

MIL-S-29409B(MC)  
9 March 1994  
SUPERSEDING  
MIL-S-29409-A(MC)  
1 AUGUST 1984

## MILITARY SPECIFICATION

### SHELTER ASSEMBLY, KNOCKDOWN

This specification is approved for use by the United States Marine Corps, Department of the Navy, and is available for use by all Departments and Agencies of the Department of Defense.

#### 1. SCOPE

1.1 Scope. This specification establishes the requirements for the manufacture and acceptance of the Knockdown Shelter Assembly. This shelter assembly is a nominal 8-foot (ft) x 8-ft x 20-ft (2.438-meter (m) x 2.438-m x 6.096-m) shelter equipped with removable side walls, personnel door, escape hatch, internal lights, and convenience outlets. Four shelters can be shipped in the configuration of an International Organization for Standardization (ISO) 20-ft container. This shelter is one of a family of rigid, walled shelters designed for Marine Corps expeditionary use.

#### 2. APPLICABLE DOCUMENTS

##### 2.1 Government documents

2.1.1 Specifications, standards, and handbooks. The following specifications, standards and handbooks form a part of this specification as specified herein. Unless otherwise specified, the issues of these documents shall be those listed in the issue of the Department of Defense Index of Specifications and Standards (DODISS) and supplement, cited in the solicitation.

Beneficial comments (recommendations, additions, deletions) and any pertinent data which may be of use in improving this document should be addressed to: Commander, Program Support Directorate (PSE-C), MARCORSSYSCOM, 2033 Barnett Ave., Suite 315, Quantico, VA 22134-5010 by using the self-addressed Standardization Document Improvement Proposal (DD Form 1426) appearing at the end of this document or by letter.

Figure 1

AMSC- N/A

FSC 5411

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SPECIFICATIONS

MILITARY

- MIL-C-5541 Chemical Film and Chemical Film Materials for Aluminum and Aluminum Alloys
- MIL-S-29410 Shelter Assembly, Rigid
- MIL-S-24912 Shelter, Complexing Kit for

STANDARDS

MILITARY

- MIL-STD-129 Marking for Shipment and Storage
- MIL-STD-130 Identification Marking of U.S. Military Property
- MIL-STD-401 Sandwich Construction and Core Materials, General Test Methods
- MIL-STD-810 Environmental Test Methods
- MIL-STD-831 Test Reports, Preparation of
- MIL-STD-907 Engineering and Design Criteria for Shelters, Expandable and Nonexpandable
- MIL-STD-1186 Cushioning, Anchoring, Bracing, Blocking, and Waterproofing, with Appropriate Test Methods

2.1.2 Other Government documents, drawings and publications.  
The following other Government, drawings and publications form a part of this specification to the extent specified herein:

PUBLICATIONS

- MCO 4035.6 Surface Transportation Joint Procedures for Coding and Marking of DoD Owned Containers
- MCO P4790.1 MIMMS Introduction Manual

DRAWINGS

MARINE CORPS

- DL80A5022A0000 Shelter, Knockdown

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DL80A5022A0357 Blackout Curtain Kit

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

2.2 Other publications. The following documents form a part of this specification to the extent specified herein. The issues of the documents which are indicated as DoD adopted shall be the issue in the current DODISS and the supplement thereto, if applicable.

INTERNATIONAL STANDARD

ISO 668 Dimensions and Ratings

ISO 1496/I Series 1 Freight Container--Specification and Testing--Part I: General Cargo Containers

(Application for copies should be addressed to International Organization for Standardization, P.O. Box 56, 1211 Geneva 20, Switzerland.)

AMERICAN SOCIETY FOR TESTING AND MATERIALS

ASTM E-864-92 Surface Preparation of Aluminum Alloys to be Adhesively Bonded in Honeycomb Shelter Panels

ASTM E-865-92 Structural Film Adhesives for Honeycomb Shelter Panels

ASTM E-866-92 Corrosion-Inhibiting Adhesive Primer for Aluminum Alloys to be Adhesively Bonded in Honeycomb Sandwich Panels

ASTM E-874-89 Adhesive Bonding of Aluminum Facings to Nonmetallic Honeycomb Core for Shelter Panels

ASTM E-1091-92 Nonmetallic Honeycomb Core for use in Shelter Panels

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

NATIONAL FIRE PROTECTION ASSOCIATION

NFPA 70-93 National Electric Code

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(Application for copies should be addressed to the National Fire Protection Association 470 Atlantic Avenue, Boston, Massachusetts 02210.)

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

2.3 Order of Precedence. In the event of a conflict between the text of this specification and the references cited herein, the text of this specification shall take precedence.

3. REQUIREMENTS

3.1 First article

3.1.1 Sandwich panel, large. One 3 ft 6 in (1.066 m) by 7 ft 9 in (2.362 m) aluminum face honeycomb sandwich panel fabricated in accordance with the requirements specified in 3.3.1 shall be subjected to the test in 4.8.1 and shall be subsequently cut into smaller specimens for panel shear testing (see 4.8.3 and 4.8.4).

3.1.2 Assemblies. When specified sample shelter assembly(ies) shall be subjected to first article inspection (see 4.4 and 6.2).

3.2 Materials. Materials shall conform to the requirements specified herein and in Data Lists DL80A5022A0000 and DL80A5022A0357.

3.3 Design and construction

3.3.1 Sandwich panels. Sandwich panels shall be fabricated and inspected in accordance with the appropriate materials and process specifications listed in Data List DL80A5022A000 and as follows:

3.3.1.1 Sandwich panels and material. The following material requirements are the minimum necessary to insure the shelter assembly fully meets all requirements stated herein.

3.3.1.1.1 Sandwich panel shear strength. The adhesive bond between the panel facings and the core shall be sufficient to allow the core to work to its failing shear stress. The composite sandwich panel shear strength at normal temperature ( $75^{\circ} \pm 5^{\circ}\text{F}$ ) shall be 80 psi (551,584 N/m<sup>2</sup>) in the  $T_L$  direction parallel to the core ribbons. Testing shall be in accordance with 4.8.1.

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3.3.1.1.2 Impact resistance. A 24-inch (in) (0.610-m) square sample of all exterior shelter panel(s) shall withstand a blow from a 70-pound (lb) (31.8-kilogram (kg)) steel cylinder (3 in (76.2 millimeter (mm)) in diameter with a hemispherical end) dropped from a height of 16 in (0.306 m) for 2.5 lb core density and 30 in (0.762 m) for 3.8 lb core density without rupture to either skin and no delamination between skins and core outside a 3-in (76.2-mm) radius from the center of impact. Localized crushing of the core is allowable. Testing shall be in accordance with 4.8.2.

3.3.1.2 Surface preparation of aluminum alloys to be adhesively bonded in honeycomb shelter panels. Preparation of clean uniform surfaces of aluminum alloys suitable for formation of durable adhesive bonds to nonmetallic honeycomb materials in the manufacture of sandwich panels for the shelter assembly shall be in compliance with ASTM E-864-92. Honeycomb core material must comply with ASTM E-1091-92.

3.3.1.3 Structural film adhesives for honeycomb sandwich panels. Film adhesives used for bonding of honeycomb sandwich panels used in the shelter assembly shall be in accordance with ASTM E-865-92 and shall be suitable for forming bonds which can withstand long exposures to temperatures from -70°F (-56.7° Celsius (C)) to +160°F (+71.1°C) and also withstand the combinations of stress, temperature, and relative humidity expected to be encountered in service. The adhesives shall be used for bonding aluminum alloy facings to nonmetallic core, inserts, edge attachments and other components of a sandwich panel. The adhesives may be used for new production or depot repair. Honeycomb core materials shall meet requirements of ASTM E-1091-92. The adhesive shall meet the requirements of the test specified in 4.4.18. This requirement is to ensure the adhesive quality has not deteriorated due to inadequate surface preparation, improper mix of ratios, contamination, long-term storage conditions, etc., and during fabrication of sandwich panels, the test specified in 4.8.18 shall be performed on a daily basis.

3.3.1.4 Corrosion-inhibiting adhesive primer for aluminum alloys to be adhesively bonded in honeycomb shelter panels. Primer shall be a sprayable, pigmented liquid primer for use on aluminum alloys which are to be adhesively bonded in the fabrication of honeycomb sandwich panels for the shelter assembly. When applied to a properly cleaned surface of aluminum alloy, the primer shall impart corrosion resistance and form a suitable surface suitable for structural bonding using adhesives complying with ASTM E-865-92 and for coating with shelter paint finishes. Corrosive-inhibiting adhesives primer shall comply

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with standards contained in ASTM E-866-92. All surfaces to be bonded shall comply with this standard or meet performance standards using alternative chemical treatment processes to be specifically approved by the contracting agency.

3.3.1.5 Adhesive bonding of aluminum facings to nonmetallic honeycomb core for shelter panels. Materials, processes and quality controls to be used in the manufacture of adhesive-bond, aluminum faces, nonmetallic, honeycomb core sandwich panels for the shelter assembly shall comply with the standards contained in ASTM E-874-89.

3.3.1.6 Core splice adhesive for honeycomb sandwich shelter panels. The adhesive shall be suitable for forming bonds which can withstand long combinations of stress, temperature, and relative humidity expected to be encountered in service. The adhesive shall be used for bonding core segments, bonding core segments to edge members, and integral members in a honeycomb sandwich panel. The adhesive shall not allow the transfer of water from one part of the panel to another either through or along the line of the adhesive.

3.3.2 Fastenings and joints. Welding, riveting and sealing of joints shall comply with the applicable standards and drawings in Data List DL80A5022A0000.

3.3.3 Panel flatness. Panel surfaces shall not be cupped or bowed in excess of 0.125 in (3.175 mm) when measured with a 48-in (1.219-m) long straightedge (for testing see 4.8.3).

3.3.4 Interchangeability. Like demountable hardware and components of the shelter shall be interchangeable.

3.3.5 Ease of operation. The demountable side panels and air conditioner panels shall permit repetitive installation and removal without binding or other loss of serviceability. Doors shall operate smoothly, maintaining adequate sealing at all times. The entire assembly shall be capable of multiple assembly and disassembly operations without degradation of components.

3.3.6 Forklift pockets. The shelter assembly shall have forklift pockets in accordance with the applicable drawings. The inner pair of pockets is intended to be used when the assembly is lifted singly in its shipping configuration while the outer pair of pockets is intended for use when the assemblies are stacked in their shipping configuration up to four assemblies high. In no case should the shelter assembly be forklifted when erected even over short distances. Testing shall be in accordance with 4.8.4.

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3.3.7 Blackout curtain kit. When specified (see 6.2), the blackout curtain kit shall be manufactured in accordance with Data List DL80A5022A0357 and shall prevent the exit of light from internal to the shelter assembly to external during entry or egress by personnel. The blackout curtain shall be constructed from black nylon fabric, 2.2 ounces per square yard (74.6 gram (gm) per square meter) and coated with neoprene, 10.5 ounces per square yard (356 gm per square meter.)

3.3.8 Electrical. The shelter assembly shall contain an electrical service entrance consisting of a 3-phase, 5-wire, wye-connected, 120/208-volt (V), 60-hertz (Hz), 60-ampere (A) circuit. The service shall be protected by a 3-phase, 60-A circuit breaker. Branch circuits to light fixtures and convenience outlets shall be protected by 15-A, single phase circuit breakers. All wiring shall conform to NFPA 70-93 and shall be housed in an electrical metallic tubing conduit. The service entrance shall have one quick disconnect inlet (MS9055C32412P) and one quick disconnect outlet (MS9055C32412S) which are to be wired in parallel with phase rotation kept the same on input and output. All light fixtures, load center, distribution wiring and wiring devices shall be surface mounted. Eight surface mounted, 3-prong, 120-V, 15-A, 60-Hz duplex convenience outlets shall be provided. Seven 2-bar, 40-watt (W), rapid start, surface mounted fluorescent light fixtures shall be provided, switchable from a single switch mounted as shown on the applicable drawings. Testing shall be in accordance with 4.8.6.

3.3.9 Leveling. The shelter assembly shall have a device at each corner to indicate level when the floor is level to within 1/16 in 6 ft (1.6 mm in 1.829 mm). Leveling shall be accomplished utilizing jacks and corresponding fittings at the corners. These jacks shall be supplied with each shelter in accordance with the applicable drawings. The jacks and fittings shall withstand the force applied during the test specified in 4.8.7.

3.3.10 Fire resistance. The shelter assembly shall be fire resistant and shall meet the test requirements of 4.8.8.

3.3.11 Coast Guard certification. The shelter assembly, when stacked four high in the shipping configuration, shall be certified as an 8-ft x 8-ft x 20-ft, 1C container for its tare weight in accordance with the applicable Coast Guard regulation for such containers for all types of transport, including motor carrier (truck), sea, railroad, and air. Qualification shall be in accordance with the requirements of ISO 1496/I. At a minimum, testing shall be in accordance with 4.8.9 through 4.8.13.

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3.3.12 Complexing. The shelter assembly shall be capable of complexing with any other similar shelter assemblies both end-to-end or side-to-side to form either a 40-ft (12.2-m) wide by any length devisable by 8-ft (2.44-m) or a 20-ft (6.1-m) wide by any length devisable by 8-ft (2.44-m) shelter assembly. It shall be capable of complexing side-to-side with a rigid shelter built in accordance with MIL-S-29410. Complexing shall be done using complexing kits built in accordance with MIL-S-29412.

3.3.13 Metal fabrication. Metal used in the fabrication of equipment shall be free from kinks and sharp bends. The straightening of material shall be done by methods that will not cause injury to the metal. Shearing and punching shall be done neatly and accurately. Corners shall be square and true. All bends of a major character shall be made with controlled means in order to ensure uniformity of size and shape.

3.3.14 Facing material. Panel facings shall be one piece seamless aluminum alloy skins of a material and thickness specified on the applicable drawings. All edges of aluminum faced honeycomb panels shall be completely sealed to prevent water intrusion between the laminates.

3.3.15 Bolted and riveted connectors. Bolt and rivet holes shall be accurately punched or drilled and shall have the burrs removed. Washers, lockwashers, or locknuts shall be provided where necessary and all bolts, nuts and screws shall be tight. Rivet heads, when not countersunk or flattened, shall be of uniform size and shape for the same diameter rivet, concentric with the rivet holes, and in full contact with the surface.

3.3.16 Welding. The surface of the parts to be welded shall be free from rust, scale, paint, grease or other foreign matter. Weld penetration shall be such as to provide transference of maximum design stress through the base metal juncture. Fillets shall be as specified on the applicable drawings.

3.3.17 Castings. Castings shall be sound and free from patching, misplaced coring, warping or defects.

3.3.18 Seals. Seals shall be installed so that the fit within the retaining track is snug and continuous contact is maintained with mating seal faces. Metered end junctions of vertical and horizontal seal runs shall be accurate, and gaps shall be sealed as specified on the applicable drawings. The resulting shelter assembly shall have an air volume leak rate of less than 200 standard cubic ft/minute (scfm) (60.96 standard m<sup>3</sup>/min) with an internal pressure of 1.2 in H<sub>2</sub>O (30.48 mm H<sub>2</sub>O).

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3.4 Maintainability. The shelter assembly has been designed so that as much of the maintenance, as possible, may be performed as far forward (preferably by the using unit), as feasible, within the Marine Corps maintenance structure, in accordance with MCO P4790.1.

3.5 Transportability.

3.5.1 Stacking. The shelter assembly shall withstand the requirements of the Coast Guard intermodal transportation requirements for land, sea and air transport as a 20-ft, 1C shipping configuration when stacked and vertically coupled together to form a 20-ft, 1C shipping container (four shelter assemblies). The gross weight is equal to the tare weight. Testing shall be in accordance with 4.8.15.7.

3.5.2 Railroad transportability. The shelter assembly in its shipping configuration, when stacked four high, shall withstand without damage the shocks normally induced by transport by the railroads and shock induced by MIL-STD-810, Method 516.4, Procedure VIII. Testing shall be in accordance with 4.8.16.3.

3.6 Environmental requirements.

3.6.1 Rainfall. The shelter assembly shall withstand rainfall up to and including 5 in per hour (in/hr) (12.7 cm per hour (cm/hr)) without leakage at any location. Testing shall be in accordance with 4.8.15.1.

3.6.2 Temperature-humidity. In storage, the shelter assembly shall be capable of withstanding exposure to temperatures of -70°F (-56.7°C) to 160 °F (71.1°C). In transit, the shelter assembly shall be capable of withstanding exposure to temperatures of -65°F (-53.9°C) to 160°F (71.1°C) with personnel access at low end of range. Operational temperature of shelter assembly shall be -65° (-53.9°C) to 125°F (51.7°C) plus solar load (see 3.6.8). The shelter assembly shall withstand daily exposure of up to 97 percent relative humidity for 20 hours and exposure of 100 percent relative humidity (with condensation) for 4 hours. Testing shall be in accordance with 4.8.15.4.

3.6.2.1 Thermal shock. The shelter assembly shall withstand sudden temperature changes from 160°F (71.1°C) to -70°F (-56.7°C) to 160°F (71.1°C) without separation, delamination, cracks or degradation of physical properties. Testing shall be in accordance with 4.8.15.4.

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3.6.2.2 Heat transfer. The shelter assembly shall maintain an overall average heat transfer coefficient less than or equal to 0.35 British Thermal Unit (BTU)/hr-ft<sup>2</sup>-°F (1.99 W/m<sup>2</sup>-°K). Testing shall be in accordance with 4.8.15.5.

3.6.3 Snow and ice. The shelter assembly shall be capable of functioning in accordance with the requirements of this specification during the periods of snow and ice storms. The shelter shall inhibit the collection of snow and ice so that its primary function is not degraded. The shelter shall be capable of snow loads of up to 40 lbs per square ft (1,915 N/m<sup>2</sup>) in addition to its internal load.

3.6.4 Wind. The shelter assembly shall be capable of withstanding steady state wind speeds of up to 65 mph (104 km/hr) and gusts up to 120 mph (192 km/hr), static load of the door of 15 lbs per square ft (718 N/m<sup>2</sup>) and a dynamic load on the door of 50 lbs (22.7 kg) applied to the midpoint of the locking edge acting in a horizontal plane perpendicular to the front panel of the door in both directions, the force increased by dropping the weight (50 lbs) a distance of 12 in (0.305 m). Testing shall be in accordance with 4.8.15.6. In winds in excess of 55 mph (88 km/hr), ground anchors are required.

3.6.5 Roof load. The shelter assembly shall withstand a uniform load for 40 lbs per square foot (1,915 N/m<sup>2</sup>) over the entire roof of the shelter without permanent damage and a concentrated load of 660 lbs (300 kg) over an area 24 in x 12 in (0.610 m by 0.305 M) without permanent damage rendering the shelter assembly unusable. Testing shall be in accordance with 4.8.15.8 and 4.8.15.9.

3.6.6 Sand and dust. The shelter assembly shall withstand the sand and dust effects on all external moving parts with particle concentrations of 0.000132 pounds per cubic foot (lb/cu-ft<sup>3</sup>) (2.19 gm/m<sup>3</sup>), with wind velocity of 1,750 ± 250 ft/min (533 ± 76.2 m/min) without degradation. Such particles shall range in size from 0.00294 in (0.150 mm) up to 0.0197 in (1.0 mm) with relative humidity less than 23 percent. Testing shall be in accordance with 4.8.15.11.

3.6.7 Sunshine. The shelter assembly shall withstand the effects of ultraviolet radiation (sunshine) without significant degradation or effect on serviceability of the assembly's components or materials during the service life of the shelter assembly, and shall withstand the test requirements of MIL-S-810, Method 505.1. Testing shall be in accordance with 4.8.15.11.

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3.6.8 Solar load. The shelter assembly shall withstand a solar heat load on its roof sufficient to raise the outer skin to at least 200°F (93.3°C) without any evidence of delamination or permanent deformation. Testing shall be in accordance with 4.8.15.12.

3.6.9 Marine environment. The shelter assembly shall be fully serviceable when exposed to sea-salt fallout equivalent to 25 pounds/acre/year (2.8 gm/m<sup>2</sup>/year. All fasteners, jacks, seals, or other hardware shall show no evidence of corrosion or degradation when tested as required by 4.8.15.13.

3.6.10 Drop shock. The shelter assembly shall withstand without damage the following drop shock when tested as a single unit in the shipping configuration and when four assemblies are connected vertically, in their shipping configuration, to form a 20-ft, 1C ISO shipping container. After each test, there shall be no permanent deformation, buckling, delamination, sealer separation or structural failures to any part of the shelter assembly. Doors and covers shall open to their full extent without binding.

3.6.10.1 Flat drop. The shelter assembly shall withstand a flat drop of 12 in (300 mm) from the ground onto a concrete surface when in its shipping configuration, both singly and when stacked vertically up to four high. Testing shall be in accordance with 4.8.16.1.

3.6.10.2 Rotational drop. The shelter assembly in its shipping configuration, both singly and when stacked four high, shall withstand rotational drops, with one edge placed on a 4-in (102-mm) block and the opposite edge raised 12 in (305 mm) and allowed to free fall onto a concrete surface with the four in (102 mm) block acting as a pivot. Testing shall be in accordance with 4.8.16.2.

3.6.11 Blackout. The shelter assembly shall be light-tight with the door closed. The shelter assembly shall have built in inserts for blackout curtains and associated electrical switches. When equipped with a blackout curtain kit built in accordance with DL80A5022A0357, light shall not escape during entry/egress. A small amount of light is permissible around bottom of curtain. Testing shall be in accordance with 4.8.17.1.

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3.6.12 Floor loading. The floor of the shelter assembly shall be capable of withstanding uniform floor loads of 65 lb/ft<sup>2</sup> (3,112 N/m<sup>2</sup>) over the entire area of the floor and a uniform concentrated load of 2,000 lbs (8,896 Newtons) over a 4-ft<sup>2</sup> (0.372-m<sup>2</sup>) area. Testing shall be in accordance with 4.8.17.2.

3.7 Dimensional characteristics. The exterior envelope of the shelter assembly shall comply with ISO Shipping Container Standards as defined in ISO 1496/I for a 20-ft (6.096-m) container. The applicable drawings fully describe all pertinent dimensions and tolerances. Should any dimensions and tolerances result in a component or assembly which will not meet the requirements of this specification, the supplier is responsible for fabrication techniques which will prevent the occurrence of such dimensions and tolerances. Testing shall be in accordance with 4.8.7.

3.8 Weight. The tare weight of the shelter assembly including all permanent accessories shall be 3,685 lbs ± 5 percent (16,391 Newtons ± 5 percent). The actual shelter weight shall be stamped on the nameplate.

### 3.9 Finish

3.9.1 Surface preparations. All surfaces shall be prepared for painting as specified on the applicable drawings. All aluminum alloy materials shall be protected by a chemical film conforming to MIL-C-5543 even if a final finish is not yet applied.

3.9.2 Priming. All surfaces to be painted shall be primed as specified on the applicable drawings. Panel edge members and frames shall be processed in accordance with ASTM E-864-92 and protected from corrosion by a chemical conversion coating in accordance with MIL-C-5541, class 3, or a corrosion inhibiting adhesive primer in accordance with AST E-866-92.

3.9.3 Final finish. Painted surfaces shall be as specified on the applicable drawings.

3.10 Marking. Marking shall be in accordance with Drawing No. 80A5022A0036 and in compliance with coding, marking and Convention for Safe Containers (CSC) plating requirements established in MCO 4035.6.

3.10.1 Identification. Each shelter assembly shall have the following information provided on a serial plate permanently affixed to the shelter assembly in accordance with MIL-STD-130:

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Manufacturer:  
Model:  
Type:  
Serial No.: (As assigned by the Procuring Agency)  
Weight:

3.10.2 Certification. Each shelter assembly shall carry the appropriate certification (CSC safety approval plate) from the approval authority as to its capability to act as a shipping container.

3.11 Workmanship. All parts, components and assemblies of the shelter assembly, including casting, forgings, molded parts, stampings, seals and sealing agents, machined surfaces and welded parts shall be clean and free from any defects that will reduce the capability of the shelter assembly to meet the requirements specified herein. Any components and assemblies which have been repaired or modified to overcome deficiencies or deficient components or assemblies which are determined to be used "as is" shall not be used unless authorized by the contracting agency.

#### 4. QUALITY ASSURANCE

4.1 Responsibility for inspection. Unless otherwise specified in the contract or purchase order, the contractor is responsible for the performance of all inspections specified herein. Except as otherwise specified in the contract or purchase order, the contractor may use his own or any other facilities suitable for the performance of the inspection requirements specified herein, unless disapproved by the Government. The Government reserves the right to perform any of the inspections set forth in the specification where such inspections are deemed necessary to assure supplies and services conform to prescribed requirements.

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

- a. First article inspection (see 4.4)
- b. Quality conformance inspection (see 4.5)
- c. Individual inspection (see 4.6)
- d. Daily inspection (see 4.7)

4.3 Inspection conditions. Unless otherwise specified, all inspections shall be performed in accordance with the test conditions specified in 4.4, 4.5, 4.6, and 4.7.

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4.4 First article inspection. Prior to beginning production of the shelter assemblies, the contractor shall fabricate one 3 ft 6 in x 7 ft 9 in honeycomb shelter panel and four first article shelter assemblies and subject them to the tests specified in Table I.

4.5 Quality conformance inspection. From each shipping lot as defined in the contract, a single shelter assembly shall be chosen at random by the Government and subjected to the tests specified in Table I. Failure of any test shall be cause for inspection of the entire lot at the contractor's expense for similar defects. Defective shelter assemblies shall not be delivered without correction of the deficiency and then only with the permission of the contracting officer.

4.6 Individual inspection. Each shelter assembly shall be subjected to the inspections and test specified in Table I. Failure to meet the requirements of the drawings and this specification shall be cause for rejection. No shelter assembly shall be reworked and retested without the expressed permission of the contracting agency.

4.7 Daily inspections. During the manufacture of the honeycomb panels, daily inspections shall be performed (see 4.8.18).

4.8 Inspection and tests.

4.8.1 Sandwich panel shear. Five preproduction sandwich panel shear specimens shall be subjected to MIL-STD-401, Test Method 5.2.4.1. The specimens shall be deemed acceptable if a shear stress in excess of 80 psi (551,584 N/m<sup>2</sup>) of the T<sub>1</sub> direction parallel to the core ribbons is achieved. The contracting agency reserves the right to require testing of production panels to the same criteria.

4.8.2 Impact resistance. A 24-in by 24-in (0.609-m by 0.609-m) sample of each exterior shelter panel, roof and floor shall be tested in accordance with MIL-STD-907. An exception is made for 2.5 lb core density panel where the drop height of the cylinder shall be 16 in.

4.8.3 Panel flatness. The shelter assembly shall be tested in accordance with MIL-STD-907.

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TABLE I. Tests

INSPECTION	REQ PARA	TEST PARA	1ST ART	QUAL CONF	IND
Sandwich panel shear	3.3.1.1.1	4.8.1	X		
Impact resistance	3.3.1.1.2	4.8.2	X		
Panel flatness	3.3.3	4.8.3	X	X	
Lift by fork pockets	3.3.6	4.8.4	X		
Dimensional	3.7	4.8.5	X	X	X
Electrical	3.3.8	4.8.6	X	X	X
Erecting, leveling, and striking	3.3.9	4.8.7	X	X	X
Fire resistance	3.3.10	4.8.8	X		
Transverse and longitudinal rigidity	3.3.11	4.8.9	X		
Lifting from top	3.3.11	4.8.10	X		
Lifting from bottom	3.3.11	4.8.11	X		
Longitudinal restraint	3.3.11	4.8.12	X		
Coast Guard certification	3.3.11	4.8.13	X		
Complexing	3.3.12	4.8.14	X		
Watertightness	3.6.1	4.8.15.1	X		
Humidity resistance	3.6.2	4.8.15.2	X		
Temperature range	3.6.2	4.8.15.3	X		
Temperature shock	3.6.2.1	4.8.15.4	X		
Heat transfer	3.6.2.2	4.8.15.5	X		
Door load	3.6.4	4.8.15.6	X		
Stacking	3.5.1	4.8.15.7	X		
Roof load, uniform	3.6.5	4.8.15.8	X		
Roof load, concentrated	3.6.5	4.8.15.9	X		
Blowing sand	3.6.6	4.8.15.10	X		
Sunshine	3.6.7	4.8.15.11	X		
Solar load	3.6.8	4.8.15.12	X		
Marine atmosphere	3.6.9	4.8.15.13	X		
Drop shock	3.6.10.1	4.8.16.1	X		
Rotational drop	3.6.10.2	4.8.16.2	X		
Railroad transport	3.5.2	4.8.16.3	X		
Blackout	3.6.11	4.8.17.1	X	X	
Floor load	3.6.12	4.8.17.2	X		
Airtightness	3.3.16	4.8.17.3	X	X	

4.8.4 Lift by fork pockets. The shelter assemblies to be tested shall be stacked vertically four high in their shelter configuration. The shelter assemblies shall be supported by two horizontal bars, each 8 in (20 mm) wide, all the way through the outer fork pockets of the bottom assembly with sufficient length protruding outside the walls to attach lifting cables. The shelter assemblies shall then be lifted clear of the ground,

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supported for 5 minutes and then lowered to the ground. Upon completion of the test, the shelter assemblies shall show neither permanent deformation nor abnormality which will render them unsuitable for use.

4.8.5 Dimensional. The length (L), width (W), height (H), and diagonals (K1 and K2) shall be measured and recorded for each shelter assembly. The requirements of Tables 3 and 4 of ISO 668 shall be satisfied for a 20-ft, 1C container.

4.8.6 Electrical. The shelter assembly shall be erected and connected to a 120/108-V, 3-phase, 5-wire, 60-A electrical power source. The lights shall be turned on and operate properly. Each convenience outlet shall be checked with a voltmeter to assure 120 V between line and neutral and line and ground, and zero voltage between neutral and ground. Each lamp shall be visually checked for its protective shield. During the first article inspection, only the phase rotation of the output connector shall be verified as the same as the input phase rotation using a 3-phase motor and assuring that its direction of rotation is identical.

4.8.7 Erection, leveling, and striking. The shelter assembly shall be erected and leveled so that all level indicators are centered. The floor shall be checked using a 6-ft (1.830-m) long level for both lateral and longitudinal level at each end of the shelter assembly. Any indication of slant in excess of 1/16 in (1.6 mm) over 6 ft (1.830 m) shall be cause for rejection. While erected, the shelter assembly shall be subjected to tests in MIL-STD-907, except the height is limited to 18 in (0.457 m), during first article and quality conformance inspection. Any level which cannot be centered shall be cause for rejection. The shelter assembly shall then be struck and assembled in the shipping configuration.

4.8.8 Fire resistance. Two 12-in by 12-in (300-mm by 300-mm) specimens of a production sandwich panel shall be subjected to tests in MIL-STD-907.

4.8.9 Transverse and longitudinal rigidity. Four shelter assemblies shall be stacked vertically four high in their shipping configuration and placed on four level supports, one under each corner fitting of the bottom shelter. They shall be restrained against lateral and vertical movement by means of anchor devices, acting through the bottom apertures of the bottom corner fittings. Lateral restraint shall be provided only at a bottom corner fitting diagonally opposite to and in the same end frame as a top corner fitting to which force is applied. When testing the two end frames separately, vertical restraint shall

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be applied only at the end frame under test. A force of 33,600 lbs (149,460 Newtons) shall be applied either separately or simultaneously, to each of the top corner fittings on one side of the shelter assemblies under test in lines parallel to both the base and to the planes of the ends. The forces shall be applied first towards, then away from, the top corner fittings. Upon completion of the test, the shelter assemblies shall show neither permanent deformation nor abnormality which will render them unsuitable for use, and shall meet the requirements of 4.8.5. This test shall be repeated with the forces acting parallel to the long side of the shelter assembly.

4.8.10 Lifting from the top. The shelter assemblies under test shall be stacked vertically four high in their shipping configuration and coupled together with appropriate vertical connectors. They shall then be carefully lifted from the side apertures of all four bottom corner fittings in such a way that no significant acceleration or deceleration forces are applied. Lifting forces shall be applied at 45° from the vertical, parallel to the long sides of the shelter assemblies. In each case, the line of action of the lifting forces and the outer face of the corner fitting shall be no further apart than 1.5 in (38 mm). The lifting devices shall be carried out in such a manner that the lifting devices bear on the bottom corner fittings only. The shelter assemblies shall be suspended for 5 minutes and then lowered carefully to the ground. Upon completion of the test, the shelter assemblies shall show neither permanent deformation nor abnormality which will render them unsuitable for use and the dimensional requirements of 4.8.5 shall be satisfied.

4.8.12 Longitudinal restraint. The shelter assemblies under test shall be stacked vertically four high in their shipping configuration and coupled together with the appropriate vertical connectors. They shall then be restrained by rigid anchor points, two on one end only. These anchors shall be through the bottom apertures of the bottom corner fittings. A force of twice the tare weight of the stacked shelter assemblies shall be applied horizontally to the shelter assembly through the bottom apertures of the other two corner fittings, first towards, then away, from the anchor points. Upon completion of the test, the shelter assemblies shall show neither permanent deformation nor abnormality which will render them unsuitable for use and the dimensional requirements of 4.8.5 shall be satisfied.

4.8.13 Coast Guard certification. The shelter assembly shall be tested for Coast Guard certification. If there is any damage to the shelter due to these tests, it will be the responsibility of the contractor to repair the damage or make any corrections necessary for the shelter assembly to pass Coast Guard

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certification at his own expense. A certificate of Coast Guard approval shall be furnished and Coast Guard certification plates shall be attached to each delivered shelter assembly.

4.8.14 Complexing. Four shelter assemblies shall be complexed side-to-side and end-to-end to form a 16-ft x 40-ft shelter using complexing kits conforming to MIL-STD-29412. Any failure to meet, match and otherwise fit together shall be cause for rejection.

4.8.15 Environmental tests.

4.8.15.1 Watertightness. The shelter assembly in its erected configuration shall be subjected for a period of 30 minutes to a simulated rainfall of  $5 \pm 1$  in per hour, as measured by a U.S. Weather Bureau type gauge. Direction of the rainfall shall be angled at 45 degrees from the vertical and the nozzles so spaced to ensure even dispersion over the test area. This test shall be repeated with the shelter assembly in its shipping configuration. The shelter assembly, without the use of any external sealing, caulking, taping, etc., shall show no evidence of leakage.

4.8.15.2 Humidity resistance. The shelter assembly shall be subjected to MIL-STD-810, Method 507.1, Procedure II, excluding steps 2-4, 7, and 8, in its shipping configuration. After cycling, the shelter assembly shall be erected and shall show no evidence of delamination, cracking, corrosion or deterioration of any part of the shelter assembly. The shelter assembly shall be energized electrically and the lights shall function normally.

4.8.15.3 Temperature range. The shelter assembly in its erected configuration shall be cold soaked in a mechanically refrigerated cold chamber at  $-70^{\circ}\text{F}$  ( $-56^{\circ}\text{C}$ ) for a minimum of 16 hours. The chamber temperature shall then be raised to  $-65^{\circ}\text{F}$  ( $-53.9^{\circ}\text{C}$ ). The shelter assembly doors shall be opened and closed (both the standard door and the emergency escape hatch). Any malfunction shall be recorded and reported. The shelter assembly shall be visually examined both internally and externally for material degradation. There shall be no damage to seals or other components and all hardware shall operate as specified during and after completion of this test.

4.8.15.4 Temperature shock. A representative shelter panel specimen measuring 3 ft 6 in (1.066 m) by 7 ft 9 in (2.362 m) shall be subjected to MIL-STD-810, Method 503.1. There shall be no separation, cracks, delamination or degradation of physical properties after completion of this test.

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4.8.15.5 Heat transfer. The shelter assembly in its erected configuration shall be subjected to heat transfer test in accordance with MIL-STD-907. The overall heat transfer coefficient shall be determined and the requirements of 3.6.2.2 shall be satisfied.

4.8.15.6 Door loads. The standard personnel door on the shelter assembly under test shall be subjected to tests specified in MIL-STD-907 for static and wind gust loading. Any evidence of unbonded components, damage to hardware, or improper open door operation shall constitute failure of this test.

4.8.15.7 Stacking. The shelter assemblies under test shall be stacked vertically four high in their shipping configuration, coupled together with appropriate vertical connectors and placed on four level pads, one under each bottom corner fitting. The pads shall be centered under the fittings and be substantially of the same plane dimensions as the fittings. The shelter assemblies under test shall then be subjected to a vertical force equivalent to a load of 100,000 lbs (45,773 kg), applied for 5 minutes simultaneously on each pair of end fittings in such a manner that the planes of application of the forces and the support of the shelter assemblies remain horizontal and unchanged during the test. The forces shall be applied through a corner fitting or a pad of the same plane area as a corner fitting. Each pad shall be offset in the same direction by 1 in (25.4 mm) laterally and 1.5 in (38mm) longitudinally. Upon completion of the test, the shelter assemblies shall show neither permanent deformation nor abnormality which will render them unsuitable for use and the dimensional requirements of 4.8.5 shall be satisfied.

4.8.15.8 Roof load, uniform. The shelter assembly under test shall be erected and placed on the ground and leveled. The roof of the shelter assembly shall then be loaded uniformly with a weight of 6,400 lbs (2,903 kg) (40 lbs/square foot) and allowed to remain loaded for a period of 5 minutes. Upon completion of the tests, the shelter assembly shall show neither permanent deformation nor abnormality which will render it unsuitable for use and the dimensional requirements of 4.8.5 shall be satisfied.

4.8.15.9 Roof load, concentrated. A load of 660 lbs (300 kg) shall be uniformly distributed over an area of 12 in by 24 in (300 mm by 600 mm) located at the weakest area of the rigid roof of the shelter assembly (centered on the roof). This load shall be allowed to remain there for a period of 5 minutes. Upon completion of the test, the shelter assembly shall show neither permanent deformation nor abnormality which will render it unsuitable for use and the dimensional requirements of 4.8.5 shall be satisfied.

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4.8.15.10 Blowing sand. The shelter assembly in its erected configuration shall be subjected to blowing sand test in accordance with MIL-STD-907. There shall be no damage to seals or other components and all hardware shall operated as specified herein upon completion of this test.

4.15.11 Sunshine. Representative samples of all gaskets and seals, as well as a 12-in by 12-in (300-mm by 300mm) panel sample, shall be subjected to MIL-STD-810, Method 505.1, Procedure I. Upon completion of this test, the samples shall be examined and any evidence of degradation of physical properties shall constitute failure of this test.

4.8.15.12 Solar load. The shelter assembly shall be subjected to solar load test-assembled shelter in accordance with MIL-STD-907. Upon completion of the solar load test, the roof panels shall be examined and any evidence of delamination or deformation will constitute failure.

4.8.15.13 Marine atmosphere. One representative sample of each fastener, jack, seal, panel, and other hardware which will be exposed to the atmosphere in the operation and storage modes shall be finished in accordance with the applicable drawings and subjected to tests as described in MIL-STD-810, Method 509.1, except that the salt solution shall have a concentrate of 10 percent and the exposure period shall be 96 hours. The test items shall show no evidence of corrosion upon completion of the test.

4.8.16 Shock tests.

4.8.16.1 Drop shock. The shelter assemblies shall be stacked vertically four high in their shipping configuration, coupled together with appropriate vertical connectors, and lifted 12 in (300 mm) above a flat concrete surface. The distance between the concrete surface and each lower corner fitting of the shelter assemblies under test shall not vary more than 0.5 in (12.7 mm) at the time of the drop. The shelter assemblies shall then be allowed to free fall to the concrete surface. Upon completion of the test, the shelter assemblies shall show neither permanent deformation nor abnormality which will render them unsuitable for use and the dimensional requirements of 4.8.5 shall be satisfied. The test shall be repeated with a single shelter in its shipping configuration.

4.8.16.2 Rotational drop. The shelter assemblies shall be stacked vertically four high in their shipping configuration, coupled together with appropriate vertical connectors and with one edge supported 4 in (102 mm) above a flat concrete surface.

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The opposite edge shall be lifted a distance of 12 in (300 mm) above the concrete surface and allowed to free fall onto the surface. This procedure shall be repeated until each edge has been allowed to free fall. Upon completion of the test, the shelter assemblies shall show neither permanent deformation nor abnormality which will render them unsuitable for use and the dimensional requirements of 4.8.5 shall be satisfied. This test shall be repeated with a single shelter in its shipping configuration.

4.8.16.3 Railroad transport. The shelter assemblies under test shall be stacked vertically four high in their shipping configuration, coupled with appropriate vertical connectors and subjected to MIL-STD-810, Method 516.4, Procedure VIII. The shelter assemblies shall be subjected to impacts at speeds of 4, 6, and 8 mph in one direction and at 8 mph in the opposite direction. Upon completion of the test, the shelter assemblies shall show no permanent deformation or abnormality which will render them unsuitable for use and the dimensional requirements of 4.8.5 shall be satisfied.

4.8.17 Construction and assembly tests

4.8.17.1 Blackout. The shelter assembly under test shall be erected and placed in an area of complete darkness, connected electrically to the appropriate power source and with the lights energized. With all apertures closed and latched, if applicable, and all internal light fixtures operating, no light shall be visible from outside the shelter in any direction. This shall be verified by an observer from all sides at a distance of 10 ft and the top from 5 ft. If so equipped, the blackout curtain shall be placed in its track. The door shall be used to enter and exit the shelter. Any visible light shall be recorded.

4.8.17.2 Floor load. The shelter assembly under test shall be subjected to the test method contained in MIL-STD-907.

4.8.17.3 Airtightness. The shelter assembly under test shall be erected and subjected to the test contained in MIL-STD-907 with all openings closed and latched, if applicable, except the port supplying the make-up air.

4.8.18 Adhesive shear. A minimum of five sample adhesive shear specimens shall be prepared and tested daily as specified in 3.3.1.1.1 in accordance with ASTM E-865-92 procedure. The tests shall be conducted at normal temperature,  $75^{\circ} \pm 5^{\circ}\text{F}$  ( $23.9^{\circ} \pm 2.8^{\circ}\text{C}$ ). Tests shall be considered satisfactory if the shear stress developed exceeds 2,903 psi (20m015,600 N/m<sup>2</sup>). Results of

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the tensile pull tests shall be recorded and identified as to the day of the test and the lot from which the adhesive was taken. Failure of any specimen shall be cause for rejection of all panels bonded with that adhesive lot.

4.9 Test reports. The results of all testing shall be reported and written in compliance with MIL-STD-831 fully describing and illustrating the test procedures and test results.

## 5. PACKAGING

5.1 Preservation. The shelter assembly in its shipping configuration requires no additional preservation.

5.2 Packing. As the shelter assembly in its shipping configuration is an exterior shipping container, no protective media need be installed prior to shipment. Conventional methods of blocking, bracing and strapping are to be employed during shipment by rail, road and air as described in MIL-STD-1186. Removable markings shall be affixed in accordance with MIL-STD-129 to show cube weight, and destination specified by the contracting agency. When feasible, shelter assemblies shall be shipped in stacks of four coupled together with appropriate vertical connectors.

5.3 Marking. In addition to the marking required by 3.10, each shelter assembly shall be marked for shipment in accordance with the requirements of MIL-STD-129.

## 6. NOTES

6.1 Intended use. The shelter assembly covered by this specification is one of a family of shelters intended for use by air and ground U.S. Fleet Marine Forces to house and support tactical military equipment and operations in the field.

### 6.2 Ordering data.

6.2.1 Acquisition requirements. Acquisition documents should specify the following:

- a. Title, number and date of this specification.
- b. First article testing required (see 3.1.2).
- c. Blackout curtain required (see 3.3.7).

# STANDARDIZATION DOCUMENT IMPROVEMENT PROPOSAL

## INSTRUCTIONS

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

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

<b>1 RECOMMEND A CHANGE:</b>	1. DOCUMENT NUMBER MIL-S-29409B(MC)	2. DOCUMENT DATE (YYMMDD) 9 March 1994
3. DOCUMENT TITLE SHELTER ASSEMBLY, KNOCKDOWN		
4. NATURE OF CHANGE (Identify paragraph number and include proposed rewrite, if possible. Attach extra sheets as needed.)		
5. REASON FOR RECOMMENDATION		
<b>6. SUBMITTER</b>		
a. NAME (Last, First, Middle Initial)	b. ORGANIZATION	
c. ADDRESS (Include Zip Code)	d. TELEPHONE (Include Area Code) (1) Commercial (2) AUTOVON (if applicable)	7. DATE SUBMITTED (YYMMDD)
<b>8. PREPARING ACTIVITY</b>		
a. NAME  COMMANDER	b. TELEPHONE (Include Area Code) (1) Commercial (2) AUTOVON (703) 640-4584 278-4584	
c. ADDRESS (Include Zip Code) PROGRAM SUPPORT DIRECTORATE, PSE-C/S, MARCORSYSCOM, 2033 BARNETT AVE, SUITE 315, QUANTICO VA 22134-5010	IF YOU DO NOT RECEIVE A REPLY WITHIN 45 DAYS, CONTACT: Defense Quality and Standardization Office 5203 Leesburg Pike, Suite 1403, Falls Church, VA 22041-3466 Telephone (703) 756-2340 AUTOVON 289-2340	