



Standard Specification for Shelter, Tactical, Expandable, One-Side¹

This standard is issued under the fixed designation E 1977; the number immediately following the designation indicates the year of original adoption or, in the case of revision, the year of last revision. A number in parentheses indicates the year of last approval. A superscript epsilon (ϵ) indicates an editorial change since the last revision or reapproval.

This standard has been approved for use by agencies of the Department of Defense.

1. Scope

1.1 This specification covers a rigid wall, one-side expandable shelter constructed of aluminum-faced, nonmetallic honeycomb sandwich panels, and meeting the International Organization for Standardization (ISO) Cargo Container specification in the transport mode. Nominal dimensions when closed (container mode) are: height 8 ft, width 8 ft, and length 20 ft. (2.4 by 2.4 by 6.1 m) Approximate dimensions, when expanded (shelter mode) are: height 8 ft, width 15 ft, and length 20 ft (2.4 by 4.6 by 6.1 m).

1.2 The values stated in inch-pound units are to be regarded as the standard. The SI units given in parentheses are for information only.

1.3 The following precautionary statement pertains to the test method portion only. Section 7, of this specification; *This standard does not purport to address all of the safety concerns, if any, associated with its use. It is the responsibility of the user of this standard to establish appropriate safety and health practices and determines the applicability of regulatory limitations prior to use.*

2. Referenced Documents

2.1 ASTM Standards:²

- E 864 Practice for Surface Preparation of Aluminum Alloys to be Adhesively Bonded in Honeycomb Shelter Panels
- E 865 Specification for Structural Film Adhesives for Honeycomb Sandwich Panels
- E 866 Specification for Corrosion-Inhibiting Adhesive Primer for Aluminum Alloys to be Adhesively Bonded in Honeycomb Shelter Panels
- E 874 Practice for Adhesive Bonding of Aluminum Facings to Nonmetallic Honeycomb Core for Shelter Panels
- E 990 Specification for Core-Splice Adhesive for Honeycomb Sandwich Shelter Panels

- E 1091 Specification for Nonmetallic Honeycomb Core for Use in Shelter Panels
- E 1749 Terminology Relating to Rigid Wall Relocatable Shelters
- E 1773 Practice for Sealing Rigid Wall Tactical Shelters with Polysulfide Based Sealants
- E 1826 Specification for Low Volatile Organic Compound (VOC) Corrosion-Inhibiting Adhesive Primer for Aluminum Alloys to be Adhesively Bonded
- E 1925 Specification for Engineering and Design Criteria for Rigid Wall Relocatable Structures

2.2 ISO Standards:³

- ISO 1161-1980 Series 1-Freight Containers-Corner Fittings, Specification
- ISO 1496/I Series 1-Freight Containers-Specification and Testing Part I-General Cargo Containers
- ISO 9001 Quality Systems—Model for Quality Assurance in Design, Development, Production, Installation, and Servicing

2.3 Military Standards:⁴

- MIL-STD-129 Marking for Shipping and Storage
- MIL-STD-810 Environmental Engineering Considerations and Laboratory Tests

2.4 ANSI/ASQC Standard:

- ANSI/ASQC 21.4-1993 Sampling Procedures and Tables for Inspection by Attributes⁵

2.5 Drawings:⁶

- 5-4-2828 Shelter, Assembly, One-Side Expandable-60 amp
- 5-4-3200 Shelter, Assembly, One-Side Expandable-100 amp⁶

2.6 SAE Standards⁷

- SAE-AMS-STD-1595 Qualification of Aircraft, Missile, and Aerospace Fusion Welding

¹ This specification is under the jurisdiction of ASTM Committee E06 on Performance of Buildings and is the direct responsibility of Subcommittee E06.53 on Materials and Processes for Durable Rigidwall Relocatable Structures.

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² For referenced ASTM standards, visit the ASTM website, www.astm.org, or contact ASTM Customer Service at service@astm.org. For *Annual Book of ASTM Standards* volume information, refer to the standard's Document Summary page on the ASTM website.

³ Available from American National Standards Institute (ANSI), 25 W. 43rd St., 4th Floor, New York, NY 10036.

⁴ Available from Standardization Documents Order Desk, DODSSP, Bldg. 4, Section D, 700 Robbins Ave., Philadelphia, PA 19111-5098

⁵ Available from American Society for Quality (ASQ), 600 N. Plankinton Ave., Milwaukee, WI 53203.

⁶ Copies of drawings are available from US Army Natick Soldier Center, ATTN: AMSRD-NSC-CP-CS, Kansas Street, Natick, MA 01760-5018.

⁷ Available from Society of Automotive Engineers (SAE), 400 Commonwealth Dr., Warrendale, PA 15096-0001.

SAE-AMS-STD-2219 Fusion Welding for Aerospace Applications

3. General Requirements

3.1 *Alternate Components*—When this specification or the referenced drawings specify use of a specific component “or equal,” the contractor may substitute a component equal to the specified component provided that the contractor complies with the following requirements. Prior to manufacture of the first article, or if none is required, prior to commencing production, the contractor shall submit for the purchaser’s approval a list identifying each proposed “or equal” component together with proof that each listed component is functionally equal to the specified component and is compatible with the end item covered by this specification. The purchaser, at his option, may require a physical sample of any “or equal” component. Approval of the submitted listing and supporting data authorizes the commencement of fabrication of the first article or of production, as applicable, but does not relieve the contractor of the responsibility that the “or equal” components perform in accordance with specified requirements when incorporated into the end item.

3.2 *Materials and Components*—Materials and components shall conform to the documents listed in Section 2 and as specified herein. Any change to the proposed materials or processes must be approved by the purchaser. It is encouraged that recycled material be used when practical as long as it meets the requirements of this specification.

3.3 *Workmanship*—The shelter, including all parts and accessories, shall be constructed and finished in a workmanlike manner with particular attention given to removal of burrs and sharp edges, accuracy of dimensions, thoroughness of soldering, welding, painting, alignment of parts of assemblies, and the tightness of screws, bolts, and so forth. Gaskets shall not be torn or split and shall be free of finish. Cloth components shall be clean and free of holes, cuts, or tears. All latches utilized for erection and closing of the shelter shall be properly adjusted before the shelter is prepared for delivery to the purchaser.

3.4 *Riveting*—Riveting joints shall be tight. The joined parts shall be undamaged, and the rivet heads shall be properly seated and tight against the bearing surfaces. All the rivets, except those used in panel bonding, shall be dipped in polysulfide sealant just prior to insertion, however, a dab of polysulfide sealant shall be applied to the head of each rivet.

3.5 *Cleaning*—After fabrication, parts shall be cleaned in accordance with the drawings.

3.6 *Welding*—Welded joints shall be such that grinding of the finished weld shall not be a requirement, except when specified on the drawing. Spot, stitch, and seam welds shall be as indicated on the drawings. All surfaces to be welded shall be cleaned and free from scale, paint, grease, and other foreign materials. Welds shall have thorough penetration, good fusion and shall be free from scabs, blisters, abnormal pock marks, cracks, voids, slag inclusions, and other harmful defects. Welded assemblies shall be cleaned to remove any scale, oxidation products, and excess flux. Any acid used in cleaning shall be completely neutralized and removed. Welders shall be

certified in accordance with **SAE-AMS-STD-1595**. Welding equipment and procedures shall conform to **SAE-AMS-STD-2219**.

3.7 *Finish*—Coatings shall level out to an adherent, continuous and uniform film without runs, wrinkles, streaks, or areas of no film. Any coating damaged during assembly or examination shall be touched up. There shall be no areas of rust. Finish shall be free of blistering, peeling and chips.

3.7.1 *Adhesion of Paint*—The shelter shall be capable of withstanding, without degradation to the finish, the tests as specified in 7.37. After top coat application, the shelter in the deployed mode shall be stored for a minimum of 168 h at a minimum of 70°F (21°C) prior to performing this test.

3.7.2 *Color*—The color of the paint film shall be compared with an appropriate color chip for the paint specified.

3.7.3 *Thickness*—Thickness of the paint film shall be checked as specified in 7.39.

3.8 *Finish and Color*—Surfaces shall be of the color, treatment, and finish as shown on the drawings. Top coat painting shall be performed on the fully assembled shelter so as to prevent mismatch of color shading, unless other control techniques are approved by the purchaser. After top coat application, the shelter in the deployed mode (that is, expanded) shall be stored in a 70°F (21°C) minimum temperature indoor facility for a minimum of 36 h to ensure adequate coating(s) cure. During this storage period the shelter doors and vents shall be opened to permit air circulation within the shelter.

3.9 *Manuals*—Unless otherwise specified (see 13.2), technical manuals shall be provided with each shelter. Stowage provision for the manuals shall be located as shown on the applicable drawings.

3.10 Terminology related to this Specification is defined in Terminology **E 1749**.

4. Design and Construction Requirements

4.1 *Design and Construction*—Design and construction of the expandable shelter shall conform to the requirements specified on the drawings, all subsidiary drawings and parts lists and hereinafter. The shelter shall be free of panel delaminations and shall meet all physical and environmental requirements specified herein.

4.2 *Container Mode*—The shelter in the closed or transport mode shall be referred to as a container, hereinafter, for the purpose of definition. The shelter, in the container mode, shall be an article of transport equipment meeting ISO freight container requirements related to cargo containers. The shelter shall show no structural damage when tested as specified in 7.20, 7.22, 7.23, 7.28-7.35 and shall show no leakage when tested as specified in 7.24, 7.24.1-7.24.3. The contractor shall ensure that the shelter receives Coast Guard Certification for ISO Containers. The container overall dimensions shall be in accordance with ISO freight container designated IC and are as shown in **Table 1**.

4.3 *Panels*—The panels used as structural members in the container configuration shall meet structurally all transportation and environmental requirements specified herein. Each panel shall be fabricated as a net panel with aluminum extrusions bonded about the panel perimeter during panel

TABLE 1 Container Overall Dimensions

Type	Height				Width				Length			
	ft	in.	Tol.	in.	ft	in.	Tol.	in.	ft	in.	Tol.	in.
IC	8	0	+0	-0.1875	8	0	+0	-0.1875	19	10.5	+0	-0.25
	(2.438 m)		+0	(-5 mm)	(2.438 m)		+0	(-5 mm)	(6.058 m)		+0	(-6 mm)

bonding. The inner and outer skins on all joints shall be sealed to provide a water barrier against the entrance of moisture to the core material and to the interior of the shelter. The water barrier is to be maintained intact at all panel cross-sectional openings. All joints and edges shall be assembled and sealed in a manner to prevent collection and retention of moisture. Particular emphasis shall be placed on the sealing of all mitered corners.

All of the above sealing procedures shall be accomplished in accordance with Practice E 1773.

Rivet shafts shall be coated with sealing compound before insertion. The sealer shall be as indicated on the drawings. The contractor shall have the appropriate equipment and facilities, use the correct procedures in accordance with Specifications E 874 and E 864, and use qualified panel components (that is, structural film and core splice adhesives, corrosion-inhibiting adhesive primer, structural nonmetallic honeycomb core, and as specified 5052-H34 or 6061-T6 aluminum skins, FRP barrier strips, 6061-T6 panel extrusions). Prior to use, all critical panel component materials must be qualified in accordance with Specifications E 865, E 866, E 990, E 1091, and E 1826. There shall be no skin splices in the panels except where noted on the drawings. Unless otherwise specified (see X1.2), prior to award of contract, the contractor shall submit to the purchaser a certified copy of a laboratory test report and a copy of their process specification covering fabrication of the metallic-faced, nonmetallic honeycomb core sandwich panels they propose to use in the construction of the end item. Using their process specification, the contractor shall fabricate qualification test sandwich panels and structural film adhesive floating roller peel test specimens, and shall perform tests in accordance with Specification E 865 and Practice E 874 (see 13.2).

4.3.1 *Panel Processing*—The shelter panels shall be processed and inspected as specified in Specifications E 864, E 865, E 866, or E 1826 depending upon which primer is being used, E 874, E 990, E 1091, and Practice E 1773. The shelter panels shall be inspected for dimensions and flatness in accordance with the “Dimensional and Flatness Inspection of Panel” Section of Practice E 874 (see 10.2).

4.3.2 *Panel Watertightness*—Panel assemblies shall not permit the entry of water (see 10.3.1) when tested as specified in 7.18.

4.3.3 *Resistance to Thermal Shock*—Panels shall be resistant to thermal shock, when tested as specified in 7.6.

4.3.4 *Panel Interchangeability*—All panels and panel assemblies bearing same part numbers shall be functionally and dimensionally interchangeable without modification or rework. Individual assemblies shall not be hand picked for fit or performance, when tested as specified in 7.7.

4.3.5 *Delaminations*—Delaminations in shelter panels shall be tested as specified in 10.3.4.

4.3.6 *Panel Frame Area Tightness*—Welded panel frames shall be air tight when tested as specified in 7.40.

4.4 *Inserts*—When tested as specified in 7.8, the following sized inserts, where used, shall withstand the torque and pullout loads as specified in Table 2, without failure of the inserts, panel, or potting compound.

4.5 *Payload*—The unit is designed to carry a maximum payload of 9480 lb (4300 kg) during transport.

4.6 *Corner Fittings*—The container shall be equipped with corner fittings at the top and bottom corners in accordance with the dimensional requirements for corner fittings for series-1 freight containers as stipulated in ISO 1161 requirements for commercial containers. The upper faces of the top corner fittings shall protrude above the top of the rest of the container by a minimum of ¼ in. (6 mm) The lower faces of bottom corner fittings shall protrude below the bottom of the container by a minimum of 7/16 in. (11 mm).

4.7 *Shelter Mode*—The shelter in the erected mode shall be referred to as a shelter herein for the purpose of definition. Hinged shelter panels shall be attached in a manner to ensure compliance with the environmental test requirements as specified in 7.6, 7.13-7.17, 7.24, and 7.26.

4.8 *Exterior Lighting*—One area lighting fixture, as shown on the drawings, shall be provided with each shelter.

4.9 *Shelter Electrical System:*

4.9.1 *General*—The system shall have all equipment, cabling and other hardware necessary to receive three phase 120/208 V, 60 Hz power from the base electrical distribution systems, and distribute it to lighting fixtures and receptacles as indicated on the drawings. The 60 A shelters shall be in accordance with Drawing 5-4-2828 and all subsidiary drawings and parts lists. The 100 A shelters shall be in accordance with Drawing 5-4-3200 and all subsidiary drawings and parts lists. All parts of the electrical system shall operate when tested for electrical continuity as specified in 7.40.

4.9.2 *Operating Temperature*—The wiring system and all individual hardware items shall be capable of operating at their required capacity within an ambient temperature range of -60 to 125°F (-51 to 52°C), except that the fluorescent lights shall operate from 0 to 125°F (-18 to 52°C), when tested as specified in 7.14 and 7.15.

4.9.3 *Current Rating*—All conductors and appropriate hardware shall be rated for current carrying in accordance with the

TABLE 2 Insert Strength (Proof Loads)

Insert (Diameter Thread Size)	Pull-out, lb (kN)	Torque, ft-lb (N-m)
10-32	1000 (4.5)	10 (13.6)
¼-28	1000 (4.5)	20 (27.2)
5/16-24	2000 (9.0)	20 (27.2)
3/8-24	2000 (9.0)	40 (54.2)