



Designation: **E1307—10 E1307 – 18**

Standard Practice for Surface Preparation and Structural Adhesive Bonding of Precured, Nonmetallic Composite Facings to Structural Core for Flat Shelter Panels¹

This standard is issued under the fixed designation E1307; 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 reapproval. 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 U.S. Department of Defense.

1. Scope

1.1 This practice covers the materials, processes, and quality controls to be used in the manufacture of durable adhesive bonded, nonmetallic faced, flat sandwich panels for rigid wall relocatable shelters.

1.2 The values stated in SI units are to be regarded as standard. The values given in parentheses are mathematical conversions to inch-pound units that are provided for information only and are not considered standard.

1.3 *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, health, and environmental practices and determine the applicability of regulatory limitations prior to use.*

1.4 *This international standard was developed in accordance with internationally recognized principles on standardization established in the Decision on Principles for the Development of International Standards, Guides and Recommendations issued by the World Trade Organization Technical Barriers to Trade (TBT) Committee.*

2. Referenced Documents

2.1 *ASTM Standards:*²

[C297/C297M Test Method for Flatwise Tensile Strength of Sandwich Constructions](#)

[E631 Terminology of Building Constructions](#)

[E865 Specification for Structural Film Adhesives for Honeycomb Sandwich Panels](#)

[E990 Specification for Core-Splice Adhesive for Honeycomb Sandwich Structural Panels](#)

[E1091 Specification for Nonmetallic Honeycomb Core for Use in Shelter Panels](#)

[E1749](#)

2.2 *Federal Standard:*³

[FED STD 209 Clean Room and Work Station Requirements](#)

2.3 *Society of Automotive Engineers (SAE) Standard:*⁴

[SAE-AMS-S-8802 Sealing Compound, Temperature-Resistant, Integral Fuel Tanks and Fuel Cell Cavities, High-Adhesion](#)

2.4 *Military Handbook:*³

[MIL-Handbook 337 Adhesive Bonded Aerospace Structures](#)

3. Terminology

3.1 *Definitions:*

3.1.1 For definitions of general terms related to building construction used in this practice, refer to Terminology [E631](#) and for general terms related to rigid wall relocatable shelters, refer to Terminology [E1749](#).

¹ This practice 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 Standardization Documents Order Desk, DODSSP, Bldg. 4, Section D, DLA Document Services, Building 4/D, 700 Robbins Ave., Philadelphia, PA 19111-5098, <http://dodssp.daps.dla.mil>, 19111-5094, <http://quickserach.dla.mil>.

⁴ Available from SAE International (SAE), 400 Commonwealth Dr., Warrendale, PA 15096-0001, 15096, <http://www.sae.org>.

4. Significance and Use

4.1 Durable adhesive bonds of composite laminates can be obtained reliably only through proper selection and careful control of the materials used and the steps in the bonding process. The preparation of the composite laminates to obtain surfaces with appropriate characteristics is a critical step. Improper surface preparation can produce seemingly acceptable bonds that can degrade rapidly with time. This practice describes how properly prepared surfaces can be obtained.

4.2 The formation of reproducible, durable, adhesive bonds in structural units requires great care in the selection of materials, the preparation of the surfaces of the parts to be bonded, the fit of parts, and the performance of the steps in the bonding process. Experience has shown that adhesive bonding carried out in accordance with this practice produces reproducible bonds.

5. Materials

5.1 *Materials*—Materials shall be as specified herein or as specified in the contract. All materials shall be stored and handled in such a manner as to provide protection against degrading environments and mechanical damage.

5.2 *Composite Reinforcement and Resin*—The composite reinforcement and resin shall meet the requirements specified in the procurement document.

5.3 *Peel Ply Fabric*—A nonreusable peel ply shall be used. Closely woven fabric of nylon, polyester, or glass has been found suitable. The peel ply fabric must be compatible with the manufacturing process.

5.4 *Precured Facings*—The facings shall be certified as complying with the reinforcement, resin binder, resin content, and thickness requirements of the procurement document. Facings shall be free of defects that may adversely affect the structural integrity of the bonded panel.

5.5 *Core*—The core material shall be as specified in Specification E1091 or the procurement document and shall meet the requirements of the applicable document.

5.6 *Structural Film Adhesive*—The adhesive shall conform to the requirements of Specification E865. It shall be stored in accordance with the ~~manufacturer's~~ manufacturer's recommendations.

5.7 *Core Splice Adhesive*—The core splice adhesive shall conform to the requirements of Specification E990. It shall be stored in accordance with the ~~manufacturer's~~ manufacturer's recommendations.

6. Facilities

6.1 *Panel Assembly Layup Area*—The panel assembly layup area is an enclosed, environmentally controlled area (ECA) that is continuously controlled for temperature, relative humidity, and concentration of airborne particles. The ECA shall be maintained at a temperature of $24 \pm 6^\circ\text{C}$ ($75 \pm 10^\circ\text{F}$) and not more than 50 % relative humidity. The temperature and relative humidity shall be recorded continuously. All incoming and recirculated air shall be filtered to control airborne particles. The air handling equipment shall provide at least five air changes per hour in the ECA. The filters shall ensure that the particle count within the ECA will not exceed 7×10^6 particles per cubic metre (200 000 particles per cubic foot) of size 1 μm and larger. The air pressure differential between the ECA and adjacent areas shall be monitored continuously and recorded at least twice weekly. The air pressure in the ECA shall be maintained above that of adjacent areas by a minimum of 50 Pa (0.015 in. Hg). The particle count shall be monitored in accordance with FED STD 209. The recorders shall be calibrated every six months. The ECA shall be conspicuously identified at all entrances as “limited access.” Unnecessary traffic within the ECA shall not be permitted. Eating and smoking within the ECA shall not be permitted and the ECA shall be so posted. All material, tools, and equipment used in the ECA shall be clean, low shed, and free from lint, oil, and grease. The use and application of oil, grease, mold release agents, or other possible contaminants within the ECA shall be prohibited. The interior, exposed surfaces of the ECA shall be nonshedding and easily cleaned to minimize dust generation. Any particle-generating preparations such as removal of peel ply, insertion of foam into honeycomb core, or cleaning must be accompanied by filtered vacuum when performed in the ECA.

7. Equipment

7.1 *Platen Press*—Pressure equipment for bonding of shelter panels shall be large enough to permit the bonding of the total panel in one step. The manufacturer shall provide calibration and test data demonstrating that the temperature on the two facings of press platens during lamination will be equal and uniform within 4 % of their nominal temperature. The pressure equipment used for curing the panels shall be capable of applying greater than 140 kPa (20 psi) and 150°C (300°F) over the entire panel surface. Platens shall be flat to within 0.17 mm/m (0.002 in./ft). The pressure equipment shall be equipped with temperature and pressure recorders and controls that accurately control heat-up rate, pressure application, dwell time, cool down (when required), and pressure removal. The pressure equipment shall also be equipped with suitable devices (for example, caul sheets) that facilitate moving the panel layup into the press without misaligning the layup.

7.1.1 *Calibrations, Temperature, and Pressure Requirements and Controls*—~~Gages~~ Gauges shall be calibrated at least every six months by an accredited independent laboratory or by the manufacturer if approved by the purchaser. The latest calibration certificate shall be attached to the equipment near each ~~gage~~ gauge. It shall be demonstrated that the actual bonding pressure is

within 10 % of the nominal pressure. It shall also be demonstrated that the average temperatures of the top and bottom panel facings during the bonding process are equal and uniform to within 4 % of the nominal temperature. Thermocouples placed within 150 mm (6 in.) of each corner and at the center of each facing shall be used to demonstrate the uniformity of the temperature. Compliance of the equipment with these requirements shall be verified at intervals not exceeding six months. A permanent record of the pressure, time, and temperature measurements during bonding compliance checks shall be maintained. All calibrations must be traceable to the National Institute of Standards and Technology (NIST).

7.2 Autoclave—The autoclave equipment for bonding shelter panels shall be large enough to permit the bonding of entire shelter panel assemblies in one step. The autoclave shall be equipped with vacuum gages/gauges and temperature and pressure recorders that accurately control heat-up rate, pressure application, dwell time, cool down, and pressure removal. Vacuum venting facilities shall be provided. The autoclave equipment used for curing the panels shall be capable of applying greater than 140 kPa (20 psi) and 150°C (300°F); 150°C (300°F). The manufacturer shall provide calibration and test data demonstrating that the temperature was maintained within 4 % of the nominal temperature and the pressure was maintained within 10 % of the operating pressure.

7.3 Testing Equipment—The supplier shall have available sufficient testing equipment to ensure that all process control specimen preparation and testing required by this practice can be accomplished. All calibrations of test equipment required by this practice shall be traceable to the NIST.

8. Preparation of Composite Facings

8.1 The composite reinforcement, number of plies, resin, and cure cycle shall meet the requirements as specified in the shelter specification.

8.2 Peel Ply—A peel ply shall be included as the surface layer for the side of the precured skin that will be later bonded. The peel ply shall extend past all edges.

8.3 Peel Ply Removal—Prior to bonding, remove the peel ply from the faying surface to provide a clean, high-area surface ideal for bonding. Removal shall be accomplished in the ECA.

9. Quality Assurance of Composite Facings

9.1 Handling—Parts with the peel ply removed or being removed shall be handled using clean gloves or other methods to prevent surface contamination.

9.2 Marking—All processed parts shall be marked with the date and time of manufacture. If the surface with the peel ply removed must be marked, marking shall be lightly scribed.

9.3 Written Process Procedure—Each processor shall keep a written record of the date and time the peel ply was removed, the time placed into the ECA, and the time the facing was bonded.

9.4 Visual Inspection—After removal of the peel ply, the faying surface shall be inspected for defects as defined by the procurement document. Any defects shall be recorded.

10. Shelter Panel Construction

10.1 The matrix resin, fiber reinforcement, thickness of the facings, edge closure details, core type, and the weights and sizes of the panels shall be as specified in the procurement document. Unless otherwise specified, the allowable deviation from flatness of the bonded panel shall be within 1.5 mm ($1/16$ in.) when measured as specified in ~~4.3.1~~15.3.1 against the concave side of the panel. With the panel in a horizontal position, lay the straight edge on the panel surface and measure the maximum gap between the straightedge and the panel. The facing surfaces may contain local bulges or depression within the allowable flatness tolerance specified above.

10.2 Edge Closures and Framing Members—The edge closures and framing members shall be as specified in the shelter design specification. When the shelter design requires the edge closures and framing members to be bonded simultaneously with panel bonding, the edge closures and framing members shall be bonded to the facings with the adhesive specified in ~~4.6.6~~6 and to the core with adhesive specified in ~~4.7.7~~7.

10.3 Preparation of Composite Facing and Edge Closures—Cutting, trimming, and sizing shall be made prior to surface preparation. Silicone based cutting fluids shall not be used in processing of detailed parts. The prepared composite facings and framing members shall be free of contaminants before application of the adhesive. Parts requiring identification shall be marked with inks or methods approved for bonding.

10.4 Preparation of Core—The core shall be cleaned of dust with dry, oil-free, filtered compressed air or vacuumed prior to delivery to the panel assembly layup area. When honeycomb core is used and the cells are filled with plastic foam, the surface of the installed foam shall be at least 1.5 mm ($1/16$ in.) below the surface of the honeycomb on both surfaces, and all bonding surfaces shall be free of foam, dust, and contaminants by vacuuming. When a panel requires more than one sheet of core, the seam between pieces shall be spliced so that the uniformity of thickness is maintained across the seam. The core splicing material must be impermeable to water and serve as a barrier to water migration and meet the requirements of Specification E990. The core splicing