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SUPERSEDING
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DEPARTMENT OF DEFENSE
DESIGN CRITERIA STANDARD

DESIGN CRITERIA FOR
SPECIALIZED SHIPPING CONTAINERS

AMSC N/A

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FOREWORD

1. This design criteria standard is approved for use by all Departments and Agencies of the Department of Defense (DoD).

2. This standard establishes the general design criteria and associated tests for specialized shipping containers used by the Department of Defense.

3. A specialized container is uniquely configured to support and protect its prescribed contents while being handled, stored, shipped to, and unpacked by the user; or to protect personnel and equipment from hazardous contents. Containers of this type frequently incorporate energy absorbing systems, temperature control systems, or special features to make handling or shipment possible, easier, or safer. Engineering drawings, or equivalent, are used to define form, fit, function, materials, tolerances, and manufacturing techniques.

4. A specialized shipping container is designed for use with a specific item when general container specifications are not sufficiently detailed to assure required protection, safety, reliability, maintainability, or configuration control. The need for a specialized container may arise with any deliverable item and invariably does so with nuclear and conventional ammunition and explosives. The container may be the result of a completely original design effort or of the modification of existing, or standard, container designs.

5. Copies of this standard may be obtained from the DODSSP, Standardization Documents Order Desk, Building 4D, 700 Robbins Avenue, Philadelphia, PA 19111-5094.

6. Beneficial comments (recommendations, additions, deletions) and any pertinent data which may be of use in improving this document should be addressed to: Commander, Indian Head Division, Naval Surface Warfare Center, Code 840M, 101 Strauss Avenue, Indian Head, MD 20640-5035, by using the 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. This standard establishes general design guidelines and associated tests for specialized shipping containers used by the Department of Defense. Definitive requirements for specific containers will be defined by the individual specification, acquisition or task order. This standard is intended to be used as the basic reference document in all specifications and standards prescribing performance requirements to be applied to a shipping container. Compliance with this intent is expected through normal application of the specification or standard preparation and revision processes.

2. APPLICABLE DOCUMENTS

* **2.1 General.** The documents listed in this section are listed in sections 3, 4, and 5 of this standard. This section does not include documents cited in other sections of this standard or recommended for additional information or as examples. While every effort has been made to ensure the completeness of this list, document users are cautioned that they must meet all specified requirements documents cited in sections 3, 4, and 5 of this standard, whether or not they are listed.

2.2 Government documents.

2.2.1 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

A-A-55057	Panels, Wood/Wood Based; Construction and Decorative
FF-N-105	Nails, Brads, Staples and Spikes: Wire, Cut and Wrought
TT-W-571	Wood Preservation, Treating Practices
TT-W-572	Wood Preservation, Water-Repellent

DEPARTMENT OF DEFENSE

MIL-S-901	Shock Tests, (High Impact) Shipboard Machinery, Equipment and System, Requirements for
MIL-D-3464	Desiccant, Activated, Bagged, Packaging Use and Static Dehumidification

	MIL-D-3716	Desiccants, Activated for Dynamic Dehumidification
*	MIL-S-7742	Screw Threads, Standard, Optimum Selected Series, General Specification For
*	MIL-S-8879	Screw Threads, Controlled Radius Root With Increased Minor Diameter, General Specification For
	MIL-C-53072	Chemical Agent Resistant Coating (CARC) System Application Procedures and Quality Control Inspection
	MIL-I-81508	Indicator Plug, for Missile Propellants

STANDARDS

FEDERAL

FED-STD-101	Test Procedures for Packaging Materials
FED-STD-209	Clean Room and Work Station Requirements, Controlled Environment
FED-STD-H28	Screw Thread Standards for Federal Services

DEPARTMENT OF DEFENSE

MIL-STD-129	Marking for Shipment and Storage
MIL-STD-130	Identification Marking of U.S. Military Property
MIL-STD-209	Slinging and Tie down Provisions for Lifting and Tying Down Military Equipment
MIL-STD-709	Ammunition Color Coding
MIL-STD-810	Environmental Test Methods and Engineering Guidelines
MIL-STD-814	Requirement for Tie down, Suspension and Extraction Provisions on Military Materiel for Airdrop
MIL-STD-913	Requirement for the Certification of Externally Transported Military Equipment by Department of Defense Rotary Wing Aircraft
MIL-STD-973	Configuration Management

	MIL-STD-1366	Transportability Criteria
	MIL-STD-1660	Design Criteria for Ammunition Unit Loads
*	MIL-STD-1686	Electrostatic Discharge Control Program for Protection of Electrical and Electronic Parts, Assemblies and Equipment (Excluding Electrically Initiated Explosive Devices)
	MIL-STD-1791	Designing for Internal Aerial Delivery in Fixed Wing Aircraft
	MIL-STD-1904	Design and Test Requirements for Level A Ammunition Packaging
*	MIL-STD-2073-1	Standard Practice for Military Packaging

* HANDBOOKS

DEPARTMENT OF DEFENSE

MIL-HDBK-304	Package Cushioning Design

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

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

DRAWINGS

NAVAL SEA SYSTEMS COMMAND (NAVSEA) (CAGE Code 10001)

2642780	Container Compatibility with Handlift Trucks Mark 42 and Mark 45
2602910	Leak Disk Indicator
5166322	Holder, Records
5166628	Plug, Humidity Indicator
5167399	Extrusion, Endlift
5167401	Endlift-Adapter

5167633	Fork Pocket
5167693	Fork Pocket
5167756	Latch
6212630	Handle
6212706	Observation Window
6212707	Access Port
6212861	Latch, Wide Handle
6212862	Shackle
6212863	Valve, Breather
6212868	Desiccator
6212876	Container Handling Beam Mark 52 MOD 0
6213102	Latch
6213762	Rings, Container Lift

(Application for copies should be addressed to: Director, Naval Surface Warfare Center, Crane Detachment, Attn.: Code 3J10, 160 Rochester Drive, Louisville, KY 40214-5001.)

NAVAL AIR SYSTEMS COMMAND (NAVAIR) (CAGE Code 30003)

799AS105	Holder, Records
3214AS110	Center Lift
616856	Weapon Cradle Hoisting Beam HLU-2l6/E
616856-3	Weapon Cradle Hoisting Beam HLU-2l6A/E
2877628	Disk Indicator

(Application for copies should be addressed to: Commanding Officer, Naval Air Technical Services Facility, Code 3.3.3.1(314), 700 Robbins Avenue, Philadelphia, PA 19111-5097.)

UNITED STATES ARMY (CAGE Code 97403)

13222E3855 Disk Indicator

(Application for copies should be addressed to: Commander, U.S. Army Belvoir Research, Development, and Engineering Center, Attn.: AMSEL-LC-EIEW-D-ED, Fort Belvoir, VA 22060-5606.)

PUBLICATIONS

FEDERAL

CODE OF FEDERAL REGULATIONS (CFR)

49 CFR 100-180 Transportation

ENVIRONMENTAL PROTECTION AGENCY (EPA)

40 CFR 261.24 Protection of Environment

Public Law 91-596 Occupational Safety and Health Act (OSHA)

Executive Order 12191 Occupational Safety and Health Act for Federal Employees

(Copies of 49 CFR 100-180, Public Law 91-596 and Executive Order 12191 are available from the Superintendent of Documents, US Government Printing Office, Washington, DC 20402-0001.)

(Applications for copies of 40CFR 261.24 should be addressed to the Office of Solid Waste, 401 M St. SW, Washington, DC 20460.)

DEPARTMENT OF DEFENSE MANUAL (DODM)

DOD 5100.76-M Physical Security of Sensitive Conventional Arms, Ammunition, and Explosives

(Application for copies should be addressed to: DODSSP, Standardization Documents Order Desk, Building 4D, 700 Robins avenue, Philadelphia, PA 19111-5094.)

(The following publication is jointly issued for the Department of Defense. Each service refers to the document using its unique numbering system. The numbers listed are for Air Force, Army, Navy, Marine Corps, and Defense Supply Agency.)

AFR 80-18 (Air Force Regulation); AR 70-44; OPNAVINST 4600.22; DOD Engineering for Transportability

MCO 4610.14B (Marine Corps Order); DSAR 4500.25

(Copies of the above publications are available from: DODSSP, Standardization Documents Order Desk, Building 4D, 700 Robins avenue, Philadelphia, PA 19111-5094.)

(The following publication is jointly issued for the Department of Defense. Each service refers to the document using its unique numbering system. The numbers listed are for Air Force, Army, Navy Supply Systems Command, Marine Corps, and Defense Logistics Agency.)

AFMCR 800-29; AMC-R 700-103; NAVSUPINST 4030.50; MCO 4030.39; DLAR 4145.37	Policies and Procedures for Hazardous Materials Package Certification

(Copies of the above publication are available from: Commander, Naval Supply Systems Command, Attn.: SUP 083, Washington, DC 20376-5000.)

AR 70-71	Nuclear, Biological, Chemical (NBC) Contamination Survivability of Army Materiel

(Army application for publication copies should be addressed to: Army Publication Distribution Center, 2800 Eastern Boulevard, Baltimore, MD 21220-2896.)

(Navy application for copies should be addressed to: DODSSP, Standardization Documents Order Desk, Building 4D, 700 Robins avenue, Philadelphia, PA 19111-5094.)

(Air Force application for publication copies should be addressed to: Army Publication Distribution Center, 2800 Eastern Boulevard, Baltimore, MD 21220-2896.)

TOP 8-2-111	Nuclear, Biological, Chemical (NBC) Contamination Survivability of Small Items of Equipment

(Application for copies should be addressed to: Director, Defense Technical Information Center, Attn.: DDR, Cameron Station, Alexander, VA 22304-6145.)

UNITED STATES DEPARTMENT OF AGRICULTURE (USDA)

Agriculture Handbook No. 72	Wood Handbook: Wood in Engineering Design

(Applications for copies should be addressed to: National Technical Information Center, 5285 Port Royal Road, Springfield, VA 22161.)

NAVAL PACKAGING, HANDLING, STORAGE AND TRANSPORTATION CENTER DOCUMENTATION (CAGE Code 040L3)

Technical Report 93003 Weapons Container Stacking Study

(Copies of the above publication are available from: Commanding Officer, Naval Weapons Station Earle, Attn.: Naval Packaging, Handling, Storage and Transportation Center; Technical Library, 201 Hwy. 34 South, Colts Neck, NJ 07722-5023.)

2.3 Non-Government publications. The following documents 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 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 NATIONAL STANDARDS INSTITUTE (ANSI)

ANSI MH10.1M Unit Load and Transport Package Sizes

(Application for copies should be addressed to the American National Standards Institute, 1430 Broadway, New York, NY 10018-1187.)

AMERICAN SOCIETY OF MECHANICAL ENGINEERS (ASME)/ AMERICAN NATIONAL STANDARDS INSTITUTE (ANSI)

* ASME/ANSI B1.1 Unified Inch Screw Threads (UN and UNR Thread Form)

ASME/ANSI B18.5 Round Head Bolts

ASME/ANSI B18.9 Plow Bolts

ASME/ANSI B18.18.1M Inspection and Quality

(Application for copies should be addressed to the American Society of Mechanical Engineers, 345 East 47th Street, New York, NY 10018-2392.)

AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

* ASTM B117 Standard Practice for Operating Salt Spray (Fog) Apparatus

ASTM B633 Standard Specification for Electrodeposited Coatings of Zinc on Iron and Steel

ASTM D257 Standard Test Methods for D-C Resistance or Conductance of Insulating Materials (DOD adopted)

ASTM D573 Standard Test Method for Rubber - Deterioration in an Air Oven (DOD adopted)

ASTM D642	Standard Test Method for Determining Compressive Resistance of Shipping Containers, Components, and Unit Loads
ASTM D880	Standard Test Method for Impact Testing for Shipping Containers and Systems
ASTM D991	Standard Test Method for Rubber Property - Volume Resistivity of Electrically Conductive and Antistatic Products (DOD adopted)
ASTM D996	Standard Terminology of Packaging and Distribution Environments
ASTM D999	Standard Methods for Vibration Testing of Shipping Containers
ASTM D1083	Standard Test Methods for Mechanical Handling of Unitized Loads and Large Shipping Cases and Crates
ASTM D1149	Standard Test Method for Rubber Deterioration - Surface Ozone Cracking in a Chamber (DOD adopted)
ASTM D2000	Standard Classification System for Rubber Products in Automotive Applications (DOD adopted)
ASTM D4003	Standard Test Methods for Programmable Horizontal Impact Test for Shipping Containers and Systems
ASTM D4577	Standard Test Method for Compression Resistance of a Container Under Constant Load
ASTM D5276	Standard Test Method for Drop Test of Loaded Containers by Free Fall
ASTM D5277	Standard Test Method for Performing Programmed Horizontal Impacts Using an Inclined Impact Tester

(Application for copies should be addressed to: American Society for Testing and Materials, 100 Barr Harbor Drive, West Conshohocken, PA 19428-2959.)

ELECTRONIC INDUSTRIES ASSOCIATION (EIA)

EIA 541	Packaging Material Standards for ESD Sensitive Items

(Application for copies should be addressed to the Electronics Industries Association, 2001 Eye Street, NW, Washington, DC 20006.)

SOCIETY OF AUTOMOTIVE ENGINEERS, INC. (SAE)

SAE AMS 3269	Sealing Compound, Polysulfide (T) synthetic rubber for integral fuel tank and fuel cell cavities high strength, for intermittent use to 360 degrees F (182 degrees C)
SAE AMS 3281	Sealing Compound, Polysulfide (T) synthetic rubber for integral fuel tank and fuel cell cavities low density (1.35 SP GR MAX), for intermittent use to 360 degrees F (182 degrees C)

SAE AS 5017 Air Filling Valves

SAE AS 5135	Desiccant Port and Desiccant Holder
SAE AS 26860	Indicator, Humidity, Plug Color Change
SAE AS 27166	Valve, Pressure Equalization Gaseous Products

(Application for copies should be addressed to the Society of Automotive Engineers, Inc., 400 Commonwealth Drive, Warrendale, PA 15096-0001.)

(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.)

2.4 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. DEFINITIONS

3.1 General. The terms used throughout this standard, and their interpretation, shall be in accordance with the following definitions. Packaging terms are in accordance with ASTM D996. Hazardous materials are defined in the Code of Federal Regulations, 49 CFR 100-180, Transportation.

3.1.1 Anthropometry. Description of the physical variation in humankind by measurement.

3.1.2 Competent authority. The legal responsible agency or authority of the State (country) tasked with the implementation and enforcement of hazardous material packaging requirements as mandated by the International Regulatory Body (Department of Transportation (DOT) for the U.S.).

3.1.3 Connected replenishment-at-sea (CONREP). CONREP is the transfer of material from ship-to-ship at sea by cable transfer system.

3.1.4 Cracking pressure (relief valve). The pressure(s) at which the container's relief valve first opens when subjected to a pressure differential, either pressure or vacuum.

3.1.5 Cushion (compressive) creep. A permanent loss of some percentage of thickness when placed under a constant load over a period of time.

3.1.6 Energy absorbing devices. For the purpose of this specification, energy absorbing devices are defined as container components employed to provide shock and/or vibration isolation. They may be composed of elastomers bonded to metal parts (commonly referred to as elastomeric shear mounts, shock mounts, resilient mounts or sandwich mounts) cushioning (open or closed cell plastic foams), spring assemblies (usually helical), torsion bars, cable isolators (utilizing wire rope) or single use energy dissipators.

3.1.7 Faying surfaces. Surfaces which are in contact with one another, but are not continuously joined together so as to prevent water intrusion between the two surfaces.

3.1.8 Fire retardant materials. Materials that do not ignite readily or propagate flames under small to moderate fire exposures. While these materials are combustible, their fire retardant nature tends to reduce the intensity and spread of fire, smoke and toxic products of combustion.

* **3.1.9 Flexible barriers.** Auxiliary non-rigid materials which primarily function to resist the penetration of water vapor and air permeance. Their secondary functions include: mechanical strength in tension, shear, impact and flexure, adhesion, elasticity, thermal stability, fire and flammability resistance, inertness to other deteriorating elements, ease of fabrication, applications and joint sealing.

3.1.10 Fragility levels. Fragility levels, or damage boundaries, are the limits below which damage or malfunction of the packaged item will not occur. They may be expressed by parameters such as maximum allowable shock response spectrum peak acceleration, pulse shape, and pulse duration, velocity change, bending moments, axial loads, shear loads, and surface pressure. An accurate determination of the fragility

level is necessary for the design of an efficient, economical container. Whenever possible fragility levels, or the damage boundary, of the item to be packaged should be determined by test.

3.1.11 Intermediate bulk container (IBC). IBCs are rigid, semi-rigid or flexible portable packagings that have a capacity of not more than 35.3 cubic feet are designed for mechanical handling and are resistant to the stresses produced in handling and transport, as determined by tests.

3.1.12 Minimum flow rate (relief valve). The minimum rate of flow (expressed in standard cubic feet per minute) required to allow a sufficient exchange of air through the relief valve in order to prevent damage to the container during handling, transportation and storage.

3.1.13 Noncombustible materials. Materials known to be inherently nonflammable such as steel and aluminum.

3.1.14 Reseal pressure (relief valve). The pressure(s) at which the container's relief valve reseals after being open.

3.1.15 Shock response spectrum (SRS). A plot of the peak responses of a large number of Single-Degree-of-Freedom systems, of differing natural frequencies, to a specific input transient. It gives an indication of the maximum dynamic loads various parts of equipment will experience, as a function of their natural frequency. Damping is almost always employed in the SRS calculations to avoid unreasonably high SRS peak responses. A comparison of the packaged item's allowable shock spectra to the test SRS is often used to determine relative damage potential.

3.1.16 Specialized shipping container. Specialized shipping containers are generally the long-life variety and are uniquely configured to support and protect a specific item, or limited variety of items, during handling, storage, forward and return shipment, unpackaging by the user, or to protect personnel and equipment from hazardous contents. Containers of this type frequently incorporate energy absorbing systems, temperature control systems, or special features to make handling or shipment possible, easier or safer. Engineering drawings, or equivalent, are used to define form, fit, function, materials, tolerances and manufacturing techniques. Specialized shipping containers, internal fixtures and other fitments result from original design efforts or the redesign or modification of an existing container to meet a specific application or need.

3.1.17 Springwood. The portion of an annual ring that is formed principally during the growing season; it is softer, more porous, and lighter than summerwood because of its higher proportion of large, thin-walled cells.

3.1.18 Standard parts and materials. Standard parts and materials are those parts or materials identified or described by military or federal specifications or standards, or an industry standard formally adopted by DOD for general applications. Standard parts and materials shall be used to the fullest extent possible.

3.1.19 Summerwood. The less porous, usually harder portion of an annual ring that forms in the latter part of the growing season.

3.1.20 Sympathetic detonation. Explosion caused by the transmission of a detonation wave through any medium from another explosion.

3.1.21 Transmissibility. The ratio of response vibration magnitude to input vibration magnitude.

$$TR = \frac{Response\ \ vibration\ \ magnitude}{Input\ \ vibration\ \ magnitude}$$

3.1.22 Underway replenishment at sea (UNREP). Either CONREP, vertical replenishment at sea (VERTREP) or a combination of the two.

3.1.23 Unit load. An assemblage of specialized shipping containers arranged and secured to permit easy handling as a single entity by common handling equipment. A unit load can also consist of a single large container or cradle. Materials handling pallets may or may not be used.

3.1.24 Vertical replenishment at sea (VERTREP). The transfer of material from ship-to-ship at sea by helicopter.

4. GENERAL REQUIREMENTS

4.1 General. Specialized shipping containers shall be designed to be consistent with the maintenance concept, with the planned distribution logistics of the contents, and to provide reliable protection at lowest life cycle cost to the contents.

4.1.1 Hazardous materials and devices. Containers designed for domestic and international shipment and storage of hazardous materials shall be designed to comply with the Performance Oriented Packaging (POP) requirements of both the Department of Transportation (DOT) Regulations, 49 CFR governing the transport of hazardous materials and service design requirements as specified herein. Container designs which exceed the weight limitations of 49 CFR or differ from the type of container prescribed by 49 CFR shall be certified as equivalent in accordance with NAVSUPINST 4030.50 (AFMCR 800-29, AMC-R 700-103, MCO 4030.39, DLAR 4145.37). Container designs which differ from the packaging type specified under DOT regulations can be used provided they are proved equivalent by testing and are acceptable to the competent authority.

4.2 Interfaces. Containers shall be designed to satisfy the following interfaces as a minimum.

4.2.1 Contents. The container shall be designed to be compatible with and protect the contents when subjected to tests prescribed herein.

4.2.2 Handling equipment. The container shall be designed to be compatible with designated handling equipment used throughout the logistic system including that used to pack and unpack the container.

4.2.3 Distribution network. The container, insofar as possible, shall be designed to move without restriction, special routing, or special escort throughout the material distribution system used by the Department of Defense. Details of the container design shall comply with the criteria established as part of the logistic analysis required by the Packaging, Handling, Storage, and Transportation (PHST) Program requirements. Handling and mobility features shall be incorporated into containers as required to facilitate handling and movement consistent with existing or planned equipment, facilities and procedures. Design, test and production of containers and packaging needed to conduct and support Development and Operational Test and Evaluation (DT&E and OT&E) and production shall be so accomplished as to assure their availability at the time and place required. They shall be suitable for use throughout the system program life without further major design and test effort unless program objectives, cost or schedules justify otherwise, or unless deficiencies are detected which require correction. The most cost-effective item-to-container design interface shall be determined using trade-off study techniques based upon program life cycle costs. Trade-off studies and transportability analyses shall be conducted to ensure compatibility between item, transportation, and handling equipment and to determine the most efficient and cost-effective packaging design required to satisfy functional requirements.

4.2.4 Unit load compatibility. Specialized shipping container designs which are to be formed into unit loads as a part of the logistic distribution plan shall have features which permit ready assembly into such unit loads. Appropriate tests shall be conducted, using the unit load configuration, to validate the integrity and suitability of the design features provided to the container. Requirements for unit loads of ammunition shall be as specified in MIL-STD-1660.

* **4.3 Configuration.** When required, configuration management practices shall be consistent with the invoked requirements of MIL-STD-973.

4.4 Transportability requirements. Specialized shipping container designs shall reflect consideration of techniques for truck, rail, air and ship loading to ensure that applicable Department of Transportation requirements are met, and that transportation costs are minimized consistent with safety considerations and container integrity (see MIL-STD-1366). Where military airlift is anticipated containers used as unit loads shall conform to the general design and performance requirements of MIL-STD-1791. For dimensional constraints and weight requirements, see MIL-STD-1366. For the definition of a transportability problem and reporting requirements, see Joint Regulation AR 70-44, (DOD Engineering for Transportability), OPNAVINST 4600.22A, AFR 80-18, MCO 4610.14B, and DSAR 4500.25.

4.4.1 Sensitive materials (transportation security). Containers shall be designed to be compatible with the requirements of DOD 5100.76-M when the container contents are "sensitive" as defined therein.

4.4.2 Transfer-at-sea (UNREP). Containers and container unit loads intended to be transferred-at-sea either by CONREP or VERTREP shall be designed to withstand the shocks of 5.2.8.

4.5 Cube and weight. Containers shall be designed for smallest cube and lightest weight consistent with protection of contents, durability, intended use, economy, safety, and ANSI MH 10.1M.

4.6 Materials and manufacturing methods. Standard commercially available materials and manufacturing processes shall be the first preference whenever feasible. However, the application of technological advancements in materials and processes is always encouraged where superior performance characteristics and economical considerations justify it. Paints, preservative treatments, coatings, additives, and so forth, shall meet or exceed the safety standards established by the Environmental Protection Agency (EPA) 40 CFR 261.24 and Occupational Safety and Health Act (OSHA) Public Law 91-596 and Executive Order 12191.

* **4.6.1 Cadmium-plated hardware.** Cadmium plating any part developed under this standard is discouraged and shall not be specified for North Atlantic Treaty Organization (NATO) containers. Cadmium plated standard parts such as small hardware items (such as nuts and bolts), may be used until current supplies are exhausted. It is recommended that zinc plating per ASTM B633 be utilized as an alternative.

4.6.2 Dissimilar metals. Dissimilar metal combinations shall be avoided as much as possible. When unavoidable, any or all of the following methods of corrosion prevention shall be implemented:

a. Appropriate surface treatments and coatings shall be applied to the material or materials in contact. If surface treatments and/or coatings are used, they must be resistant to physical removal, such as wear or abrasion, from the base metal being protected.

b. The design shall attempt to have the larger of the two dissimilar metals in contact as the anode.

c. The design shall attempt to use dissimilar metals which are as close to one another on the galvanic scale as possible.

4.6.2.1 Acceptance criteria. Dissimilar metal combinations shall continue to perform their functions. The following are cause for rejection:

a. Any corrosion which penetrates to a material depth that will render the design unsafe (no longer meet defined factors of safety from a strength stand point).

b. Any corrosion which allows penetration completely through the shell of a sealed or controlled breathing container.

c. Any corrosion which allows: surface coatings (ex., CARC), stenciled markings, adhesive backed labels, or any other items to lose their adhesion to the applied surface, inside or outside of the container, in such a way that they no longer meet their intended purpose.

4.6.3 Screw threads. Screw threads shall comply with FED-STD-H28 and all supplements thereto, or be in accordance with MIL-S-8879, MIL-S-7742 or ASME B1.1.

4.6.4 Rubber and synthetic rubber parts. All rubber and synthetic rubber parts of shock mounts shall be cure dated in addition to any other required marking. Cure date must be visible when elastomeric part is installed. If it is not, the cure date shall be stamped on the top surface of the elastomer with white waterproof ink.

4.6.5 Standard parts and materials. Standard parts and materials shall be used unless they are technically or economically impractical. Items and processes shall be selected or tailored from existing standards, specifications and technical data packages (or an individual drawing) which are technically suitable in every respect for the intended application. Factors, such as function, environment, quality, transportability, reliability, strength, safety and interchangeability shall be considered in the selection to satisfy the design parameters in every respect. The use of a standard, specification, technical data package (or individual drawing) or other document does not, in itself, ensure the suitability of an item or process for any specific application. A listing of common standard parts which may be used on appropriate applications for Navy containers is given in table I.

4.6.6 Material stability. All material used shall be stable after prolonged exposure to extremes of temperature and humidity which may be reasonably encountered during the expected logistic cycle. In this sense, stability shall be considered after return to room conditions and shall be construed as freedom from the following defects:

a. Change of state of the material, (such as crystallization, hydrolytic conversion, and so forth).

b. Permanent deformation which adversely affects serviceability under normal static load pertinent to the manner in which the material is used, (such as sagging or irreversible creep).

c. Significant changes in physical properties, (such as degradation in modulus of elasticity).

* TABLE I. Common standard parts for Navy containers.

Description	Commercial Specification	Navy Drawing	648 Section
Access Port		6212707	4.9 4.15.4.4
Holder, Records		799AS105 5166322	4.9 4.9
Latch		5167756 6213102	4.10 4.10
Latch, Wide Handle		6212861	4.10
Desiccator	SAE AS 5135	6212868	4.15.4.4
Plug, Humidity Indicator	SAE AS 26860	5166628	4.15.4.5
Valve, Breather	SAE AS 27166	6212863	4.15.4.11
Observation Window		6212706	4.15.4.13
Handle		6212630	4.17.2
Rings, Container Lift		6213762	4.17.3
Shackle		6212862	4.17.3
Fork Pocket		5167633 5167693	4.17.6.1 4.17.6.1
Extrusion, Endlift		5167399	4.17.7.a
Endlift-Adapter		5167401	4.17.7.a
Center Lift		3214AS110	4.17.7.b

4.6.7 Internal packaging materials.

4.6.7.1 Materials compatibility. Internal packaging materials shall not adversely affect the contents because of incompatibility of chemical and hygroscopic properties. Where packaging materials are placed in direct contact with the contents, the design shall provide adequate protection to the contact surface(s) of the contents.

4.6.7.2 Blocking and bracing materials. For those unique specialized shipping containers whose logistics requires internal wooden blocking and bracing, design guidance is as follows:

a. Wood or plywood may be used alone or in combination for blocking and bracing. Wood or plywood blocking and bracing members shall bear against only those parts of the packed item

capable of withstanding the applied dynamic forces or shall bear against blocking pads or pressure strips that adequately distribute these forces. Wood or plywood blocking and bracing shall be designed to permit easy removal without damage to the item. Strengths of wood and plywood members may be calculated from information given in USDA Agriculture Handbook No. 72.

b. Wood used for blocking and bracing shall be of sufficient structural quality for the application. One wood member of each size and type used in the blocking and bracing shall be tested for moisture content just prior to use. Structural members (those subject to critical bending stresses) shall possess a maximum allowable width of knots of two inches, but not over one-quarter of the width of the wood member and a maximum slope of cross grain of one in ten. All other blocking and bracing members that are nonstructural shall possess a maximum allowable width of knots of four inches, but not over one-half of the width of the wood member and a maximum slope of cross grain of one in eight. Whenever possible wood blocks or braces shall be socketed or fitted and secured into appropriate notches in load-bearing members.

c. Plywood used for blocking and bracing shall conform to A-A-55057 type B.

d. Nails shall conform to the requirements of specification FF-N-105. All nails that are not clinched shall be cement coated, etched or mechanically deformed (helically or annularly threaded). Unclinched nails shall be as long as practicable without splitting the material, but not shorter than three times the thickness of the member holding the nail head for ten penny nails and smaller, or not shorter than the thickness of the same member plus one and one-half inches for twelve penny nails and larger. Nails loaded in shear blocking and bracing joints need not be clinched. End grain nailing in solid wood or edge nailing in plywood shall not be permitted. Nails shall be driven through the thinner member into the thicker member wherever possible. Nails shall not be subject to withdrawal stresses. Nails shall be driven not closer to the end of a piece of lumber than the thickness of the piece and not closer to its side than one-half of its thickness. There shall be at least two nails in each joint. Lateral loading of nails for blocking and bracing shall be in accordance with table II.

TABLE II. Lateral loading of nails.

	Load, pounds per nail								
Species of Wood	**4d**	**6d**	**8d**	**10d**	**12d**	**16d**	**20d**	**30d**	**40d**
Group I	14	17	21	25	26	29	38	42	48
Group II	21	26	32	39	40	45	58	65	73
Groups III & IV	26	32	40	48	49	55	71	80	90

Ends of blocks and braces shall not be fastened to a wood container by end-grain nailing, toe nailing, or similar methods but shall be fastened to a sturdy part of the container or held in place by parallel cleats or other side-grain nailing methods. Blocking and bracing shall be applied against areas of the item(s) that are of sufficient strength and rigidity to resist damage.

i. Group I species of wood consist of:

Aspen (poplar)	Cypress	Red alder
Basswood	Fir (true firs)	Redwood
Buckeye	Magnolia	Spruce
Cedar	Pine (except southern	Willow
Chestnut	yellow pine)	Yellow-poplar
Cottonwood		

Group I embraces the softer woods of both the coniferous and the broad-leaved species. These woods are relatively free from splitting in nailing, have moderate nail-holding power, moderate strength as a beam and moderate shock-resisting capacity. They are soft, light in weight, easy to work, hold their shape well after manufacture, and as a rule are easy to dry.

ii. Group II species of wood consist of:

Douglas-fir	Southern yellow pine	Western larch
Hemlock	Tamarack	

Group II consists of the heavier coniferous woods and includes no hardwood species. These woods usually have a pronounced contrast in the hardness of the springwood and the summerwood. They have greater nail-holding power than the group I woods, but are more inclined to split and the hard summerwood bands occasionally deflect the nails and cause them to run out at the side of the piece.

iii. Group III species of wood consist of:

Ash (except white ash)	Soft elm	Sycamore
California black oak	Soft maple	Tupelo
California maple	Sweetgum	

Group III consists of hardwoods of medium density. No coniferous species are included. These woods have about the same nail holding power and strength as a beam as the group II woods, but are less inclined to split and shatter under impacts. Group III species are the most useful woods for box ends and cleats. They also furnish most of the rotary-cut veneer for wire bound and plywood boxes.

iv. Group IV species of wood consist of:

Beech	Hard maple	Pecan
Birch	Hickory	Rock elm
Hackberry	Oak	White ash

Group IV woods are hardwood species. They have both the greatest shock-resisting capacity and the greatest nail-holding power, but because of their extreme hardness, they present difficulties with respect to the driving of nails and also have the greatest tendency to split at the nails. They are the heaviest and hardest domestic woods and are difficult to work. They are especially useful where high nail-holding power is required and many of them make excellent rotary-cut veneer for wire bound and plywood boxes.

e. Bolts shall be used as fastenings for wood or plywood blocking and bracing where necessary to facilitate disassembly for removal of container contents. Bolts shall also be used for fastening, blocking and bracing members that are too thick for proper fastening with nails. Bolt holes in wood or plywood shall be of the same diameter as the bolts. A flat washer of proper size shall be used under the nut of each bolt. Bolts, nuts and washers shall conform to the requirements of ASME/ANSI B18.5 and ASME/ANSI B18.9 with ASME/ANSI B18.18.1M.

* **4.6.7.3 Cushioning materials.** Wherever practical, materials conforming to Government specifications or Government-adopted industry specifications shall be used in preference over those conforming to other industry specifications. Unless justified, materials conforming solely to manufacturers specifications shall be avoided. Refer to MIL-HDBK-304, section 5.0, for cushion characteristics important to container design. In addition to these characteristics, consideration shall be given to the following:

a. Cushion assemblies in reusable containers should be suitably located in, or attached to, the interior of the containers so that cushioning is applied at the intended areas. The attachment should not be so permanent as to prevent replacement of the cushion.

b. Where molded shapes are used, surfaces having a skin should be in contact with the packaged article if material compatibility exists and if consistent with other objectives of the cushion.

c. Cushion (compressive) creep should be consistent with the life or maintenance cycle of the container.

d. The cushion's ability to absorb and retain moisture should be considered in the event that the container's logistic cycle dictates use in cold environments where any retained moisture will freeze and stiffen the cushion system. Closed cell foam systems should be used whenever possible.

* e. When the container's contents are susceptible to damage by electrostatic discharge (ESD), the cushioning material shall have an average decay time of not greater than 2.0 seconds when measured in accordance with Method 4046 of FED-STD-101. The resistivity of surface conductive cushioning material shall be equal to or greater than 1.0×10^5 ohms per square but less than 1.0×10^{12} ohms per square. The resistivity of volume conductive cushioning material shall be 1.0×10^4 ohm-cm but less than 1.0×10^{11} ohm-cm. Surface and volume resistivity shall be measured in accordance with ASTM D257 and ASTM D991. Use MIL-STD-1686 as a guide for the control of electrostatic discharge conditions.

4.6.7.4 Resilient mounts. Resilient mounts shall be designed to meet the shock and vibration requirements of 5.2 and 5.3, respectively, of this standard. The resilient materials shall be resistant to aging and deterioration and shall be capable of meeting all performance requirements following exposure to the tests of 5.4.

4.6.7.5 Dynamic characteristics. Materials for use in shock or vibration attenuation systems shall protect the contents to fragility levels established by the designer of the contents; preferably by actual fragility assessment testing. The required tests of section 5 of this standard shall be the criteria by which this requirement is satisfied.

4.6.8 Interchangeability. All parts having the same part number shall be directly and completely interchangeable with respect to installation and performance.

4.6.9 Support fasteners and closure devices. All support fasteners and closure devices shall have mechanical provisions to prevent loosening, such as self-locking nuts, safety wiring, or other suitable devices.

4.6.10 Wood preservation. Generally, a protective finish need not be applied to wood containers (boxes/crates) pallets or finished wood products, however, the wood members must be impregnated with a preservative suitable to prevent deterioration in accordance with TT-W-571, TT-W-572, or another nonhazardous preservative. If a protective finish is required, the finish shall meet the paint requirements of 4.19.1.

* **4.6.11 Nonmetallic materials.** Nonmetallic materials shall not produce more than one percent permanent deformation when loaded to one and one-half times the rated load measured 24 hours after removal of the load. To avoid creep, the design load should be selected in the range of one-tenth to one-fifth of the breaking strength; the former being preferred. In addition, the material shall withstand a load not less than five (5) times the rated load without any sign of failure.

* **4.6.12 Corrosion.** All metal parts of the container, both internal and external, shall be protected from corrosion. Parts shall show no sign of corrosion, pitting or scaling when exposed to 12 hours of salt spray per ASTM B117. For containers meant for use aboard ships, or near marine environments, parts shall show no sign of corrosion, pitting, or scaling when exposed to 96 hours of salt spray per ASTM B117.

4.7 Fire resistance. Containers intended for use aboard Naval ships shall utilize packaging materials that are either noncombustible or fire retardant and meet the requirements of 5.11.

4.8 Drainage. To the maximum extent practical, free drainage shall be provided in the normal storage position, (for example, all pockets on the exterior of containers shall have provisions for drainage). Where containers are of such size that water cannot be conveniently poured out of the lower shell, drain plugs may be included in the design at locations where water is apt to collect. The drain plugs are not a requirement of all containers, they are only necessary when unique elements of the container's logistics cycle dictate their use. When drain plugs are employed either in sealed or controlled breathing containers, they shall maintain a seal integrity equal to or greater than the overall containers allowable leakage pressure rating. All containers shall have all faying surfaces and discontinuous welds filled with a sealing compound conforming to SAE AMS 3269, SAE AMS 3281 or other suitable sealing compound, in areas where water intrusion may result in damage to the container.

4.9 Records receptacle. When the container's contents are to be accompanied by pertinent records (such as logbooks and so forth), a suitably-sized externally accessible watertight record receptacle shall be provided. If a Navy standard part is desired for this application, see the reference for records holder in 4.6.5. If permitted by the logistics associated with the container's contents, the receptacle may be located within, and protected by, the interior of a sealed or controlled-breathing container. If a Navy standard part is desired for this application, see the reference for access port in 4.6.5. Otherwise, the receptacle shall be a separate enclosure, and if additional protection is required for the records, it shall provide an environment controlled to specified limits.

4.10 Closure devices. Latches or other closure fasteners shall permit rapid packing and unpacking without the use of tools other than standard issue (such as screwdriver or wrench). All such fasteners shall be captive to the container and shall be either recessed or provided with a protective guard. The requirement for rapid packing may be waived for those containers which will not be opened frequently for maintenance or inspection and which contain materials not likely to be urgently needed. When elements of the container's logistics cycle dictate, the rapid packing and unpacking shall be accomplished while wearing arctic gloves. If a Navy standard part is desired for this application, see the reference for latch and wide handle latch in 4.6.5.

* **4.11 Static electricity.** The effect of static electricity on the contents of the container and the environment in which it will be unloaded shall be considered in the design of the container. Use MIL-STD-1686 (which defines and classifies ESD sensitive items) as a guide for the control of electrostatic discharge conditions. In those instances where a potential hazard exists, the design shall prevent buildup of a static charge or provide a conducting path to ground by one or more of the following practices:

a. Firm metal-to-metal contact shall be used to provide an acceptable ground.

b. Items suspended in a shock-mounted cradle shall be grounded to the container structure. If the container structure is nonmetallic, a clearly identified metallic external grounding connection shall be provided. The maximum resistance of the ground path is dependent on the acceptable limits of the container's contents. If no maximum resistance is known, then the maximum resistance of the ground path shall be one ohm.

c. Flexible barriers shall discharge to ground (a grounding connection to structure shall be provided) in 2 seconds when tested in accordance with Method 4046 of FED-STD-101, with the following conditions:

(1) Definition: Decay time is defined as the time it takes to dissipate 99% of the initial 5000 volt charge (both positive and negative).

(2) Change to test environment: Testing shall be performed in an atmosphere maintained at $73^{o} \pm 5^{o}F$ ($23^{o} \pm 5^{o}C$) and 12 ± 3 percent relative humidity.

(3) The average value for the specimens (three required) tested for each exposure condition (as received, after aging, and after shower exposure) shall meet the requirement as listed in table III. Only conductive flexible barriers shall be used for explosives or materials which generate flammable vapors or for devices which are sensitive to static electricity.

d. Plastic material in contact with the contents shall be conductive or shall be surface treated to reduce static charge buildup.

TABLE III. Expected temperature extremes.

Minimum extremes for all containers	Typical extremes for ground troop usage
-20 ± 5°F	-65 ± 5°F
+140 ± 5°F	+160 ± 5°F

4.12 Preservation. Containers shall be designed to be compatible with methods of preservation selected for the contents.

4.13 Clean-room operations. The container system shall be designed to be compatible with clean-room operations and maintain required component cleanliness during shipment and storage, whenever such requirements exist. Clean-room criteria shall be as defined in FED-STD-209.

* **4.14 Security seal.** The container shall be designed to enable detection of unauthorized entry. Unless designed for a specific security seal, security seal holes in both the cover and base shall be 3/8 inch (9.5 mm) diameter or larger. When security seals are used to enable detection of unauthorized entry the following provisions must be accounted for:

a. As a minimum two seals must be installed on the container.

b. As a minimum seals must be on diagonally opposite corners, sides or ends.

c. The seals must be attached to the container in such a way that separation of the container's cover from base will result in the removal / breakage of the seal.

d. The seals must be protected from damage during normal handling operations.

Seals may take many forms such as: adhesive backed stickers, wire rope with lead seals or flat strip seals. Depending on the style selected provisions must be included for their installation and removal. For adhesive backed stickers sufficient area must be provided for on the container for their installation and for security seal information to be scribed on the base material. The base material must also be manufactured using appropriate materials such that the seal information will not be lost due to environmental conditions that the container is subjected to, and that any tampering with the information is clearly evident. For wire rope with lead seals or flat strip seals sufficient provisions must be integral to the container's base and cover structures to allow for installation based on their geometry.

4.15 Protection of contents against corrosion and water damage.

* **4.15.1 General.** The nature of the contents and the expected environments encountered in the logistic pattern determine the type of container and its closure and sealing requirements. Design criteria for the various classes of container sealing are provided in 4.15.2 through 4.15.4.

4.15.2 Closed containers without auxiliary barriers. These are conventional boxes or crates which are both unit containers and shipping containers; but the class also includes ventilated metal shipping containers. Larger containers, and containers with contents which fill the enclosed volume only partially, should incorporate provisions for ventilation and drainage as follows:

4.15.2.1 Ventilation. Ventilators shall be placed in the ends of containers but in such fashion as not to interfere with primary structural members. Louvered metal ventilators, slotted ventilators, or drilled hole ventilators shall be screened on the inside with 1/16 inch or smaller galvanized or aluminum wire cloth. Slotted ventilators (without external louvers) and drilled hole ventilators shall also be furnished with an interior baffle structure designed to trap driving rain, draining to the outside. Except for lumber sheathed crates, total surface area of ventilating openings shall be not less than 0.15 square inch per cubic foot of container volume. Maximum size of any one slot in a ventilator shall be 4 x 12 inches. For lumber sheathed crates, drilled hole ventilators, with each hole drilled upward as viewed from the outside on a 45° angle, may be used. Holes shall be 3/4 inch in diameter. The number of holes shall be not less than one hole per 20 cubic feet of the container volume. Holes may be clustered in each end or may be uniformly spaced about the periphery of the crate.

4.15.2.2 Drainage. Each low point in the container shall be furnished with a drain hole so located as to freely drain all water which might collect in the affected area. For flat bottomed containers one drain hole shall be provided in each corner of a potential water trap in the base. Satisfaction of this requirement can also be achieved by spacing lumber floor board members approximately 3/8 inch apart and cover with screen as specified in paragraph 4.15.2.1.

* **4.15.3 Closed containers with auxiliary barriers.** Design features of these containers are essentially the same as those previously described (see 4.15.2) except that provision is incorporated for use of an

auxiliary water vapor barrier of sufficiently low water vapor transmission rate (and desiccant contained therein) to provide Method 50 preservation as defined in MIL-STD-2073-1.

4.15.4 Integral-barrier containers. Containers of this class use the container walls to form the protective barrier. The controlled breathing type of integral barrier container is most commonly specified or chosen. One of the other two types; non-breathing or free breathing may be specified or justified based on size considerations, the expected logistics flow, or cost-effectiveness. The following features shall be provided in all integral barrier containers.

4.15.4.1 Structural. Integral-barrier containers shall be designed to meet the pressure requirements of 5.5.

4.15.4.2 Leakage. Integral-barrier containers shall be sufficiently leakproof to meet the requirements of 5.6.

4.15.4.3 Closures (except removable head drums). Mating surfaces shall be resistant to mechanical damage and prevent gasket overloading. Assembly guides shall be provided when appropriate to assure alignment of mating surfaces and to prevent shear action on gasket surfaces. The removable cover shall be designed such that the gasket sealing surface is protected from mechanical damage while the cover is apart from the base during container loading/unloading operations. Preformed gaskets or seals that can be readily replaced and which are retained in place by the structure shall be used. Gaskets shall conform to ASTM D2000, unless otherwise specified, and be of the class and grade required to be compatible with any content, service liquid lubricants, or liquid fuels shipped therewith. Molded one-piece gaskets are preferred but joints may be cemented or joined by vulcanizing, provided the joints are the same dimensions as any other place on the gasket and that all minimum tensile strength characteristics specified by the container specification are met. If no minimum is specified, a value of 40 percent shall be used. Nominal gasket compression shall be 15 to 25 percent unless specifically designed otherwise, and sufficient to meet the pressure and/or leakage requirements of 4.15.4.1 or 4.15.4.2, respectively.

* **4.15.4.4 Desiccant storage.** Where applicable, a refillable enclosure shall be provided for bagged desiccant conforming to MIL-D-3464. Volume of desiccant is approximately 3 cubic inches per unit of desiccant. For containers requiring large quantities of desiccant, 8 unit bags are commonly used. The approximate dimensions of those marginally flexible bags are: 3.5 inches (89 mm) x 6.5 (165 mm) inches x 1 inch (25 mm). The size of the enclosure shall be such that a sufficient volume exists to contain the proper quantity of desiccant required in accordance with MIL-STD-2073-1. If a Navy standard part is desired for this application, see the reference for desiccator in 4.6.5. Air enclosed in the container shall have free access to the desiccant bed. When the container's logistics dictate that the desiccant be easily removable/refillable without removing the container's cover, a desiccant port shall be supplied. The port shall have a minimum opening dimension of 3.5 inches (diameter). The port shall be positioned such that all spent desiccant bags from the enclosure may be removed through the port and subsequently refilled through the same port. If a Navy standard part is desired for this application, see the reference for access port in 4.6.5. When allowed by the container design, the desiccant shall not be located in the container as to come into direct contact with any accumulation of condensate (for example, on the container's walls). The desiccant port cover shall be capable of being removed and replaced by hand without the use of tools.

4.15.4.5 Humidity indicator. A humidity indicator, conforming to SAE AS 26860 or as specified by the design activity, shall be provided in all dehumidified packages. The inside of the container shall be configured to provide free access of the enclosed air to the indicator. Electrical humidity-indicating devices may be used, provided the logistic flow indicates prolonged storage in one place. The content's sensitivity to moisture shall dictate the percentage of relative humidity which is to be sensed for each specific design. If required, the humidity indicator shall be designed such that the indicator card may be replaced without removing the cover of the container. The humidity indicator shall be located apart from the desiccant storage area while remaining on the same end of the container, unless otherwise dictated by the container's maintenance logistics. If a Navy standard part is desired for this application, see the reference for humidity indicator plug in 4.6.5.

4.15.4.6 Pressurizing fitting. When required for pressure or leak testing, each container shall be provided with a 1/8-inch NPT boss for convenient installation of a pressurizing fitting. The threaded boss shall be closed with a 1/8-inch pipe plug. As an option, each container shall be provided with a standard size tire valve in conformance with SAE AS 5017. The tire valve shall be corrosion resistant. When the container's logistics permit, the container's pressure equalizing valve may be removed and the resulting port be used for the installation of a pressurizing fitting of a corresponding size.

4.15.4.7 Leakage indicator. When the packaged items contain toxic or flammable liquids or gasses, (for example, Class A or B poisons) externally visible indicators shall be located at both ends of the shipping container to detect leakage of the packaged item into the shipping container. For mixed amine fuels and for fuming nitric acid, the indicator shall conform to MIL-I-81508. For Fuel Air Explosive Bombs containing either ethylene oxide or propylene oxide the indicator shall conform to NAVSEA Drawing 2602910, NAVAIR Drawing 2877628, or Army Drawing 13222E3855.

4.15.4.8 Container accessories. Valves (except drain valves), humidity indicators, record receptacles, pressure fittings, desiccant ports, leakage indicators, umbilical connectors and so forth, that are subject to routine inspection shall be grouped in one end of the container, unless the size of the container would warrant placement of an accessory item in more than one location or unless the logistics of the component dictate another location (for example, observation windows require either one on each end or one on each side). All container accessories (such as desiccant port, records receptacle) possessing removable covers shall have them captive to the container by lanyards or other suitable means.

4.15.4.9 Transparent window in auxiliary barrier. Where a transparent window is used in the auxiliary barrier to permit viewing an internal indicator, either a corresponding opening with a readily-openable cover or an observation window shall be provided in the container. If a Navy standard part is desired for this application, see the reference for observation window in 4.6.5.

4.15.4.10 Special requirements for non-breathing integral-barrier containers. Except for smaller sizes of standard drums (15 gallons or less) a simple, manually-operated bleeder valve to equalize pressure before opening shall be provided.

4.15.4.11 Special requirements for controlled-breathing integral-barrier containers. Unless otherwise specified, each container shall be provided with a pressure and a vacuum relief valve in conformance with SAE AS 27166. A simple, manually-operated bleeder valve shall also be provided to

equalize pressure before opening the container. This valve may be integral with any required automatic relief valve. Container designs shall be based upon the design and testing requirements of 5.5.2.1 and 5.6.2.1 unless superseded by the operational logistics requirements of the container and it's contents. If a Navy standard part is desired for this application, see the reference for breather valve in 4.6.5.

4.15.4.12 Special requirements for free-breathing containers. Free breathing should be considered only for very large structures where pressure tightness, on the order of one pound per square inch gage (psig), is not a practical design solution. A refillable desiccant breather unit with each container shall be provided. The breather unit shall have the following general characteristics:

a. The breather shall be designed to accommodate one ounce of Type I, Grade H, MIL-D-3716, desiccant per cubic foot of empty container volume.

b. A sight glass on the container side of the desiccant bed shall be provided to determine bed exhaustion.

c. End filters and plenum chambers to assure air flow distribution over the full face of the bed shall be provided. Filter characteristics shall be determined by cleanliness requirements of internal voids and desiccant particle size.

d. Spring loaded devices, or their equivalent, shall be provided to prevent development of voids in the breather charge resulting from packing or reduction of charge particle size.

e. Openings to ambient environment shall face downward and shall have a length-to-diameter ratio of at least 10 to 1.

f. Minimum flow rate through breather shall be 6 percent of container volume-per-minute at design pressure.

g. Provisions for a charge of MIL-D-3464 desiccant shall be provided to assist in initial drawdown and to compensate for sudden weather changes. The size of the charge shall be in accordance with the rigid barrier formula of MIL-STD-2073-1.

4.15.4.13 Observation window. When the container or contents' logistics so require, observation windows shall be placed in each end or each side of the container such that an unbroken light path will indicate that the container is void of its intended contents. If a Navy standard part is desired for this application, see the reference for observation window in 4.6.5.

* **4.15.4.13.1 Alternate observation window location.** When necessary the design agent may specify as an alternative the installation of observation windows on the same surface (side or end) six (152 mm) to 24 inches (610 mm) apart. The windows' opening must be large enough to allow the user to clearly identify whether the container is loaded or empty.

4.16 Stacking and stowing.

4.16.1 General. Containers shall be capable of being stacked in warehouses or magazines and stowed in ships for prolonged periods. Open storage capability is required for all troop issue containers, for all containers which will be transferred at sea, and in other cases as specified by the design agency. For items requiring insensitive munitions protection, consideration should be given to designing the stacking features such that containers can be stacked forward to forward or forward to aft, interchangeably.

4.16.2 Stacking stability. Design features shall assure a stable stacking configuration. Stacking stability provisions shall, in general, include positive means for restricting relative displacement under impact or internal loads encountered in shipment, as a result of ship motion, during truck deceleration and/or rounding of curves or multiple package handling and shall meet the requirements of 5.2.7.1. Where the interface between like containers is wood-to-wood, fiberboard-to-fiberboard, or combinations of these two materials, the design may utilize friction and palletizing or carloading procedures in combination to achieve a stable load. Flat-surfaced metal, plastic, or fiberglass containers shall be provided with interlocking dimples, ribs, or panels to provide longitudinal and transverse (lateral) restraint. Stacking brackets (with interlocking features) and tie bars, where required, shall be furnished to provide vertical as well as longitudinal and transverse (lateral) restraint. When containers are stacked (vertically) there shall be no provisions in the load path that are allowed to move rotationally or otherwise. If structural provisions in the vertical load path must be removable to meet special handling logistics requirements (i.e. for removal or loading clearances) they must be designed in such a way that they be rigid when in the installed orientation. The use of Technical Report 93003 shall be used to determine the stability of container stacks.

4.16.3 Stackability. Unless justified by logistic considerations, each container shall be designed to support a load of like containers placed thereon in orderly fashion. The total load shall be determined by the procedures of Method 5016 of FED-STD-101 except that a safety factor of 1.5 shall be used for containers to be stowed or transported aboard ships for level A packs. To qualify for Performance Oriented Packaging (POP) testing, the test time shall be 24 hours and a safety factor of 1.0 shall be used. Provisions shall be included in the container's design that allow for easy stacking interface of containers. These interfaces may also serve as the interlocking features described in 4.16.2. If the container's logistics dictate, it may be desirable to provide visual alignment marks on the container's cover and base to assist operators during stacking operations. These marks may be in the form of stampings, etchings, engravings, stencillings, etc.

4.16.4 Distributed load. The top structure of large flat-topped containers, such as crates, shall be designed to carry a uniformly distributed long term static load and meet the requirements of Method 5017 of FED-STD-101.

4.16.5 Stacking strength. Stacking strength for like-on-like containers shall be determined in accordance with the test of 5.7.2. If the containers are to be shipped by rail flatcar, the stacking provisions shall also meet the requirements of 5.2.7.1.

4.17 Handling.

4.17.1 General. Specialized shipping containers shall be provided with lifting, hoisting, and tiedown provisions commensurate with their weight, size and intended mode of transportation to ensure safe and

efficient movement. Handling provisions for overhead lifting shall be designed as much as possible to avoid lifting through welded joints.

4.17.2 Lifting. Handles or handholds shall be provided on all containers between 70 and 150 pounds inclusive, gross weight. However, when the logistics of container dictate, handles or handholds, may be provided on lighter or heavier containers. If four handles are used, they shall be located conveniently about the center of balance of the container for two-person lifting (exceptions may permit multiple person lifting provided adequate handles are included in the design). If two handles are used, they shall be located on the short sides above the center of gravity. When required by the design activity, handles or handholds may be required on containers of under 70 pounds gross weight to permit convenient one-person handling. Containers may employ molded-in or structurally integral handles provided the requirements of 4.17.2.1b through 4.17.2.1e are met. If a Navy standard part is desired for this application, see the reference for handle in 4.6.5.

4.17.2.1 Handle characteristics. Handles shall have the following strength and design features:

a. Handles shall swing freely down against the side of the container when not in use, while in the normal storage orientation, and stop open at approximately a 90 degree angle when in the handle's lifting position.

b. For handle loads in excess of 40 pounds, the grip diameter shall be not less than 1/2 inch, the clear inside dimension shall be not less than 4¼ inches in length and 2 inches in depth. For use with arctic mittens, these dimensions shall be 5¼ inches in length and 3 inches in depth. When the container's shell is a Military Standard (MS) drum, the handle opening sizes may be relaxed by the design activity if all of the container's handling logistics can still be accommodated.

c. When handles are used to lift the loaded container, they shall meet the strength requirements of 4.17.3.

d. Handles used to lift empty containers or covers shall be clearly labeled to avoid misuse. They shall meet the strength requirements of 4.17.3 except that three times the weight of the object to be lifted shall be used.

e. Handles used as tiedown provisions shall meet the strength requirements of 4.17.4.

f. Handles intended for use with two hands shall be a minimum of 9½ inches in length and 3 inches in depth.

4.17.3 Hoisting. Means shall be provided for hoisting all specialized shipping containers weighing more than 150 pounds gross weight. Hoisting provisions shall result in safe and stable handling, compatible with the intended logistic cycle (for example, containers intended for airdrop shall meet the requirements of MIL-STD-814 and MIL-STD-1791, containers intended for transfer-at-sea shall be compatible with the transfer system, and containers intended for shipboard use shall have provisions to make them compatible with common shipboard handling equipment used in limited-access stowage areas).

Unless otherwise specified, containers which are to be transported via VERTREP shall be certified for external air transport (EAT) by rotary wing aircraft. The hoisting provisions of these containers shall conform to the requirements of MIL-STD-209. If a Navy standard part is desired for this application, see the references for shackle and container lift rings in 4.6.5.

4.17.3.1 Hoisting provisions. Hoisting provisions shall have characteristics and be located as follows:

a. Hoisting provisions shall meet the minimum hoisting strength requirements of 5.8. The tests require that each hoisting point be capable of lifting the total gross weight of the container, or unit load if it is to be so shipped, by single-point suspension.

b. Hoisting provisions which are to be used as tiedown provisions shall meet the strength requirements of 5.8.

c. Where containers are to be assembled into unit loads without pallets, the set of hoisting provisions shall be capable of supporting five times the total gross weight of the unit load.

* d. When practical, hoisting provisions shall be placed as far from the loaded center of balance as practical to provide the greatest handling stability. Consideration should be given to specific hoisting sling configurations which may be used so that the spacing of the hoisting provisions will not result in sling leg angles with the horizontal of less than 30 degrees, 45 degrees preferred. If the sling configuration is not known, lift rings should not be placed more than 120 inches (3048 mm) apart.

e. Unless the configuration of the hoisting sling is known, strength of the fittings and supporting structure shall be based on sling leg angles of 30 degrees to the horizontal.

f. Hoisting provisions shall not protrude beyond the container envelope when not in use.

g. When practical, hoisting provisions shall not be placed at locations which require the container closure fittings to carry the lifting loads (for example, containers having a removable top section or cover shall not have the hoisting provisions located on the cover). However, when cover weights approach or exceed the weight limitation for a two-person lift, hoisting provisions, clearly labeled "COVER LIFT ONLY" may be utilized in the cover design.

h. The hoisting fittings shall have a clear inside opening large enough to accommodate all handling equipment which will be employed through it's logistics cycle. If the container's logistics are not known, the hoisting fittings shall have a clear inside opening of at least 2½ inches.

i. Unless specifically permitted otherwise, wire rope or other materials which are capable of fraying shall not be used for the construction of hoisting fittings.

j. Hoisting fittings shall be replaceable without damaging, or requiring alteration of any other part of the container.

4.17.4 Tiedown. A minimum of four tiedown provisions shall be provided on all containers for nuclear weapons. Tiedown provisions shall also be provided on all specialized shipping containers having a gross weight of 1,000 pounds or more. Containers designed to be handled only by fork lift trucks and shipped in limited transport modes do not require tiedown provisions. If the container's design permits, the hoisting fittings may also be utilized as a provision for tiedown. Tiedown attachment design shall be guided by the following:

a. Tiedown provisions for containers to be shipped by air shall meet the general design and performance requirements of MIL-STD-1791 and the test requirements of 5.8. They shall be compatible with the attachment points on aircraft floors which, in general, have a capacity of 5,000 pounds or greater and are placed on 20 inch centers.

b. The strength of each fitting shall be such that, when they are used according to normal practice, the set of fittings will restrain the container when subjected to the loads incident to the intended logistic cycle of the container or to the acceleration loads provided in table IV (whichever is greater).

c. Where tiedown provisions are required, not less than two on each of the longest sides shall be used.

d. Tiedown provisions shall be located as high on the container structure as practical to provide optimum balance of restraint vectors.

e. Clear inside diameter of the tiedown provisions shall be the same as that required for the hoisting provisions (see 4.17.3.1h).

TABLE IV. Acceleration loads for containers.

Direction	Load Factor	Criteria
Up	2.0 G (3.7 G for nuclear cargo)	Without loss of serviceability.
Down	4.5 G	Without loss of serviceability.
Forward	3.0 G	Without loss of structural integrity.
Aft	1.5 G	Without loss of structural integrity.
Lateral	1.5 G	Without loss of structural integrity.

4.17.5 Skids. Skids or rubbing strips shall be provided on all containers over 40 inches in the longest dimension and exceeding 150 pounds gross weight. They shall be arranged to permit handling by forklift

trucks and shall permit easy blocking and bracing in carloading and truckloading. Preferred orientation of skids is parallel to the long dimension of the container base, if consistent with meeting forklift capability requirements. Any ramping of skid ends to accommodate skidding of containers shall be kept to a minimum (15 degrees ramp angle is recommended with a maximum ramp rise of 3/4 inch) to minimize blocking and bracing problems. Additionally, the protrusion of skid ends beyond the end of the container shall be limited to the minimum length necessary for protecting the container surface and accessories. The design activity may incorporate inseparable skids into the container's shell or frame. For containers whose unique logistics dictate the use of wooden skids, the wooden members shall be fabricated from Group II, III, or IV woods of 4.6.7.2 and impregnated with a preservative suitable to prevent deterioration in accordance with TT-W-571, TT-W-572 or another nonhazardous preservative suitable to prevent deterioration. Skid attachments shall meet the shock test and the forklift truck compatibility test of 5.2.7 and 5.9, respectively.

4.17.6 Forklift truck compatibility. Containers of over 40 inches in the longest dimension or over 150 pounds gross weight shall be capable of being handled safely from at least two sides (four-way entry is preferred) by forklift trucks of rated capacity appropriate to the gross weight and geometry of the container. When unique logistics of the container so require, smaller containers shall be designed to permit forklift handling. In such cases, the dimensions and spacing of forklift openings may be compromised as necessary; a vertical clearance of 1.5 to 3.0 inches, with no enclosure features, may be adequate.

* **4.17.6.1 Forklift truck opening.** Provisions shall be provided to permit access and handling by forklift truck. Containers having a length greater than 90 inches (2286 mm) long and containers requiring fork lift interface which are handled aboard ship or as dictated by the container's logistics, shall have completely enclosed fork tine pockets which straddle the center of balance. Containers requiring fork lift interface are those whose weight (loaded or empty) exceed anthropometric limits and or dimensions which make the container awkward or difficult to carry, lift or handle. Completely enclosed fork tine pockets are defined as pockets that will completely encompass the fork tine for the entire length of the pocket (i.e., width of the container). The need for completely enclosed fork tine pockets on other containers shall be determined by a design analysis or by the performance of the applicable forklift truck compatibility test of 5.9. Both the empty and loaded conditions shall be considered. Unless unique logistics of the container dictate, the minimum inside dimensions of each pocket shall be 3 by 10 inches (3 x 15 inches for containers intended for use on ships or in other areas having restricted movement areas). Unless unique logistics of the container dictate, the openings shall be spaced 30 inches apart on centers with the center of gravity located between forklift pockets. If the container fork pockets are to be used for unitizing or tiedown, special consideration should be given to the loads and forces which are involved. If the fork pockets are to be used for creating a unit load by use of steel strapping through the fork pockets, then the top and bottom edge of each opening of the fork pockets must be either beveled or rounded to prevent sharp creasing of the strapping during tensioning. The maximum inside-to-inside dimensions shall be 20 inches. Wooden or wood-reinforced containers may have a single opening 40 inches wide or more to provide forklift access. If a Navy standard part is desired for this application, see the references for fork pockets in 4.6.5.

4.17.7 Shipboard handling. Containers of over 300 pounds gross weight or 3 feet long, or longer, which are intended to be end handled by mechanical means aboard combatant or auxiliary Naval ships shall have special provisions for handling and storage in confined and limited-access stowage areas as follows:

a. A metallic fitting shall be provided at each end of the container to permit handling with the Handlift Truck, MK 45 and all MOD's. Each container fitting shall be capable of supporting three times the maximum weight, including fleet issue unit loads if applicable, that it is required to support. The fittings shall be located as shown on NAVSEA Drawing 2642780. The container structure shall be sufficiently stiff to permit a minimum clearance of 3 inches between the bottom of the container and a level deck, along the container's entire length, with the Handlift Truck in its fully elevated position and when tested in the configuration in which it will be used (for example, with or without cover applied). The fitting and container structure shall meet the strength requirements of the tests described in 5.10. If a Navy standard part is desired for this application, see the references for endlift extrusion and endlift-adapter in 4.6.5.

b. Where appropriate, containers handled and stored on aircraft carriers shall have provisions to permit overhead handling of a loaded container at the center of balance by utilizing the HLU-2l6/E Beam shown on NAVAIR Drawing 616856, HLU-216A/E Beam shown on NAVAIR Drawing 616856-3, or the MK 52 MOD 0 Beam shown on NAVSEA Drawing 6212876. The provisions, or "lift arms", shall be designed to be capable of supporting three times the maximum weight that it is required to support. Fleet issue unit loads are not to be lifted by the HLU-2l6/E, HLU-2l6A/E or MK 52 MOD 0. Only single containers are to be handled by these handling beams. The lift arms shall not protrude beyond the container's envelope when not in use. Provisions shall be made to allow for stacking of like containers in both the forward-to-forward or forward-to-aft configurations with the lift arms in their up position, unless the lift arms are designed to slide vertically into the cover's wall while remaining recessed and accessible without the use of tools. Unless specified otherwise, wire rope or other materials which are capable of fraying shall not be used for the construction of lift arms. If a Navy standard part is desired for this application, see the references for center lift in 4.6.5.

4.17.8 Handling provision maintainability. Handling provisions shall be designed as much as possible to be readily repairable and replaceable without damaging, or requiring alteration of any other part of the container.

4.18 Special protection devices.

4.18.1 Temperature control. Special provisions for controlling or limiting the extremes of temperature within a container shall be avoided. In those cases where such provisions may be justified and specifically required by the design activity, they shall be as simple and as lightweight as possible and meet all the performance requirements of this standard. Detailed design requirements shall be established on a case by case basis by the design activity by consideration of the thermal properties of the item to be protected and the temperature environment in which it must survive.

4.18.2 Field-force protection. When the contained item is susceptible to damage from electrostatic, electromagnetic, magnetic, microwave, radio frequency, or radioactive forces during handling, shipment and storage, the container shall be designed to provide the required protection from the appropriate field-force as specified by the design activity.

4.18.3 Magnetic shielding. For packaging and transportation purposes, magnetic items may be handled as non-magnetic material when the maximum field strength at a distance of 7 feet from the package of the item is 0.002 gauss or less. However, items in this category, when consolidated, may exceed the 0.002 gauss limitation and labeling or shielding may be required. When the magnetic field strength of an item exceeds 0.002 gauss at 7 feet, but does not exceed 0.00525 gauss at 15 feet, labeling only shall be required. Containers for items which are considered to possess a magnetic field strength exceeding 0.00525 gauss when measured at a distance of 15 feet from any face of the packaged item and which may be shipped by air shall be provided with appropriate shielding. Adequacy of shielding shall be determined in accordance with 5.12.

4.19 Protecting and identifying the container.

4.19.1 Painting requirements. Painting, when required, shall be as specified by the design agent and shall meet Occupational Safety and Health Administration (OSHA) and Environmental Protection Agency (EPA) guidelines. Painting shall be primarily required for Nuclear, Biological, and Chemical (NBC) survivability, corrosion prevention, or to provide camouflage. Interior surfaces of closed painted containers need be painted with primer only. Where the contents incorporate plated hardware (see 4.6.1), the primer shall be of a synthetic type known to be compatible with the plating in use. The specific color and paint grade, required for exterior top coats, shall be as indicated by the design activity. Chemical Agent Resistant Coating (CARC) requirements will be defined by the using agency.

4.19.2 Identification and instructional markings.

4.19.2.1 Identification marking. Fully reusable containers shall be identified in accordance with MIL-STD-130 unless otherwise specified by the design activity. When the name of the contents is classified, the permanent identification shall include only the approved nomenclature (for example, MK and MOD number, Container Numerical Unit (CNU) number) and National Stock Number (NSN) of the container.

* **4.19.2.2 Basic instructional markings.** Markings on shipping containers shall include all basic instructional and operating caution markings required for safe, expeditious handling and use of the container. Markings shall include, but not limited to, as applicable: Center of Balance; ESD sensitive contents; Forklift and Stacking Points; identification of any special Sling needed; Records Receptacle; Desiccant Receptacle; Pressure Relief Valve(s); Humidity Indicator; Hoisting and Tiedown Attachment Points; Warning notes; instructions for Opening, Closing and Repressurizing the container; AFT; Cover Lift; FWD; Lift Arm; Observation Window; and Reusable Container—Do Not Destroy.

4.19.2.3 Color coding. Space shall be reserved (5 by 8 inches, if possible) on each end of ammunition containers (except for small arms ammunition containers) for applying color coding and identification markings in accordance with MIL-STD-709 unless otherwise specified.

4.19.3 Container markings. Provisions shall be incorporated for applying container markings and bar codings in accordance with MIL-STD-129 unless otherwise specified.

4.20 Nuclear, Biological, Chemical (NBC) survivability. Containers used to package mission-essential items that may encounter an NBC environment shall be designed of materials that meet the following criteria:

a. Selection of non-metallic materials used in the construction/fabrication of containers shall be chemical agent decontaminable to acceptable levels as specified in the U.S. Army Nuclear and Chemical Agency (USANCA) criteria and AR 70-71 when tested in accordance with TOP 8-2-111.

   NOTE: The USANCA criteria and any questions pertaining therein may be addressed to the Mission Sustainment and Survivability Division, ATTN: SMCCA-OP, at the U.S. Army Chemical Research, Development and Engineering Center, Aberdeen Proving Grounds, MD 21010-5423.

b. For metallic materials, application of a CARC shall be applied in accordance with MIL-C-53072.

c. Container design shall be such that overall configuration will minimize contamination by NBC agents and facilitate effective decontamination to the maximum possible extent in view of the container's specific cost and functional restrictions imposed.

5. DETAILED REQUIREMENTS

5.1 Fit and compatibility.

5.1.1 General. The container shall be designed to be compatible with the contained item. It shall permit easy loading, movement, and unloading. It shall be compatible with the normal logistic patterns for its contents as well as with any special requirements which are specified design constraints. The container shall be designed so that the intended load will fit securely but without interference or binding. It shall support and restrain the item at points and by methods which are not likely to result in damage due to careless manipulation or handling. Loading and unloading shall be a simple process by the normal handling equipment intended to be available at the points of use.

5.1.2 Fit test. This test shall be conducted by bringing together the container and the intended load. The load shall be placed in position in the container and the container shall be assembled in its normal shipping condition by fitting the cover, fastening all restraining devices, placing desiccant, and otherwise completely securing the container for shipment. The container is then unloaded. Only the normal handling equipment likely to be available at points of loading and unloading may be used. Care shall be exercised to assure that both the container and the load are representative of the final configuration and that normal dimensional variations are considered. A lack of "fit" or extreme awkwardness during the necessary loading and unloading process is cause for rejection. Loading and unloading times shall be recorded if such times are a specified design constraint. Not meeting specified loading or unloading times with the specified number of appropriately qualified personnel shall be cause for rejection.

5.2 Mechanical shock.

5.2.1 General. Containers shall be designed to protect the contents from damage resulting from exposure to applicable shock tests described herein. Tests shall be selected from 5.2.2 through 5.2.10 as applicable or as specified by the design activity. Shock tests shall be at the level A severity unless otherwise specified. When the container's design requirements mandate that it be carried by hand, ergonomics may be allowed to dictate the qualification test drop heights. Anthropometry data may be used to determine these heights. The qualification drop height in these instances shall equal the average palm grip elevation above floor level minus distance from the container's handle elevation in the carrying position to the lowest position of the container's shell.

5.2.1.1 Acceptance criteria. The function of a container shall not be significantly impaired by the shock tests, except as specifically noted. Significant evidence of one or more of the following shall be cause for rejection:

a. Damage to the contents. Such damage may be established by either functional tests or other specific evidence of sensitivity to the test conditions.

b. Failure of the containers' energy absorbing devices to protect the contents to the fragility level established as a design constraint by the equipment designer.

NOTE: In the absence of specific frequency information it is assumed that only those frequency components under 3 times the natural frequency of the shock isolation system are damaging. As such, it is acceptable to filter recorded test data at 3.5 times the natural frequency. Unless otherwise specified, shock spectrum analysis shall be performed with a damping factor of 0.05.

c. Failure of a water vapor or water proof container to prevent water vapor transmission or water leakage within the specified limits given in 5.6.2.1.

d. Failure of the container to retain the contents.

e. Failure of the container to permit continued safe handling.

f. Loosening of restraining material or devices which may permit the contents to be damaged if further handling is experienced.

g. Permanent deformation of any portion of the container that affects its functional performance throughout the anticipated logistic cycle.

h. Evidence of the contents striking the container walls, unless it can be shown that such contact does not degrade performance of the item being packaged.

NOTE: Weld cracks in other than principal load paths which do not result in rejection as stipulated above, and are repairable, shall not be cause for rejection.

5.2.1.2 Test loads. Operable articles are the perfect load to be used during the container development and evaluation phase. These articles shall be completely representative of the container's intended contents with the exception that any explosive or hazardous material is to be replaced by inert materials of equivalent mass properties. In the event that operable articles are not available, then test loads such as Dimensional Inert Missiles (DIMs), Inert Operational Shapes (IOS's) or the like may be used if the prime contractor agrees that it is a valid representative test shape. As a minimum, the IOS's characteristics shall be identical to those of the object being simulated (within the tolerance envelope of the real operable article) as follows:

a. Envelope dimensions including external features, such as safing pins, antennas and lanyards which may have a bearing on the package design.

b. Mounting points or external hard zone area geometry and strength (i.e. bending and shear moment along the operable article's entire length, skin thicknesses representing soft zones, etc.).

c. Surface finishes which require special handling provisions.

d. Weight, center of gravity and radii of gyration in the three principal axes.

e. Internal joints and shock mounts identical to the operable article.

f. Identified stations where fragility readings are critical, and allowable levels of fragility at those locations.

g. For operable articles which possess electronic systems, operable electronics within the shape that possess Built In Test (BIT) features that are to be queried prior to and upon completion of testing.

5.2.1.3 Instrumentation. When required, the test load shall be suitably instrumented and data shall be collected during testing to assure that established fragility levels are not exceeded. Unless otherwise specified, shock histories (G's vs time) in the major directions shall be recorded on the test load at: hard zones near the center of gravity, hard zones near the extremities and/or at zones where the fragility is clearly defined. The recorded shock histories shall then be reduced into shock spectra plots as a means of supplying additional information for evaluation of the isolation system. For uniquely configured or irregularly-shaped items, and in cases where known fragility points have not been established, engineering judgment shall be used in selecting instrumentation locations.

5.2.1.4 Temperature combined with shock. Container designs using materials which may be affected by temperature variations shall be subjected to the shock tests of this section, except as noted, at the extreme temperatures which may be expected in service. Table III contains a guideline for expected temperature extremes. At the discretion of the design activity, a single container may be required to survive tests at the required temperature extremes. In such cases, wherever possible, the impact points shall be at locations not previously impacted. Each test is considered to be a unique individual event. As such, during qualification testing, the container's isolation system may be replaced after each test event. When required by the design activity, ambient testing shall be performed at 70 ± 5°F.

5.2.2 Repetitive shock test. This test shall be conducted in accordance with Method 5019 of FED-STD-101, except that, if circular input motion is used, table frequency shall be adjusted to assure that one edge of the container leaves the table not less than 3/16 inch on each cycle. This test is normally conducted at an ambient temperature of 70 ± 20°F. The temperature of the resilient mounts should not be allowed to exceed the safe operating temperature of the elastomer. Army munition containers issued to ground troops shall be tested in accordance with 6.13 of MIL-STD-1904 at the three temperatures (-65°F, 70°F, 160°F) specified in 5.2.1.4. As an alternate, ASTM D999, Method A1 or A2 as applicable, may be used as an acceptable test method.

5.2.2.1 Repetitive shock test (stacked). This test shall be conducted as specified in 5.2.2 except for the following:

a. The containers shall be tested two layers high.

b. The distance the upper container lifts from the lower container shall be measured.

* **5.2.3 Drop test (free-fall).** This test shall be conducted in accordance with Method 5007 of FED-STD-101. Procedure A shall be used for cylindrical containers. Procedure G shall be used for rectangular

containers. At the option of the design agency, the more extensive procedure A may be specified. Army munition containers issued to ground troops shall be three and seven-foot free fall drop tested in accordance with 6.4 of MIL-STD-1904 at the 3 temperatures (–65°F, 70°F, 160°F) specified in 5.2.1.4. As as alternate, ASTM D5276 may be used as an acceptable test method. Drop heights from Method 5007 may be used with this alternate test method, or at the option of the design agency, a more representataive drop test height, which duplicates the maximum potential drop expected for a special shipping container during its normal service life, may be substituted in lieu of the value found in Method 5007's Table 1. As a guideline, for normal handling and transportation mishaps of non-person portable containers for level A protection, 15 inches is an acceptable height while for level B protection, 12 inches is an acceptable height regardless of overall gross weight or dimensional size. For person portable containers, the anthropometry guidelines in 5.2.1 may be used to establish the drop heights.

* **5.2.4 Cornerwise-drop (rotational) test.** This test shall be conducted in accordance with Method 5005 of FED-STD-101. At the option of the design agency, a more representative drop test height, which duplicates the maximum potential drop expected for a special shipping container during its normal service life, may be substituted in lieu of the value found in Method 5005's Table 1. As a guideline, for normal handling and transportation mishaps of non-person portable containers for level A protection, 15 inches is an acceptable height while for level B protection, 12 inches is an acceptable height regardless of overall gross weight or dimensional size. When symmetry permits, these tests should be conducted on diagonally opposite corners to prevent generation of redundant data. Army munition containers issued to ground troops shall be tested in accordance with 6.6 of MIL-STD-1904 at the 3 temperatures (-65°F, 70°F, 160°F) specified in 5.2.1.4.

5.2.5 Edgewise-drop (rotational) test. This test shall be conducted in accordance with Method 5008 of FED-STD-101. At the option of the design agency, a more representative drop test height, which duplicates the maximum potential drop expected for a special shipping container during its normal service life, may be substituted in lieu of the value found in Method 5008's table I. As a guideline, for normal handling and transportation mishaps of non-person portable containers for level A protection 15 inches is an acceptable height while for level B protection 12 inches is an acceptable height regardless of overall gross weight or dimensional size. Army munition containers issued to ground troops shall be tested in accordance with 6.5 of MIL-STD-1904 at the 3 temperatures (-65°F, 70°F, 160°F) specified in 5.2.1.4.

5.2.6 Tipover test. The tipover test, Method 5018 of FED-STD-101 shall be performed if the container and content weight and balance are such that the container will tip over when an edge or corner is raised sufficiently for the base to form a 20° angle with the floor. At the option of the design activity, the rollover test, Method 5014 of FED-STD-101, may be substituted for this test. Army munition containers issued to ground troops shall be tested in accordance with 6.7 of MIL-STD-1904 at the 3 temperatures (-65°F, 70°F, 160°F) specified in 5.2.1.4. As an alternate, ASTM D1083's Tip Test, Tipover Test and Rolling Test may be used as acceptable test methods.

5.2.7 Impact test. This test shall be conducted in accordance with either the procedures of Method 5023 (incline-impact test) or Method 5012 (pendulum-impact test) of FED-STD-101. Impact velocity shall be 7 ft/sec. Army munition containers issued to ground troops shall be tested in accordance with 6.8 of MIL-STD-1904 at the 3 temperatures (-65°F, 70°F, 160°F) specified in 5.2.1.4. As an alternate, ASTM D880 may be used as acceptable test method.

* **5.2.7.1 Impact test (stacked).** Containers likely to be unitized, stacked and shipped by railcars shall be designed to survive humping operations. The test shall be identical to the impact test of 5.2.7 except that the normal number of containers shall be unitized in the shipping configuration. One impact shall be made on each end of the bottom container at 11.7 ft/sec. All containers likely to be stacked and shipped by flatbed trailers only shall be designed to pass one impact on each end of the bottom container at 5 ft/sec. For all containers likely to be shipped by both rail and truck the test shall be limited to the 11.7 ft/sec velocity. Dummy contents may be used. Evidence of failure of the connecting structures which would permit any of the containers to become unattached shall be cause for rejection. In lieu of the stacked impact test, and at the option of the design agency, a rail impact test may be conducted in accordance with the requirements of the Association of American Railroads (AAR), Bureau of Explosives (BOE). As an alternate, ASTM D4003 or ASTM D5277 may be used as acceptable test methods. Use MIL-STD-810 Method 516.3 procedure VIII.

5.2.8 Transfer-at-sea shock test. Containers and container unit loads planned for transfer-at-sea shall be designed to withstand the shocks associated with the appropriate mode of transfer as shown in table V. Where CONREP can be confined to the use of the Standard Tension Replenishment Alongside Method (STREAM) strongback and sliding padeye, impact velocity may be reduced to 7 ft/sec. For VERTREP, the container shall be subjected to an 18 inch flat bottom drop and one impact on each of four sides at 7 ft/sec. Following the tests, the container shall continue to protect the contents and shall not be damaged in any way that would prevent its use and continued safe handling.

TABLE V. Shock test for containers-at-sea.

Test	Connected replenishment (CONREP)	Vertical replenishment (VERTREP)	Dock side only
[1] Impact velocity	10.0 ft/second	7.0 ft/sec	5.0 ft/sec
Flat bottom drop	18.0 inches	18.0 inches	18.0 inches

[1] Impact velocity testing shall be performed on ends and sides.

5.2.9 Shipboard shock test. When the loaded container is to be used aboard Naval ships and contains an item which must survive the near-miss environment, the loaded container shall be designed to pass the shock tests of MIL-S-901. Items to be tested shall be classified as either Grade A or Grade B. Grade A items are items which are essential to the safety and continued combat capability of the ship. Grade A items shall withstand shock tests conducted in accordance with MIL-S-901 without unacceptable effect upon performance and without creating a hazard. Grade B items are items whose operation is not essential to the safety and combat capability of the ship but which could become a hazard to personnel, to Grade A items, or to the ship as a whole as a result of exposure to shock. Grade B items shall withstand shock tests conducted in accordance with MIL-S-901 without creating a hazard to personnel or to grade A equipment. Damage to the container is permissible provided it is possible to remove the contents without special tools and provided the container can be handled in a conventional manner. The loaded container shall be arranged and secured during shock tests in a similar manner as it is intended to be arranged and secured aboard ship. Ambient temperature shall be 70 ± 20°F.

5.2.9.1 Shipboard shock test (eligibility). When specified, the container in its shipping condition shall be subjected to a drop test (free-fall) by raising it vertically from its normal storage position and then allowing it to fall freely onto a rigid surface from a height of 18 inches.

NOTE: This test is not a substitute for the shipboard shock test of MIL-S-901 but may be regarded as a preliminary test to establish eligibility.

5.2.10 Safety drop test. Specialized containers, when specified by the design activity, shall be designed to survive a 40-foot drop test without the creation of unsafe conditions. The test shall be conducted by allowing a completely assembled container to fall onto a rigid surface from a height of 40 feet. The impact surface shall be that which is the most critical with respect to safety. The container may be completely destroyed, but the contents shall be safe for subsequent handling for disposal. Ambient temperature shall be 70 ± 20 °F or as otherwise specified. Army munition containers issued to ground troops shall be tested in accordance with 6.12 of MIL-STD-1904 at the 3 temperatures (-65 °F, 70 °F, 160 °F) specified in 5.2.1.4.

5.2.11 Railcar shock test for nuclear weapon containers. When specifically required for nuclear weapon containers, the loaded container shall be securely restrained through the container tiedown provisions (blocking and bracing of skids is acceptable if container tiedown points cannot be used) to an appropriate shock machine. Unless otherwise specified, the test platform shall then be subjected to a one-half sine wave acceleration input pulse of 47 g of 17 milliseconds duration. This test shall be repeated in all directions in which the container is likely to be shipped by rail.

5.3 Vibration.

5.3.1 General. Containers which employ special energy-absorbing devices for shock insolation purposes, or which have sufficient structural flexibility that resonances below 50 Hertz (Hz) may be created, shall be designed to satisfactorily survive exposure to the appropriate vibration test. The nature of the contents and the expected logistic pattern shall determine both the type of vibration testing to be utilized (for example, random, sine, et cetera) and the temperature of the container and contents. Test loads, as defined in 5.2.1.2, may be used. The container and associated isolation system shall meet the requirements of 5.2 and the following:

a. Peak transmissibility shall be clearly defined by the prime contractor of the object being packaged. In the event that this information is not available a design goal of peak transmissibility across the isolators in the major translational modes of vibration (as measured during resonance search portion of the test of 5.3.2) is 5.0 if the resonant frequency is less than 15 Hz, 8.0 if the resonant frequency is between 15 and 25 Hz, and 10.0 from 25 to 50 Hz.

b. If consistent with the shock requirements of 5.2 and other design considerations, the resonant frequency in the major translational modes of vibration should be above 7.5 Hz.

5.3.1.1 Acceptance criteria. The container and the isolation system shall continue to perform their functions following vibration tests. Evidence of the following shall be cause for rejection:

a. Damage to the contents. Such damage may be established by either functional tests or other specific evidence of sensitivity to the test conditions.

b. Permanent deformation of any portion of the container that affects its functional performance throughout the anticipated logistic cycle.

c. Structural failure of the isolation system.

d. Failure of the isolation system to meet the transmissibility or resonant frequency requirements of 5.3.1.

e. Loosening of the restraining material or devices which may permit the contents to be damaged if further handling is experienced.

f. Evidence of the contents striking the container walls, unless it can be shown that such contact does not degrade performance of the item being packaged or the container.

g. Leakage in excess of the criteria given in 5.6.2.1, if the container is intended to be leak-proof.

h. Excessive rotation or shifting of the contents which could cause damage or prohibits removal of the contents by the intended means.

NOTE: Weld cracks in other than principal load paths which do not result in rejection as stipulated above, and are repairable, shall not be cause for rejection.

5.3.2 Resonance survey and dwell test. The container, in its normal position, shall be rigidly attached to a vibration exciter. Suitable instrumentation shall be used to obtain transmissibility data at the points of interest. A search for resonance shall be conducted by applying sinusoidal vibration excitation in the vertical direction. Transmissibility data shall be obtained for the fundamental translational vibration mode over a frequency range of 5 to 50 Hz. Input vibration should follow a schedule level associated with the intended logistic cycle as defined by the design activity. Sweep rate shall be approximately one half octave per minute and the total sweep time shall be 7.5 minutes. A dwell test of 30 minutes total duration (the test may be interrupted if necessary to prevent excessive temperature rise of resilient materials) shall be conducted at the predominant resonance for elastomeric and mechanical suspension systems (helical springs, torsion bars and other types of mechanical suspensions). Dwell tests should not be performed on plastic foam isolation systems. The input excitation for the dwell test shall be equal to that used during the sweep test at that frequency. Adjustment in frequency may be necessary during the course of test to compensate for shifts in resonant frequency due to temperature rise of the isolator. If the logistic environment is undefined, the input vibration for the search and dwell tests shall be 0.125 inch double amplitude or 1.0 g (0 to peak) whichever is the lesser value, or, for reaction type test machines, the syllabus of table VI can be used for the resonance survey. If table VI is used and resonance occurs above 12.5 Hz, the test shall be repeated with the input amplitude adjusted to produce 1 g at resonance. When specified by the design activity, the test shall be repeated with vibration excitation applied in the transverse and longitudinal directions with the container in its normal shipping position. A new container, or new set of isolators installed in the same container shell, of the same design may be used for each test direction. Ambient temperature shall be 70 ± 20°F unless

otherwise specified. The temperature of resilient materials should not be allowed to exceed the safe operating temperature of the isolator.

TABLE VI. Test syllabus for reaction type test machine.

Frequency band (Hz)	Input double (amplitude) (inches)	Minimum sweep time in band (minutes)
5-15	0.125	3.5
16-25	0.040	1.5
26-35	0.020	1.5
36-50	0.010	1.0

5.3.3 Sinusoidal cycling test. When specified, a cycling vibration test shall be performed in accordance with Method 5020 of FED-STD-101. If this test is specified in addition to the test of 5.3.2, the dwell test at resonance of Method 5020 shall be deleted. Variations in frequencies and amplitude may be made by the design activity.

5.3.4 Random vibration. When specified, random vibration testing in accordance with MIL-STD-810, (Method 514.4, Category I, Basic Transportation), shall be conducted in the vertical direction using common carrier input. When specified by the design activity, the test shall be conducted with vibration excitation applied in the transverse and longitudinal directions with the container in its normal shipping position. A new container, or new set of isolators installed in the same container shell, of the same design may be used for each test direction. Army munition containers issued to ground troops, shall be tested in accordance with 6.3 of MIL-STD-1904 at the 3 temperatures (-65°F, 70°F, 160°F) specified in 5.2.1.4. The test shall be conducted (preferably before) on the same container used in the mechanical shock tests of 5.2, utilized for the ground troop testing.

5.4 Shock mount aging. Shock mounts exposed to the atmosphere, such as in open or free- breathing containers, shall be qualified to be capable of meeting all performance requirements following exposure to the following tests. Shock mounts for non-breathing and controlled-breathing containers shall be qualified to meet the performance requirements following exposure to the test of

5.4.1 Salt fog test. The mount under 20 percent strain shall be tested in accordance with MIL-STD-810 Method 509.3, for a period of 50 hours.

5.4.2 Ozone resistance test. The mount under 20 percent strain shall be tested in accordance with ASTM D1149. The mount shall be subjected to an ozone concentration of 50 parts per hundred million at 104°F. The period of the test shall be 168 hours.

5.4.3 Air-heat aging test. The mount under 20 percent strain shall be tested in accordance with ASTM D573. The mount shall be subjected to this test at an operating temperature of 176 ± 2 °F for an aging interval of 7 days.

5.5 Structural integrity.

5.5.1 General. Containers with integral barrier (non-breathing, controlled-breathing or free-breathing) shall be designed to withstand internal pressures or vacuum as specified in 5.5.2.1.

5.5.2 Pressure test. The container shall be prepared for test by sealing all breathing devices and inserting suitable pressurizing fittings and gages. However, if so desired, the breathing device(s) may be removed and replaced by the pressurizing fittings and gages through the breathing port. The container shall be closed and sealed as it would be in service. The test shall be conducted by raising or lowering the internal pressure so that the desired test pressure is obtained. The failure of latches, fasteners, or any part of the container structure in such a way that any unsafe condition could exist shall be cause for rejection. Permanent deformation of the container structure sufficient to prevent the safe removal of the contents shall also be cause for rejection. Leakage is not a consideration.

WARNING **Container may explode or fasteners may fail during this test! Use protective barriers to avoid injury to personnel.**

5.5.2.1 Test pressures. The test for structural integrity shall be accomplished after all other testing of the container (being qualified) is complete, and shall adhere to the following criteria:

a. Non-breathing containers. The test pressures shall be set as follows: 15.00 ± 0.25 psig and −3.00 ± 0.25 psig.

* b. Controlled-breathing containers. The test pressures shall be set as follows: 1.50 ± 0.25 psig above the required positive reseal pressure and 1.50 ± 0.25 psig below the required vacuum reseal pressure. For containers issued to ground troops, the positive and vacuum cracking pressure shall be 3.00 +0.50/−0.00 psig and −3.00 +0.00/−0.50 psig, respectively.

c. Free-breathing containers. No pressure test is required.

5.6 Leakage integrity.

5.6.1 General. Internal barrier containers shall be designed to prevent leakage from the inside of the container in excess of the pressure drop criteria indicated in 5.6.2.1. Leakage requirements apply before and after all testing except POP testing, 7-foot free-fall drop and 40-foot safety drop test, unless specified by the design activity.

5.6.2 Leak test. The container shall be prepared for testing by sealing all breathing devices and inserting suitable pressurizing fittings and gages. However, if so desired, the breathing device(s) may be removed and replaced by the pressurizing fittings and gages through the breathing port. The container

shall be closed and sealed by the same procedures used in service. The pneumatic-pressure technique and or vacuum retention Method 5009 of FED-STD-101 shall be used to detect leakage.

5.6.2.1 Test pressures. The test for leakage integrity shall be accomplished following each series of shock, vibration and handling tests, or at the discretion of the design activity shall be accomplished before the first of all the tests and after completion of all testing, and shall adhere to the following criteria:

a. Non-breathing containers. The test pressures shall be set as follows: 3.50 ± 0.50 psig and −3.00 ± 0.25 psig. The continuous formation of bubbles or intrusion of fluid into the containers, using either the immersion or soap solution test method, shall be unacceptable. For Army munition containers issued to ground troops, a flow rate which exceeds 0.3 cubic inches per minute shall be unacceptable.

* b. Controlled-breathing containers. The test pressure shall be set as follows: 1.00 +0.25/−0.00 psig above the required positive reseal pressure and 1.00 +0.00/−0.25 psig below the required vacuum reseal pressure. A drop in pressure magnitude in excess of 0.10 psig per hour, corrected for variations in air temperature and ambient pressure shall be unacceptable. For Army munition containers issued to ground troops, the positive and vacuum cracking pressure shall be 3.00 +0.50/−0.00 psig and −3.00 +0.00/−0.00 psig, respectively. A flow rate which exceeds 0.3 cubic inches per minute shall be unacceptable.

c. Free-breathing containers. No pressure testing is required.

5.7 Superimposed load.

5.7.1 General. Containers shall be designed to permit the stacking of like containers, or to support other lading, without structural failure of the stacking features or damage to the contents. Deformation sufficient to result in any unsafe stacking configuration or condition shall be cause for rejection.

5.7.2 Load test (like containers). Proof of adequate stacking strength shall be determined by testing in accordance with the procedure of Method 5016 of FED-STD-101. If the principal support structure is a plastic or other nonmetallic material or material which may deteriorate when exposed to elevated temperatures or very humid conditions, the test shall be conducted at a temperature of 120 ±5 °F and 90 percent relative humidity for a period of 168 hours. In this latter case the constant "s" of Method 5016 used to calculate the load shall be 1.5. As an alternate, ASTM D642 or ASTM D4577 may be used as acceptable test methods. When using the ASTM alternate tests the period of test and applied loads shall be equal or greater in value to those specified in Method 5016 of FED-STD-101.

5.7.3 Load test (unlike containers). Containers required to support loading different than like containers shall be tested in accordance with the of Method 5017 of FED-STD-101.

5.8 Hoisting fitting and tiedown attachment points.

5.8.1 General. Containers shall be designed to permit handling by a set of hoisting fittings and shall be equipped, unless otherwise justified by logistic considerations, with tiedown attachment points. If the container's design allows for it, the hoisting fittings may also be utilized as a provision for tiedown.

5.8.2 Acceptance criteria. Each tiedown attachment point, hoisting fitting and set of hoisting fittings shall be identified and shall be capable of safely supporting the required test load. Evidence that the set of hoisting fittings or tiedown attachment show the following conditions shall be cause for rejection. Further, any single hoisting fitting showing evidence of the following specific conditions shall be cause for rejection.

a. Failure of any part of the hoisting or tiedown structure.

b. Permanent deformation (ex., necking) of any part of the structure supporting or attachment point which renders the container unsafe or unsuitable for continued handling.

5.8.3 Hoisting fittings strength test. The container shall be loaded to 5 times the gross weight of the container. If the container is to be assembled into a unit load and if the hoisting fittings can be used to handle the unit load, the total test load shall be equal to 5 times the gross weight of the unit load. A sling, lifting beam, or other device representing normal procedure shall be attached to the hoisting provisions and the container lifted until it is free of the support. It shall be allowed to hang for 5 minutes prior to examination for damage. Hoisting fittings on containers intended for external air transport shall be tested in accordance with the requirements of MIL-STD-209 and MIL-STD-913. If any part of the hoisting provision or container structure is a plastic or non-metallic material, the test duration shall be 1 hour each at −65°F and +160°F.

5.8.4 Tiedown strength test. A load shall be applied to each tiedown provision in the same way that it would be applied in service. In the absence of clearly identified tiedown procedures, the load shall be applied at an angle of 45° downward from the horizontal and simultaneously 45° outboard from the container surface. The test load shall be equal to that which would be applied if the loaded container were subjected to the restraint loads required in MIL-STD-1791. The load shall be applied in each of the directions which may reasonably result from shipment. The duration of the test shall be 5 minutes in each of the test directions. If any part of the tiedown provision or container structure is a plastic or non-metallic material, the test duration shall be 1 hour each at -65°F and +160°F. For nuclear weapons containers, a test load shall be applied in accordance with the individual service regulations.

5.8.5 Single hoisting fitting strength test. Each hoisting provision on the container or unit load shall be individually tested by hoisting the loaded container or loaded unit load into the air and keeping it suspended for a period of 5 minutes. If any part of the hoisting structure is a plastic or nonmetallic material, the test duration shall be 1 hour each at -65°F and +160°F. As an alternate procedure, the container may be suitably restrained and the hoisting loads applied to the container in a manner which simulates the conditions given above.

5.9 Forklift truck (fully captive fork tine enclosures) compatibility test. This test shall be conducted in accordance with the "lifting and transporting by forklift truck" portion of Method 5011 of FED-STD-101. In addition, the "pushing" and "towing" portions of Method 5011 of FED-STD-101 shall be conducted. When the container is more than 45 inches wide or more than 91 inches long, the pushing and towing tests shall be repeated with one end of the container lifted off the ground about 6 inches by the tips of

the forks inserted between the skids. The strength of the container structure, as well as the skids, shall survive the tests without failure of any part or permanent deformation of any part which renders the container unsafe or unsuitable for continued handling. The handling provisions shall be convenient to use and shall create no unsafe condition or practice.

5.9.1 Forklift truck (non-captive lift) compatibility test. The test shall be conducted in accordance with "lifting and transporting by forklift truck" portion of Method 5011 of FED-STD-101. Except, conduct the first pass with the tines in the full back tilt position. The first pair of boards shall be nominal 2" x 4", instead of the 1-inch boards required in the test. After the first pass is completed over the required 100 foot course, turn around maintaining the required speed, and proceed with a second pass in the opposite direction with fork tines in the level position. In addition, the "pushing" and "towing" portions of Method 5011 of FED-STD-101 shall be conducted. When the container is more than 45 inches wide or more than 91 inches long, the pushing and towing tests shall be repeated with one end of the container lifted off the ground about 6 inches by the tips of the forks inserted between the skids. The strength of the container structure, as well as the skids, shall survive the tests without failure or permanent deformation. The handling provisions shall be convenient to use and shall create no unsafe condition or practice.

5.10 Handlift truck MK 45 compatibility.

5.10.1 General. Containers and containers assembled into a unit load which are to be used and stowed aboard Naval ships must have fittings which permit the Handlift Truck MK 45 to be used. The following tests define the required strength of the fittings and container structure.

5.10.2 Static overload. Each end lift fitting shall be loaded to 3 times the actual load (but not to exceed 3 times the handlift truck capacity) that it is required to support for a period of not less than 5 minutes. The supporting device may be either a Handlift Truck MK 45 or a test fixture which simulates the loading conditions. The end lift fittings shall not show any permanent structural deformation. For containers stowed aboard ship the test shall be run 3 times. Once each in the level position and once at a 15 degree angle along it's length and end.

5.10.3 Shock test. The container or containers assembled into a unit load, weighted to its maximum normal load, shall be supported by a Handlift Truck MK 45 and all MOD's (or test fixture which simulates the loading conditions) and raised to a height of 3 inches above ground level. It shall then be moved longitudinally at a speed of not less than 2 feet per second up a 30° ramp to a height of 1 inch and then allowed to fall abruptly onto a rigid surface. The entire container shall be tested 6 times in this manner. Three times with the forward end first, then three 3 times with the aft end first. The end lift fittings shall not show any permanent structural deformation.

5.10.4 Rolling test. Move the container or containers assembled into a unit load, weighted to its maximum normal load, at a speed of not less than 4 feet per second on a dry, smooth level concrete surface or a surface on which the wheel of the end lift fitting test fixture will have a coefficient of sliding friction of 0.6. After 20 feet of movement, engage brakes of the trailing end lift fitting test fixture only. In

addition, the test shall be repeated during both right and left hand sharp turns (approximately 45 degrees) with the brakes being abruptly applied during each turn. The container end lift fittings shall not show any sign of deformation or structural degradation.

5.11 Fire test, external source. When specified, a minimum of 2 containers shall be placed in the stacked configuration (minimum height of 24 inches) under simulated environmental conditions (for example, as they would be stowed aboard Naval ships). The test area shall be a simulated magazine or other similar confined space, with sufficient air available to furnish oxygen for combustion. The stacking configuration and contents shall be simulated. An acetylene flame source shall be used as an ignition source. The hottest portion of the torch flame shall be applied to those locations on the lower container which are likely to produce a self-sustaining fire. Withdraw flame source after 5 minutes at each location. The containers shall be acceptable for stowage and use aboard Naval ships if sufficient flames are not generated by lower containers to ignite upper containers; flames, if any, generated by the lower container self extinguish after removal of the ignition source; and, toxic fumes are not emitted from either the upper or lower container during application of the torch.

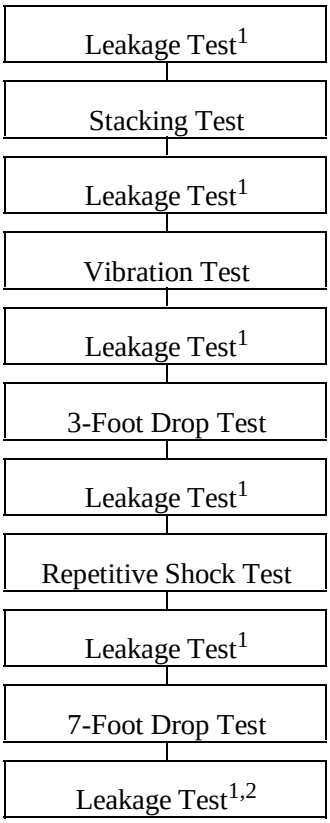
5.12 Measurement of magnetic fields. The container with all the intended contents packed as ready for normal shipment shall meet the requirements of 4.18.3. All shielded units shall be inspected to determine compliance with 4.18.3. A gauss meter capable of measuring a magnetic field strength of .002 gauss with an accuracy of ±5 percent shall be used. If the measured field strength exceeds 0.00525 gauss the item shall be rejected. Improper or missing marking, labeling or improper packing shall also be cause for rejection.

5.13 Sympathetic detonation. For containers whose contents pose a threat of sympathetic detonation, and whose intended handling logistics dictate, provisions shall be included to assist in the prevention of sympathetic detonation. As required, the prevention shall be accomplished between like containers stowed vertically, side-by-side or in a diagonal stack configuration. In addition, if the logistics dictate, the protection shall be increased to protect the contents of the container from itself when 2 or more explosive items are contained within the same container.

5.14 Testing sequences.

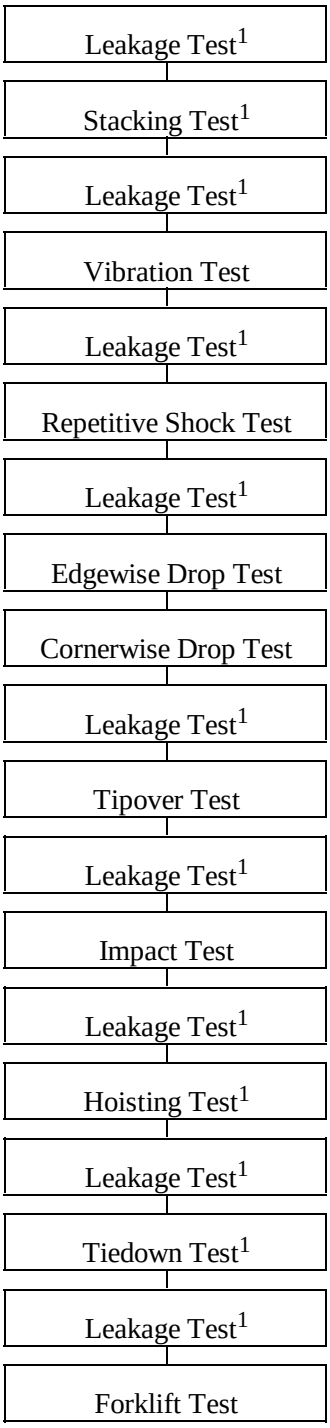
5.14.1 Army Containers. The sequence of testing shall be as shown on figures 1 and 2 between repetitive shock test and 7-foot drop test a block with leakage test. These tests are normally conducted at each of 3 temperatures; low: –65°F, ambient and high: +160°F.

5.14.2 Air Force Containers. The sequence of testing shall be as shown on figures 3 and 4. These tests are normally conducted at each of 3 temperatures; low: –40°F, ambient: 72 ±20°F and high: 140°F.



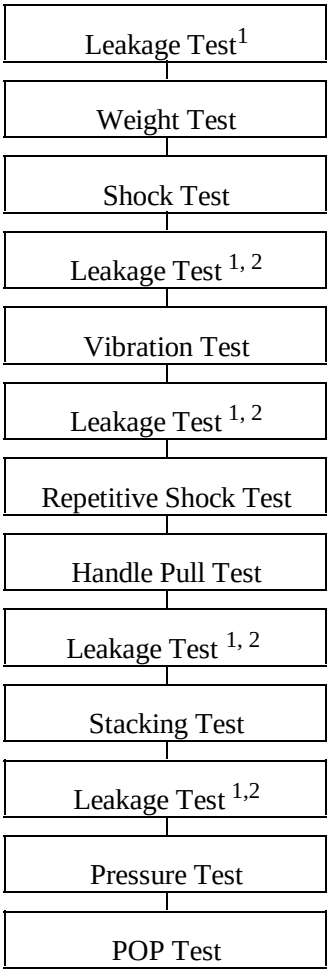
[1] Leakage retention test should be conducted at ambient temperature unless otherwise specified.
[2] Leakage test shall be conducted for information only.

FIGURE 1. Test sequence for containers under 150 pounds and issued to ground troops.



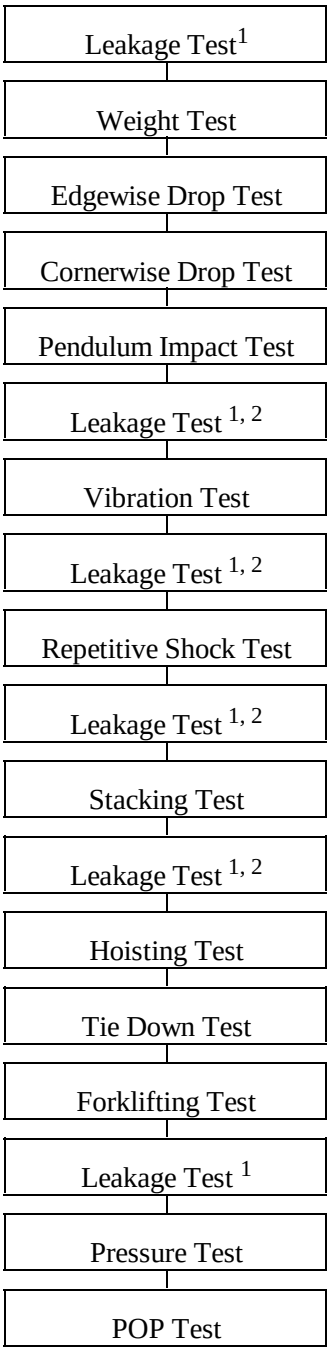
[1] Test should be conducted at ambient temperature only unless otherwise specified.

FIGURE 2. Test sequence for containers 150 pounds or more and issued to ground troops.



[1] Leakage retention test should be conducted at ambient temperature unless otherwise specified.
[2] Leakage test shall be conducted for information only.

FIGURE 3. Air Force test sequence for containers under 150 pounds.



[1] Leakage retention test should be conducted at ambient temperature unless otherwise specified.
[2] Leakage test shall be conducted for information only.

FIGURE 4. Air Force test sequence for containers over 150 pounds.

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 standard is intended to be used as a guide in preparing a development specification, or equivalent, to establish the interface constraints and performance requirements of shipping containers for specific items of equipment. It is not intended that all of the requirements, or tests, contained herein shall be invoked in any particular case. Instead, the development specification should contain only appropriate requirements from this document along with any other requirements which may be dictated by unique operational, logistic, international shipment or safety considerations.

6.2 Subject term (key word) listing.

CONREP
Development specification
Development specification, preparing
Energy absorbing
Equipment
Handling provisions
Interface constraints
International shipment
Logistic
NBC survivability
Noncombustible materials
Operational
Performance requirements
Safety
Special indicators
Specific items
Unique
UNREP
VERTREP
Vibration

* **6.3 Changes from previous issue.** The margins of this revision are marked with asterisks to indicate where major changes from the previous issue were made. This was done as convenience only and the Government assumes no liability whatsoever for any inaccuracies in these notations.

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STANDARDIZATION DOCUMENT IMPROVEMENT PROPOSAL

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I RECOMMEND A CHANGE:	1. DOCUMENT NUMBER MIL-STD-648C	2. DOCUMENT DATE (YYMMDD) 980728

3. DOCUMENT TITLE
DESIGN CRITERIA FOR SPECIALIZED SHIPPING CONTAINERS

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) DSN (*If applicable*)	7. DATE SUBMITTED (*YYMMDD*)

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c. ADDRESS (*Include Zip Code*) Standardization Team (Code 840M) 101 Strauss Avenue Indian Head, MD 20640-5035	IF YOU DO NOT RECEIVE A REPLY WITHIN 45 DAYS, CONTACT: Defense Standardization Program Office, Attn: DLSC-LM 8725 John J. Kingman Road, Suite 2533 Fort belvoir, VA 22060-6221 Telephone (703) 767-6888 DSN 427-6888

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