parts, Assemblies and Equipment (Excluding Electrically Initiated Explosive Devices). (Metric)

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(Unless otherwise indicated, copies of federal and military specifications, standards, and handbooks are available from the Standardization Documents Order Desk, Bldg. 4D, 700 Robbins Avenue, Philadelphia, PA 19111-5094.)

2.1.2 Other Government documents, drawings, and publications. The following other Government documents, drawings, and publications form a part of this document to the extent specified herein. Unless otherwise specified, the issues are those cited in the solicitation

## NAVAL SEA SYSTEMS COMMAND (NAVSEA)

0900-074-4010 - TRIDENT CCS SPECIFICATION, Appendix 60.2:  
Measurement of Airborne and Structureborne  
Noise.

0910-LP-047-6300 - Handbook of Shipboard Electromagnetic Shield-  
ing Practice, STEPS No. S9407-AB-HBK-010

(Application for copies should be addressed to the Standardization Documents Order Desk, Bldg. 4D, 700 Robbins Avenue, Philadelphia, PA 19111-5094.)

2.2 Non-Government publications. The following document(s) form a part of this document to the extent specified herein. Unless otherwise specified, the issues of the documents which are DOD adopted are those listed in the issue of the DODISS cited in the solicitation. Unless otherwise specified, the issues of documents not listed in the DODISS are the issues of the documents cited in the solicitation (see 6.2)

## AMERICAN CONFERENCE OF GOVERNMENT AND INDUSTRIAL HYGIENISTS (ACGIH)

ISBN 0-936-712-39-2 - Threshold Limit Values (TLVs) for Chemical  
Substances and Physical Agents in the Work  
Environment.

(Application for copies should be addressed to the American Conference of Government and Industrial Hygienists.)

## AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

F 1166 - Standard Practice for Human Engineering Design for  
Marine Systems, Equipment and Facilities

(Application for copies should be addressed to the American Society for Testing and Materials, 1916 Race Street, Philadelphia, PA 19103).

(Non-Government standards and other publications are normally available from the organizations that prepare or 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 document and the references cited herein, the text of this document takes precedence. Nothing in this document, however, supersedes applicable laws and regulations unless a specific exemption has been obtained

## 3. REQUIREMENTS

3.1 First article. When specified (see 6.2), both a preproduction and a production sample shall be subjected to first article inspection (see 6.4) in accordance with 4.3

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3.2 Characteristics.

3.2.1 Performance Enclosures shall provide support and protection of electronic equipment so that the complete assembly shall withstand the shock and vibration stresses specified herein without any part of the assembly loosening, coming adrift, or otherwise creating a hazard to personnel or degrading operation of vital systems.

3.2.1.1 Protection Enclosures shall provide protection of the integrated equipment so that the latter shall perform to design limits or simulation thereof after exposure of the complete assembly to the environmental stresses specified in 3.2.5 and the transportation stresses specified in 3.2.6.

3.2.1.1.1 Environmental stress. Grade A equipment as defined in MIL-S-901 shall perform to design limits during the environmental stress tests specified in 4.5.8 when properly integrated with the enclosure. Unless otherwise specified (see 6.2), no equipment fault that is attributable to the stress shall occur in the grade A equipment for 100 operating hours after the stress episode.

3.2.1.2 Electrical Enclosures using electrical power shall comply with the relevant requirements of MIL-E-16400 and MIL-STD-1399, section 300.

3.2.1.3 Access times. Maximum access times shall be established for each enclosure opening, door, and access panel. Access times for each access facility shall be tested during the maintainability demonstration (see 3.2.4.2).

3.2.2 Physical characteristics

3.2.2.1 Accessibility Enclosures shall support removable chassis, assemblies, and equipment. Enclosures shall provide access to all internal line replaceable units such as circuit card assemblies and other replaceable subassemblies and parts, from the front without requiring disassembly of the enclosure or subassemblies. Drawers, hinged chassis, and other movable assemblies shall have mechanical locking stops in the maintenance positions. Electrical and ground connections shall be readily accessible when an item is open for maintenance.

3.2.2.2 Access panels The number of fasteners provided to secure access panels, doors, and other openings shall be kept to the minimum consistent with mechanical, electrical, and electromagnetic compatibility (EMC) integrity of the enclosure (see 3.2.4.2). All such fasteners shall be captive. A positive means shall be provided to properly secure enclosure openings, doors, and panels after being opened for access.

3.2.2.3 Equipment requiring grounding Equipment utilizing electrical power shall be connected to the ground system in accordance with MIL-STD-454, requirement 1, and MIL-STD-1310. Unless otherwise specified (see 6.2), no convenience outlets shall be provided with the equipment. If provided under these conditions, three conductors shall be used, with the green wire connected to the cabinet or safety ground and with voltages obtained from an over-current protected utility power circuit separate from the equipment service power circuit.

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3.2.2.4 Dimensional limitations. The overall size and form factors for the unit shall conform to the dimensional requirements specified (see 6.2). Electrical and piping connector protrusions shall not exceed 6 inches. No assembled and installed unit shall exceed a height of 72 inches, exclusive of connectors.

3.2.2.5 Weight. The weight of the unit shall be kept to a minimum commensurate with good engineering design practices and the detailed requirements of the specification.

3.2.2.6 Degree of enclosure. The enclosure shall meet the degree of enclosure requirements as defined in MIL-STD-108, specified in MIL-E-16400, and as specified in the contract or order (see 6.2). The preclusion of moisture pockets within the enclosure shall conform to requirement 31 of MIL-STD-454.

3.2.2.7 Heaters Where necessary, automatic heaters shall be provided to prevent any adverse effects which might be caused by condensation or moisture penetration when the system is secured.

3.2.2.8 Mounting Enclosures shall mount to a foundation that will be part of the ship structure. (The foundation will be fabricated by the installer in accordance with installation control drawings furnished as part of the enclosure design information.) Enclosure mounts (such as "C" mounts) shall minimize requirements for opening or disassembly of the enclosure (which would invalidate factory acceptance or land-based test site verification)

3.2.2.8.1 Resilient mounting. Unless otherwise specified (see 6.2), enclosures shall be designed for rigid mounting. If resilient mounting is used, suitable damping shall be employed to withstand the shock and vibration environments. Unless otherwise specified (see 6.2), the deck or other mounting surface shall be assumed to be rigid.

3.2.2.8.2 Internal support. All internally mounted assemblies shall have adequate support both front and rear (such as, shock pins, rack shelves, angle braces) to withstand shock and vibration stresses. Plug-in devices shall have positive restraints to prevent dislodging by shock or vibration.

3.2.2.8.3 Chassis slide support. Assemblies equipped with chassis slides shall employ alternative means for support when in the closed position (such as, shock pins and cam blocks) so that the chassis slides do not bear a significant portion of the load under this condition.

3.2.2.8.4 Circuit card security. Circuit card assemblies shall be secured in a positive manner to preclude dislodgment, unseating, or breakage due to shock, vibration, thermal expansion, or any other cause except maintenance action.

3.2.2.9 Cooling. Enclosures shall be cooled in accordance with MIL-E-16400 and the equipment specification. Water cooling shall meet the requirements of MIL-W-21965 except as otherwise specified herein. Cooling water piping connections shall be as approved by the contracting activity. External valves for isolating the equipment from the cooling water system shall be part of the ship's service piping. Internal vents shall be provided unless it is possible to fill the cooling system completely by using the external couplings as vents. Accessible drains, such as weepholes and draincocks, shall be provided for removing water accumulation in enclosures and shall not adversely affect the environmental integrity of a unit.

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3.2.2.9.1 Water fittings. For water-cooled equipment, supply and return water connections to the ship's cooling water system shall be in accordance with MIL-W-21965. The equipment water fittings shall be located in positions that are readily accessible when the unit is installed in its intended environment. Enclosure drains shall be included as an integral portion of the enclosure design and shall be accessible from the front of each enclosure.

3.2.2.9.2 Emergency cooling. Water-cooled equipment shall have provisions for emergency cooling in accordance with MIL-W-21965.

3.2.2.10 Cabling. All external electrical connections shall be made by multicontact cable connectors meeting the requirements of this specification. The master keyway of each external connector shall be oriented toward the top or front of the enclosure. Input and output interface connectors shall be keyed differently.

3.2.2.11 Installation and interface. Interfaces with shipboard systems shall comply with MIL-STD-1399; at a minimum, the cooling water interfaces shall comply with section 532 and the electrical interface with section 304. All component mounting hardware requirements in excess of grade 5 screws or bolts in accordance with MIL-S-1222 shall be identified and supplied with the enclosure. Special bolt torquing requirements shall be stenciled on the exterior of the enclosure in the vicinity of bolts and on the interface control drawing (ICD).

3.2.2.12 Circuit breakers. Circuit breakers shall not be used for loads less than 10 amps per phase. Resistance to mechanical shock shall be considered when selecting and mounting circuit breakers. Circuit breakers shall be situated in front of the enclosure for easy accessibility.

3.2.2.13 Battleshort. The battleshort function shall be implemented as specified in MIL-STD-454, requirement 1. Terminals shall be provided in the enclosure for connecting the external battleshort switch or switches.

3.2.2.14 Handling provisions. All drip-proof equipment weighing more than 150 pounds shall have blind inserts to accommodate lifting eyes in accordance with MIL-E-16400. Removal of eyebolts shall not affect the degree of enclosure requirements of 3.2.2.6.

3.2.2.14.1 All standard enclosure designs shall consider the requirement to move the equipment with portable handling devices using a bottom lift to facilitate transportation of the equipment through a designed flow path. Hardware fasteners used in the transport of equipment shall not be used for shipboard installation.

3.2.2.14.2 Unless otherwise specified, the enclosure shall minimize requirements for opening, disassembly, or panel removal for transport or handling (which would invalidate factory acceptance or land-based test site verification).

3.2.2.14.3 Enclosure design shall consider the requirement for both land and high-altitude air transport pressure-equalizing features.

3.2.2.14.4 Enclosure design shall incorporate temporary protective covers where necessary for shipment, handling, and installation of such items as cathode-ray tubes, radio frequency gasket materials, protruding controls, and other items susceptible to damage.

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3.2.3 Reliability. The enclosure shall have inherent reliability by minimizing the component count and using high-reliability parts. The reliability shall be as specified in the equipment specification.

3 2.4 Maintainability.

3.2.4.1 Maintainability program The contractor shall establish and conduct an effective maintainability program in accordance with MIL-STD-470. This program shall be integrated with the equipment design engineering program to assure effective, timely, and economical accomplishment. The program shall be consistent with the type and complexity of systems or equipment and phase of the acquisition, and shall ensure attainment of the contractual maintainability requirements.

3.2.4.2 Maintainability and design requirements. The enclosure shall be designed for organizational level repair by replacement of faulty elements. Access panel removal and replacement shall be demonstrated to take one minute or less to accomplish. This shall include the time required to release and fully secure all of the fasteners on the doors, panels, and access plates that must be removed to perform the operation. Replacement time for faulty elements shall be as specified (see 6 2)

3.2.4.2.1 Planned maintenance. Planned organizational level maintenance shall be limited to such activities as inspecting, cleaning, and lubricating the equipment, and replacing aging or worn parts subject to approval of the contracting activity

3.2.4.2.2 Maintenance skills The enclosure design shall not require maintenance skills beyond those required for maintenance of the equipment which it contains.

3.2 4.2.3 Special tools and test equipment The need for special tools and test equipment to perform organizational level maintenance of the enclosure shall require contracting activity approval

3.2.5 Environmental service conditions The enclosure shall perform as set forth in 3.2.1 under the environmental service conditions specified in MIL-E-16400 for the shipboard sheltered environment (range 4). The enclosure shall also perform as specified when subjected to the following test conditions

3.2.5.1 Air temperature The ambient air temperature range for test purposes shall be as follows.

3.2.5.1.1 Operating The operating test ambient air temperature range shall be as specified in MIL-E-16400

3.2.5.1.2 Nonoperating. The enclosure shall not be damaged nor shall its operating performance be degraded when restored to the operating air temperature range after exposure for long periods to the nonoperating ambient air temperature range specified in MIL-E-16400, or exposure to the thermal shock test of MIL-STD-810, method 503, or MIL-STD-202, as appropriate.

3.2.5.2 Water temperature. For water-cooled equipment, the enclosure shall perform as specified with an inlet water temperature range as specified in DOD-STD-1399, section 532.

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3.2.5.3 Humidity. The enclosure shall maintain the specified performance when exposed to a relative humidity of 95 percent, including conditions wherein condensation appears in the form of both water and frost

3.2.5.4 Pressure

3.2.5.4.1 Operating. Enclosures shall perform as specified under atmospheric pressure ranging from 24 to 36 inches of mercury and, if used, cooling water pressure up to 150 pounds per square inch (lb/in<sup>2</sup>) gauge in accordance with MIL-W-21965.

3.2.5.4.2 Nonoperating. Enclosures shall perform as specified after exposure to a pressure of two atmospheres (14.7 lb/in<sup>2</sup> gauge positive differential pressure on the equipment) and, if used, a cooling water pressure of 150 lb/in<sup>2</sup> gauge in accordance with MIL-W-21965.

3.2.5.5 Shock The enclosure shall perform as specified when subjected to the tests of MIL-S-901 for grade, mounting, and weight as specified in the contract or order (see 6.2)

3.2.5.6 Vibration The enclosure shall perform as specified when subjected to the type I vibration tests of MIL-STD-167-1.

3.2.5.7 Inclination The enclosure shall perform as specified when subjected to the inclination tests of MIL-E-16400

3.2.5.8 Ambient light. The enclosure shall operate in a white normal, red normal, and white maintenance ambient as follows

- (a) White normal - 18 foot candles (fc) maximum
- (b) Red normal - 1 fc maximum.
- (c) Maintenance ambient - 28 fc maximum.

3.2.5.9 Fire When specified in the contract or order (see 6.2), the enclosure shall perform as specified in 3.2.1 when exposed to compartment fire conditions consisting of flames and heat up to 1000 degrees Fahrenheit (°F) for up to 15 minutes and firefighting conditions consisting of high-pressure sprays of various fire-extinguishing materials (such as, water, carbon dioxide, Halon, and Aqueous Film Forming Foam (AFFF)).

3.2.6 Transportability conditions. The enclosure, when prepared for transportation by truck, rail, or air, shall withstand and be protected against damage from the following environmental conditions

3.2.6.1 Temperature

- (a) Air transport Minus 40°F to plus 150°F with gradient of 33°F/minute for 5 minutes.
- (b) Truck or rail 0°F to plus 150°F with gradient of 5°F/minute.

3.2.6.2 Humidity Up to 100 percent relative humidity.



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3.2.6.3 Altitude.

- (a) Air transport: Minus 300 to plus 50,000 feet in nonpressurized compartments with a change of 2,000 feet in 1 minute.
- (b) Truck or rail: Minus 300 to plus 8,000 feet.

3.2.6.4 Vibration.

- (a) Air transport
  - (1) Steady state. (Not concurrent with gusts or landing) - plus or minus 0.5 grams (g) peak amplitude, 15 to 45 hertz (Hz), sinusoidal; plus or minus 2.5g peak amplitude, 45 to 300 Hz, sinusoidal.
  - (2) Landing. Plus or minus 2g peak amplitude, decaying sinusoidal acceleration, with frequency range of 7.5 to 12.5 Hz, and decay rate of 0.08 (logarithmic decrement equals 0.5).
  - (3) Gusts. Plus or minus 1g acceleration, with period of 0.5 to 2.0 seconds in the vertical direction.
- (b) Truck or rail: Plus or minus 1.5g decaying sinusoidal vibration, with decay range of 0.05, from 2 to 300 Hz.

3.2.6.5 Storage conditions. When prepared for storage, the enclosure shall withstand or be protected against benign storage conditions as specified in the contract or purchase order. Unless otherwise specified, the storage period will not exceed 5 years and the temperature range will be within the limits of minus 62°C and plus 75°C. Where applicable, consideration shall be given to maintaining desiccants for long-term storage in humid conditions.

3.3 Design and construction.3.3.1 Materials, processes and parts

3.3.1.1 Materials and processes. Materials and processes shall be selected in accordance with MIL-E-16400 and as specified below to meet the performance, environmental, and other requirements specified herein.

3.3.1.1.1 Unacceptable materials. Unacceptable materials, as specified in MIL-E-16400, shall not be used unless either approved by the contracting activity or used in the fabrication of approved or standard parts.

3.3.1.1.2 Prohibited materials (submarine applications)

3.3.1.1.2.1 Toxic materials. Components, fittings, paint, insulation, adhesives or other items containing materials or compounds that would give off noxious fumes at the operating temperature or at any temperature below 200°F shall not be installed or applied.

3.3.1.1.2.2 Mercury. No component, repair part, special tool, or part thereof destined for use or installation in a submarine shall come in direct contact with mercury, mercury compounds, or mercury-bearing instruments or devices employing only a single boundary of containment during manufacture, test, or

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inspection without specific contracting activity approval. No mercury or mercury-bearing components are to be installed or used in the equipment without contracting activity approval.

3 3.1.1.3 Metal corrosion. Metals and alloys shall be of corrosion-resistant types or shall be given suitable corrosion-resistant treatment or coating. Where it is necessary that dissimilar metals be assembled in contact with each other, they shall be protected from electrolytic corrosion in accordance with MIL-STD-454, requirement 4.

3 3.1.1.4 Moisture gaskets. Gaskets for doors, access panels, or other openings, where drip-proofing or moisture-proofing is required, shall be made of solid or tubular compliant material in accordance with either MIL-R-900 requirements for neoprene rubber or a comparable military specification for other materials. The durometer requirements of MIL-R-900 may be modified to meet optimum conditions for sealing. The use of open or closed cell cellular rubber for drip and moisture gaskets, except for silicone rubber closed cell cellular gaskets, is prohibited.

3 3.1.1.5 Water-cooling materials. Stainless steel coolant pipes and heat exchanger tubes shall have a minimum wall thickness of 0.028 inch. Cooling systems shall preclude galvanic action within the systems or at the interfaces.

3 3.1.1.6 Painting. The enclosure shall be prepared and painted in accordance with MIL-E-16400.

3 3.1.2 Parts. Unless otherwise specified, all parts used in the construction of the enclosure shall be in accordance with MIL-E-16400. Parts shall be selected in accordance with the order of precedence established in MIL-E-16400.

3 3.1.2.1 Intracabinet connections. Internal cabinet connectors and conductors shall be in accordance with MIL-E-16400.

3 3.1.2.2 Electrostatic discharge (ESD) protection requirements. When metal oxide semiconductor parts and other specified parts sensitive to ESD are used in the equipment, the contractor shall follow the requirements of MIL-STD-1686, including but not limited to the following steps:

- (a) Ensure that ESD-sensitive parts and subassemblies are protected in all phases of handling and testing.
- (b) Affix warning labels to protective packaging and to the equipment.
- (c) Provide warnings in all relevant areas of the equipment technical manual.
- (d) Use identification markings on all ESD-sensitive subassemblies visible to maintenance handling in the equipment, except standard electronic modules.

ESD-sensitive spare parts and subassemblies shall also be protected from ESD damage. DOD-HDBK-263 shall be used as guidance for the protection of electronic components and assemblies.

3 3.1.2.3 External receptacles. All external receptacles not in continuous use shall have a protective cap affixed by chain adjacent to the receptacle.

3 3.2 Electromagnetic radiation. The enclosure shall meet the EMC require-

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ments of MIL-STD-461 to the extent specified (see 6.2). The following subparagraphs shall apply to each equipment of the enclosure. The enclosure shall not contribute in any way to the non-compliance of the equipment it contains in the following areas:

Direct current magnetic field susceptibility  
 Alternating current magnetic field susceptibility  
 Electric field susceptibility  
 Magnetic field emissions  
 Electric field emissions  
 Conducted emissions (power lines)

3.3.2.1 Electromagnetic compatibility design. Enclosures shall employ radio frequency interference door gaskets and shielding of control and indicator openings as necessary to provide proper radio frequency interference shielding of the enclosed electronics. Internal wiring shall be shielded and/or twisted and of a minimum length to limit the wire lengths and loop areas exposed to E- and H-fields consistent with the shielding effectiveness of the enclosure and the noise margins of the circuits. There shall be an E- and H-field (RS01 and RS03) noise safety margin of at least 6 decibels (db).

3.3.2.2 Interenclosure connectors and cabling. Enclosure external (ship's) cabling connectors shall have conductively plated shells mounted to conductively treated surfaces on the enclosures. The cabling shall be routed in accordance with NAVSEA 0910-LP-047-6300 to provide sufficient separation between cable classifications. Low smoke cabling shall be used.

3.3.3 Nameplate and product marking. Nameplate and product marking shall be in accordance with MIL-STD-454, requirement 57.

3.3.4 Interchangeability. The enclosure shall be designed so that like assemblies, subassemblies, and parts are physically interchangeable.

3.3.5 Safety. Safety requirements shall be in accordance with MIL-STD-454 and ASTM F 1166.

3.3.5.1 Personnel safety. The enclosures shall protect from electrical and physical injury when being operated or maintained. Enclosure doors and the like shall be electrically bonded to the enclosure for safety and electromagnetic compatibility in accordance with MIL-STD-1310.

3.3.5.2 Ground, personnel safety. A ground contact for personnel safety shall be provided with a conductivity of 0.1 ohm (direct current resistance) or less between the equipment housing and ground potential. This ground contact can be established either by equipment installation methods (class B bond), by the installation of a bond strap (class C bond), or by the installation of a ground wire.

3.3.5.3 High voltage. Personnel shall be protected from dangerous voltages by the use of guards, grounding, interlocks, and warning placards in accordance with MIL-STD-454, requirement 1, and ASTM F 1166. Unless otherwise specified (see 6.2), bypassable interlocks and momentary override switches as defined in MIL-STD-454, requirement 1, shall be provided.

3.3.5.4 Toxic hazards. The enclosure shall not expose personnel to toxic

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substances in excess of the threshold limit values contained in ACGIH ISBN 0-936-712-39-2.

3.3.5.5 Inflammability. Unless otherwise specified (see 6.2), flammable materials as defined in MIL-STD-454, requirement 3, shall not be used. When specified (see 6.2), a means of controlling a fire originating within the enclosure shall be provided.

3.3.5.6 Mechanical hazards. The enclosure design shall provide personnel with safe mechanical access in accordance with MIL-STD-454, requirement 1, and ASTM F 1166 while installing, operating, and maintaining the equipment. The design shall also provide for a positive means of securing the enclosure after access to preclude damage caused by improperly secured doors, access panels, and other openings (see 3.3.5.7)

3.3.5.7 Other hazards. Where failure will cause damage to the equipment or injury to personnel, one or more of the following shall be applied, in descending order

- (a) A fail-safe design with proven qualified components to preclude the hazard
- (b) For hazards which cannot be eliminated, suitable safety devices for detecting and eliminating the hazardous situation
- (c) If the hazardous situation cannot be precluded, suitable devices to detect the hazard and generate a warning
- (d) If the nature of the hazard is such that the foregoing fail to significantly reduce the magnitude of the hazard, warning placards in accordance with MIL-STD-454, requirement 1, and ASTM F 1166 to designate danger, caution requirements, and actions to be taken in the event of a hazardous occurrence

3.3.6 Human performance/human engineering. Human engineering design criteria and principles shall be in accordance with MIL-STD-454, requirement 62, and as specified herein.

3.3.6.1 Anthropometry. The enclosure shall be designed for operation and maintenance of the equipment by personnel with anthropometry characteristics of the 5th through 95th percentile (90 percent) of US Navy personnel as described in ASTM F 1166.

3.3.6.2 Airborne noise. Airborne noise limits shall be in accordance with MIL-STD-740-1. For submarine applications, airborne noise limits shall be in accordance with MIL-STD-740-1 as modified by NAVSEA 0900-074-4010, appendix 60.2

3.3.6.3 Operator panel layouts. ASTM F 1166 shall be used as a guide in the design, layout, and coding of front panel controls and indicators. The arrangement and coding of front panel controls and indicators shall be submitted to the contracting activity for approval.

3.4 Survivability. Unless otherwise specified (see 6.2), this specification supersedes the requirements of MIL-E-2036 for survivable electronic enclosures, if applied.

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3.5 Workmanship. Workmanship shall be in accordance with MIL-STD-454. All surfaces shall be free from pits, holes, dents, slivers, and rough or sharp edges. All screws shall be set with heads tight against the surface. Parts shall be as specified and shall not be missing, broken, fractured, punctured, malformed, dented, buckled, warped, or bent out of shape.

3.5.1 Painting. Painted surface coat shall be free from runs, tackiness, blisters, scratches, grit, areas of no film, and color separation

3.5.2 Welding Welding shall be in accordance with MIL-STD-454, requirement 13 or 24, as applicable. Surfaces or parts to be welded shall be free of rust, scale, paint, grease, or other foreign matter. All welds shall be sound with no indication of weld missing, cracked, partly or completely broken, or not being fused or adherent. Welds shall be continuous and free from undercut, flux, spatter, or poor surface appearance caused by craters or piling up of deposited material. All scale and flux shall be removed from the finished weld area.

#### 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 (examinations and tests) 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 this specification where such inspections are deemed necessary to ensure supplies and services conform to prescribed requirements.

4.1.1 Responsibility for compliance. All items shall meet all requirements of sections 3 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 ensuring that all products or supplies submitted to the Government for acceptance comply with all requirements of the contract. Sampling inspection, as part of the manufacturing operations, is an acceptable practice to ascertain conformance to requirements, however, this does not authorize submission of known defective material, either indicated or actual, nor does it commit the Government to accept defective material.

4.1.2 Enclosure testing. The enclosure shall be tested with dummy or operational equipment in place, as specified (see 6.2)

4.1.3 Failure criteria. Unless otherwise specified, the enclosure subjected to the tests specified herein shall be considered to have failed the test when any of the following occur:

- (a) Performance parameters of the equipment do not meet the requirements specified in the equipment specification
- (b) Catastrophic or structural failure.
- (c) Distortion or displacement of mechanical parts that causes difficulty of servicing or replacing a part.
- (d) Any condition that results in a hazard to personnel or equipment safety.

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- (e) Deterioration, corrosion, or change in performance limits causing failure to meet operational service or maintenance requirements.
- (f) Leakage or discoloration of fluids, lubricants, or impregnating compounds that would indicate a decrease in service life or reliability.

4.2 Classification of inspections. The inspection requirements specified herein are classified as follows

- (a) First article inspection (see 4.3).
- (b) Quality conformance inspection (see 4.4).

4.3 First article inspection First article inspection shall consist of the examinations and tests indicated in table I (see 6.2)

TABLE I Examination and tests

Examination and tests	Requirement	Test	First article inspection	Quality conformance inspection
Physical examination				
Accessibility	3 2 2.1	4.5.1	X	
Access panels	3.2.2.2	4 5 1	X	
Grounding	3 2.2.3	4 5 1	X	
Size	3.2.2.4	4 5 1	X	X
Weight	3.2.2.5	4.5.1	X	X
Space heaters	3 2.2.7	4.5.1	X	
Mounting	3 2 2 8	4 5 1	X	
Resilient mounting	3 2 2 8.1	4.5.1	X	
Internal support	3 2 2.8.2	4.5.1	X	
Chassis slide support	3.2.2.8.3	4.5.1	X	X
Circuit Card Security	3 2.2 8 4	4 5.1	X	X
Cooling	3.2.2.9	4 5 1	X	
Water fittings	3 2.2.9 1	4.5.1	X	
Cabling	3 2.2 10	4.5.1	X	
Installation and interface	3.2 2.11	4 5 1	X	
Circuit breakers	3 2 2.12	4.5.1	X	
Battle short	3.2.2.13	4.5.1	X	
Handling provisions	3 2.2 14	4 5.1	X	X
Packaging	4 7	4 5 1	X	X
Product marking	3 3 3	4 5 1	X	
Workmanship	3.5	4.5.1	X	X
Painting	3 5.1	4 5 1	X	X
Welding	3 5 2	4.5.1	X	X
Interchangeability	3 3 4	4 5 1	X	
Safety	3 3.5	4 5 1	X	X
Human engineering	3 3.6	4.5.1	X	
Performance	3 2.1	4 5.2	X	

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TABLE I. Examination and tests - Continued.

Examination and tests	Requirement	Test	First article inspection	Quality conformance inspection
Electrical	3.2.1.2	4.5.3	X	X
Mechanical & structural				
Airborne noise	3.3.6.2	4.5.4.1	X	
Weld test	3.5.2	4.5.4.2	X	X 1/
Thermal tests				
Thermal performance	3.2.2.9	4.5.5.1	X	
Emergency cooling	3.2.2.9.2	4.5.5.2	X	
Reliability	3.2.3	4.5.6	X	
Maintainability	3.2.4	4.5.7	X	
Environmental stress	3.2.5			
Temperature	3.2.5.1	4.5.8.1	X	X 1/
Thermal shock	3.2.5.1.2	4.5.8.1.3	X	
Humidity	3.2.5.3	4.5.8.2	X	
Pressure	3.2.5.4	4.5.8.3	X	
Shock	3.2.5.5	4.5.8.4	X	
Vibration	3.2.5.6	4.5.8.5	X	
Inclination	3.2.5.7	4.5.8.6	X	
Fire	3.2.5.9	4.5.8.7	X	
Degree of enclosure	3.2.2.6	4.5.8.8		
Electromagnetic radiation	3.3.2	4.5.9	X	
Transportability	3.2.6	4.6	X	

1/ Sampling shall be as specified (see 6.2).

4.4 Quality conformance inspection. Unless otherwise specified in the contract (see 6.2), quality conformance inspection shall be performed on each item offered for delivery. Quality conformance inspection shall consist of the examinations and tests indicated in table I (see 6.3).

#### 4.5 Tests

4.5.1 Physical examination. The enclosure shall be examined to determine compliance with the requirements as listed in table I. In the process of examination, the enclosure shall not be disassembled in a manner that will affect its performance, durability, or appearance.

4.5.2 Performance test. The enclosure shall be subjected to a performance test to determine compliance with 3.2.1.

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4.5.3 Electrical tests. Enclosures using electrical power shall be tested in accordance with the applicable portions of MIL-E-16400 to determine compliance with 3.2.1.2.

4.5.4 Mechanical and structural tests.

4.5.4.1 Airborne noise The equipment shall be tested in accordance with MIL-STD-740-1 to determine compliance with 3.3.6.2 (see 6.3).

4.5.4.2 Weld test. Samples representative of production (see 6.2) shall be tested to destruction to determine compliance with 3.5.2. These samples shall be welded by the same methods and equipment used for production of the enclosures.

4.5.5 Thermal tests

4.5.5.1 Thermal performance A thermal performance test shall be conducted to determine compliance with 3.2.2.9. Upon completion of the test, a visual examination shall be made to detect evidence of deterioration of parts and materials used in the equipment or the enclosure.

4.5.5.2 Emergency cooling The enclosure shall be tested in accordance with the emergency cooling test of MIL-W-21965 to determine compliance with 3.2.2.9.2.

4.5.6 Reliability tests Reliability tests shall be conducted with the equipment mounted in the enclosure. Requirements for reliability shall be as specified in the equipment specification.

4.5.7 Maintainability demonstration A maintainability demonstration shall be conducted to determine compliance with 3.2.1.3 and 3.2.4.

4.5.8 Environmental stress tests

4.5.8.1 Temperature tests Samples (see 6.2) shall be tested as follows to determine compliance with 3.2.5.1.1 and 3.2.5.1.2.

4.5.8.1.1 Low temperature. The low temperature test shall be in accordance with method 502.2, procedure II, of MIL-STD-810.

4.5.8.1.2 High temperature The high temperature test shall be in accordance with method 501.2, procedure II, of MIL-STD-810.

4.5.8.1.3 Thermal shock The thermal shock test shall be in accordance with MIL-STD-810, method 503.

4.5.8.2 Humidity The enclosure shall be tested in accordance with method 507.2, procedure II, of MIL-STD-810.

4.5.8.3 Pressure. The enclosure shall be tested to determine compliance with 3.2.5.4 and subparagraphs.

4.5.8.4 Shock. The enclosure shall be tested to determine compliance with 3.2.5.5.

4.5.8.5 Vibration The enclosure shall be tested to determine compliance with 3.2.5.6.



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4 5.8.6 Inclination The enclosure shall be tested to determine compliance with 3 2.5.7.

4.5.8.7 Fire. The enclosure shall be tested to determine compliance with 3.2.5.9. The equipment shall operate satisfactorily during and after the test.

4 5.8.8 Degree of enclosure. The enclosure shall be subjected to the degree of enclosure test of MIL-STD-108 to determine compliance with 3.2.2 6. This test shall be conducted after completion of the vibration, inclination, shock, and noise tests, as applicable

4.5.9 Electromagnetic interference tests. The enclosure shall be tested in accordance with the applicable requirements of MIL-E-16400 to determine compliance with 3 3 2

4 6 Transportability The enclosure shall be tested to determine compliance with 3.2.6, both as an empty unit and with operational equipment or dummy equipment in place, as specified (see 6.2).

4 7 Inspection of packaging. Sample packages and packs, and the inspection of the preservation, packing and marking for shipment and storage shall be in accordance with the requirements of section 5 and the documents specified therein

## 5 PACKAGING

(The packaging requirements specified herein apply only for direct Government acquisition. For the extent of applicability of the packaging or preparation for delivery requirements of referenced documents listed in section 2, see 6 6.)

5.1 Packaging requirements. The packaging (preservation, packing and marking requirements shall be in accordance with MIL-E-17555 for the level of preservation, the level of packing, including marking and packaging acquisition options therein as specified (see 6.2) In addition, for Navy acquisitions, the following applies.

a Navy fire-retardant requirements.

- (1) Treated lumber and plywood. When specified (see 6.2), all lumber and plywood including laminated veneer material used in shipping container and pallet construction, members, blocking, bracing, and reinforcing shall be fire-retardant treated material conforming to MIL-L-19140 as follows:

Level A and B -	Type II - weather resistant Category I - general use
Level C -	Type I - non-weather resistant Category I - general use

- (2) Fiberboard Fiberboard used in the construction of interior (unit and intermediate) and exterior boxes including interior packaging forms shall conform to the class-domestic/fire retardant or class-weather resistant/fire retardant materials requirements as specified (see 6.2) of PPP-F-320.

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5.1.1 Resilient mounts. Resilient mounts (see 3.2.2.8.1) which have been used during shock or vibration tests (see 3.2.6 and 4.5) shall be replaced with new mounts prior to offering the equipment for delivery.

5.1.2 Special marking In addition to the shipment markings required by 5.1, storage markings shall be applied to packed and unpacked shipments to meet the requirements of 3.2.6.5

## 6 NOTES

(This section contains information of a general or explanatory nature that may be helpful, but is not mandatory.)

6.1 Intended use. This specification is intended to constrain the development and integration of enclosures for shipboard electronic systems or equipment to achieve survivability of the resulting system or equipment item in the shipboard combat environment. It is intended that the equipment, whether of an existing design or new development, be integrated and tested with the enclosure to achieve this end. This requires that the designer apportion the resistance to stress between the enclosure and the equipment to achieve the required degree of resistance to the anticipated stress environment for the complete assembly.

6.2 Acquisition requirements Acquisition documents must specify the following

- (a) Title, number, and date of this specification.
- (b) Issue of DoDISS to be cited in the solicitation, and if required, the specific issue of individual documents referenced (see 2.1.1 and 2.2)
- (c) When first article testing is required (see 3.1) and the number of samples to be tested (see 4.3)
- (d) Operating period if other than as specified (see 3.2.1.1.1).
- (e) When convenience outlets are to be provided (see 3.2.2.3).
- (f) Dimensional requirements (see 3.2.2.4).
- (g) Degree of enclosure requirements (see 3.2.2.6).
- (h) When enclosures are for resilient mounting (see 3.2.2.8.1)
- (i) When deck or mounting surface is not rigid (see 3.2.2.8.1).
- (j) Replacement time for faulty elements (see 3.2.4.2)
- (k) Shock requirements (see 3.2.5.5).
- (l) When compartment fire conditions apply (see 3.2.5.9).
- (m) EMC requirements (see 3.3.2).
- (n) When bypassable interlocks and momentary override switches are not required (see 3.3.5.3).
- (o) When flammable materials are allowed (see 3.3.5.5)
- (p) When fire control equipment is required (see 3.3.5.5)
- (q) When survivability requirements of MIL-E-2036 apply (see 3.4)
- (r) Whether dummy or operational equipment is used (see 4.1.2)
- (s) Number of samples to be weld tested (see 4.4 and 4.5.4.2)
- (t) Number of samples to be temperature tested (see 4.4 and 4.5.8.1).
- (u) Level of preservation, level of packing and packaging options required (see 5.1).
- (v) When fire retardant lumber and plywood is required (see 5.1 a (1)).
- (w) Class of fire retardant fiberboard required (see 5.1 a (2)).
- (x) When self-resonance is other than MIL-STD-167-1 requirements.

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- (y) When to test with operational or dummy equipment in place (see 4.6).
- (z) Weight requirements.
- (aa) When quality conformance testing is required (see 4.4).

6.3 Consideration of data requirements. The following data requirements should be considered when this specification is applied on a contract. The applicable Data Item Descriptions (DID's) should be reviewed in conjunction with the specific acquisition to ensure that only essential data are requested/provided and that the DID's are tailored to reflect the requirements of the specific acquisition. To ensure correct contractual application of the data requirements, a Contract Data Requirements List (DD Form 1423) must be prepared to obtain the data, except where DoD FAR Supplement 27.475-1 exempts the requirement for a DD Form 1423

<u>Reference Paragraph</u>	<u>DID Number</u>	<u>DID Title</u>	<u>Suggested Tailoring</u>
4 4	DI-T-2072	Reports, test reports	----
4 5 4 1	DI-HFAC-80272	Equipment airborne sound measurements test report	----

The above DID's were those cleared as of the date of this specification. The current issue of DoD 5010 12-L, Acquisition Management Systems and Data Requirements Control List (AMSDL), must be researched to ensure that only current, cleared DID's are cited on the DD Form 1423

6 4 First article When first article inspection is required, the contracting officer should provide specific guidance to offerors whether the item(s) should be a preproduction sample, a first article sample, a first production item, a sample selected from the first 10 production items, a standard production item from the contractor's current inventory (see 3.1), and the number of items to be tested as specified in 4 3. The contracting officer should also include specific instructions in acquisition documents regarding arrangements for examinations, approval of first article test results, and disposition of first articles. Invitations for bids should provide that the Government reserves the right to waive the requirement for samples for first article inspection to those bidders offering a product which has been previously acquired or tested by the Government, and that bidders offering such products, who wish to rely on such production or test, must furnish evidence with the bid that prior Government approval is presently appropriate for the pending contract. Bidders should not submit alternate bids unless specifically requested to do so in the solicitation.

#### 6 5 Definitions.

6.5.1 Equipment, electronic. Electronic equipment is any equipment whose primary function is to generate, transmit, convey, receive, store, process, or otherwise use electronic signals. Examples are transmitters, receivers, amplifiers, computers, underwater detection equipment, fire control equipment, and associated test equipment.

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6 5.2 Enclosure. An enclosure is a housing such as a cabinet, case, or the like, which provides physical and environmental protection and support to equipment, parts, or subassemblies. An enclosure may also provide shielding and contain cooling for equipment installed herein.

6.5.2.1 Shipboard-survivable electronic equipment enclosure. A shipboard-survivable electronic equipment enclosure is an enclosure having the functions of housing shipboard electronic equipment integrated with the enclosure and protecting the equipment from the environmental and transportation stresses specified in 3.2.5 and 3.2.6, respectively.

6 5.3 Failure. Details involving failure criteria, to include required functions and performance parameter limits, must be stated in the equipment specification and test procedures approved by the contracting activity. For test purposes, the following general definitions shall apply:

- (a) Failure is an event in which a previously acceptable item does not perform one or more of its required functions within the specified environmental or operational limits under specified conditions.
- (b) Failure is the condition in which a mechanical or structural part or component of an item found to be broken, fractured, or damaged would cause failure under operational conditions.

6 6 Sub-contracted material and parts. The packaging or preparation for delivery requirements of referenced documents listed in section 2 do not apply when material and parts are acquired by the contractor for incorporation into the equipment and lose their separate identity when the equipment is shipped.

6 7 Subject term (key word) listing

Access facility  
Chassis slide  
Drawers  
Enclosure mounts  
Hinged chassis  
Integrated equipment

Preparing activity.  
Navy - SH  
(Project number 59GP-N080)

# STANDARDIZATION DOCUMENT IMPROVEMENT PROPOSAL

## INSTRUCTIONS

1. The preparing activity must complete blocks 1, 2, 3, and 8. In block 1, both the document number and revision letter should be given.
2. The submitter of this form must complete blocks 4, 5, 6, and 7.
3. The preparing activity must provide a reply within 30 days from receipt of the form.

NOTE: This form may not be used to request copies of documents, nor to request waivers, or clarification of requirements on current contracts. Comments submitted on this form do not constitute or imply authorization to waive any portion of the referenced document(s) or to amend contractual requirements.

<b>1. RECOMMEND A CHANGE:</b>		1. DOCUMENT NUMBER MIL-E-24762(SH)	2. DOCUMENT DATE (YYMMDD) 28 MAY 1991
3. DOCUMENT TITLE ENCLOSURES FOR ELECTRONIC EQUIPMENT, SURVIVABLE, NAVAL SHIPBOARD USE			
4. NATURE OF CHANGE (Identify paragraph number and include proposed rewrite, if possible. Attach extra sheets as needed.)			
5. REASON FOR RECOMMENDATION			
6. SUBMITTER			
a. NAME (Last, First, Middle Initial)		b. ORGANIZATION	
c. ADDRESS (Include Zip Code)		d. TELEPHONE (Include Area Code) (1) Commercial (2) AUTOVON (if applicable)	7. DATE SUBMITTED (YYMMDD)
8. PREPARING ACTIVITY			
a. NAME Technical Point of Contact (TPOC): r. H. Demattia (SEA 06R2) LEASE ADDRESS ALL CORRESPONDENCE AS FOLLOWS:		b. TELEPHONE (Include Area Code) (1) Commercial (2) AUTOVON TPOC: 703-602-9121 8-332-9121	
c. ADDRESS (Include Zip Code) Commander, Naval Sea Systems Command Department of the Navy Washington, DC 20362-5101		IF YOU DO NOT RECEIVE A REPLY WITHIN 45 DAYS, CONTACT: Defense Quality and Standardization Office 5203 Leesburg Pike, Suite 1403, Falls Church, VA 22041 3466 Telephone (703) 756-2340 AUTOVON 289-2340	