



Designation: E1794 – 22a

Standard Specification for Adhesive for Bonding Foam Cored Sandwich Panels (200 °F Elevated Humidity Service), Type II Panels¹

This standard is issued under the fixed designation E1794; 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 specification covers two-part adhesives for bonding foam core sandwich panels. The adhesive may be used for new production or depot maintenance. The adhesive should be suitable for forming bonds that can withstand long-term exposure to temperatures from $-55\text{ }^{\circ}\text{C}$ to $93\text{ }^{\circ}\text{C}$ ($-67\text{ }^{\circ}\text{F}$ to $200\text{ }^{\circ}\text{F}$) and also withstand combinations of stress, temperature, and humidity expected to be encountered in service. The adhesives shall be used for bonding aluminum alloy facing to foam core, inserts, internal aluminum framing members, and other components of a foam cored sandwich panel.

1.2 The values stated in SI units are to be regarded as the standard where only SI units are given or where SI units are given first followed by inch-pound units; where inch-pound units are given first followed by SI units, the inch-pound units are to be regarded as the 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

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.

B209 Specification for Aluminum and Aluminum-Alloy Sheet and Plate (Metric) B0209_B0209M

D1002 Test Method for Apparent Shear Strength of Single-Lap-Joint Adhesively Bonded Metal Specimens by Tension Loading (Metal-to-Metal)

E631 Terminology of Building Constructions

E864 Practice for Surface Preparation of Aluminum Alloys to Be Adhesively Bonded in Honeycomb Shelter Panels

E1749 Terminology Relating to Rigid Wall Relocatable Shelters

E1801 Practice for Adhesive Bonding of Aluminum Facings in Foam and Beam Type Shelters

2.2 *Military Standard:*³

MIL-STD-202-101 Method 101, Salt Atmosphere (Corrosion)

2.3 *SAE Specification:*⁴

AMS-QQ-A-250 Aluminum and Aluminum Alloy, Plate and Sheet General Specification for

3. Terminology

3.1 Definitions:

3.1.1 For definitions of general terms related to building construction used in this specification, refer to Terminology E631, and for general terms related to rigid wall relocatable shelters, refer to Terminology E1749.

3.2 Definitions of Terms Specific to This Standard:

3.2.1 *adhesive life, n*—the maximum time that an adhesive, when mixed in a prescribed quantity can set at a designated temperature, after which the adhesive, when used to prepare specimens, will deliver the required properties.

4. Requirements

4.1 *Material*—The adhesive shall be a two-part thermosetting epoxy paste containing no asbestos and, when tested using the test methods described in Section 6, shall meet the requirements of Section 4. The adhesive shall not have a

³ Available from DLA Document Services, Building 4/D, 700 Robbins Avenue, Philadelphia, PA 19111-5094, <http://quicksearch.dla.mil/>.

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

deleterious effect on the components being bonded over the range of temperatures at which the adhesive will be used.

4.2 Working Characteristics:

4.2.1 *Application*—The adhesive shall be suitable for application to facings and foam core materials. The adhesive shall be suitable for spray application to faying surfaces.

4.2.2 *Curing*—The time, temperature, and pressure used to cure the adhesive shall be within the range specified herein.

4.2.2.1 *Curing Time and Temperature*—The adhesive, when mixed in accordance with the manufacturer’s instructions, shall meet the requirements of this specification when cured at a temperature of not more than 99 °C (210 °F) for 60 min, or 107 °C (225 °F) for 45 min. The timing of the cure shall start when the panel skins have reached the specified temperature. The temperature for the cure shall be fully attained within 3 h after the first application of the adhesive to the faying surface.

4.2.2.2 *Curing Pressure*—Specimens for testing under this specification shall be cured under a normal load of 50 kPa ± 14 kPa (8.0 psi ± 1.0 psi). No more than 2 h at 25 °C (77 °F) shall elapse between the application of the adhesive to the faying surface and the application of the pressure.

4.2.3 *Mix Ratio*—The mix ratio for the two parts of the adhesive shall be as defined by the manufacturer.

4.3 *Storage Life*—The storage life shall not exceed one year from the date of manufacture, when the components of the adhesive are stored at a temperature between 10 °C (50 °F) and 42 °C (90 °F). The adhesive shall be considered to have met this storage life requirement if all the characteristics described in 4.1 and 4.5 are met by the adhesive after the one year storage period described above.

4.4 *Adhesive Working Life*—The adhesive working life is defined as the time period after mixing during which the adhesive will produce acceptable bonds following the guidelines of ASTM E1801 process practice for a Type II shelter panel. The adhesive working life of the properly prepared mixed adhesive at 25 °C (77 °F) shall be a minimum of 120 min. Verification shall be determined by preparing lap shear coupons with adhesive that has been mixed and allowed to sit for 120 min before applying 8 psi bonding pressure and attaining maximum cure temperature not less than 3 h following adhesive mixing. Coupons prepared by this method shall meet the requirements of 4.5.

4.5 *Mechanical Properties*—The minimum mechanical properties of the adhesives, when cured as specified, shall meet the requirements of Table 1.

5. Significance and Use

5.1 This specification is intended to provide information on the properties of adhesives, and the test methods required to

evaluate adhesives to be used in the production bonding of aluminum alloys to foam core materials for the manufacture of tactical shelters.

6. Test Methods

6.1 *Qualification Tests*—For qualification, the adhesive shall be tested using the tests described in this section. Shear tests shall be performed in accordance with Test Method D1002 except that the length of the test coupon shall be 103.7 mm (4¼ in.) and the thickness shall be 2.196 mm (0.090 in.).

6.2 *Preparation of Test Specimens*—Prepare at least ten specimens for each separate test. The metal to be bonded shall be 6061 T6 (SAE Specification AMS-QQ-A-250 or Specification B209) and cleaned as specified in Practice E864. Time, temperature, and pressure for curing the adhesive shall be as specified in 4.2.2.1 and 4.2.2.2.

6.3 *Room Temperature Shear*—Subject specimens to a tensile shear test at a room temperature of 27 °C ± 6 °C (80 °F ± 10 °F).

6.4 *Low Temperature Shear*—Test specimens at –54 °C ± 3 °C (–65 °F ± 5 °F). Bring the specimens to temperature as indicated by a thermocouple at the bond area and stabilize for 10 min ± 1 min just prior to test. Stabilize the chamber used to test the specimens at the test temperature for 45 min prior to testing.

6.5 *High Temperature Shear*—Test specimens at 93 °C + 0 °C, –3 °C (200 °F + 0 °F, –5 °F). Bring the specimens to temperature as indicated by a thermocouple at the bond area and stabilize for 10 min just prior to test. Stabilize the chamber used to test the specimens at the test temperature for 45 min prior to testing.

6.6 *Humidity Exposure*—Test lap shear specimens at 93 °C ± 3 °C (200 °F ± 5 °F) after 2 weeks exposure to 100 % +0/–5 % relative humidity and 93 °C ± 3 °C (200 °F ± 5 °F). Bring the specimen to temperature as indicated by a thermocouple at the bond area and stabilize for 10 min just prior to test. Stabilize the chamber used to test the specimens at temperature and humidity for 45 min prior to testing. Start the test of each humidity exposure test specimen no later than 30 min after removing it from the humidity chamber.

6.7 *Salt Spray Exposure*—Test specimens at 27 °C ± 6 °C (80 °F ± 10 °F) after exposure to the salt spray test of MIL-STD-202-101 using a 20 % NaCl solution at 35 °C ± 3 °C (95 °F ± 5 °F) for a duration of 240 h. Stabilize the specimens at the test temperature as indicated by a thermocouple at the bond area for 10 min just prior to test.

7. Inspection

7.1 *Qualification Inspection*—The inspection requirements specified herein are classified as follows:

7.1.1 *Qualification Test*—Unless otherwise specified by the purchaser, adhesives that have not passed the qualification tests, or that have previously passed the tests but have subsequently been modified in any manner, shall be tested against this specification and shown to meet its requirements.

TABLE 1 Physical Property Requirements

Test	Requirement
Room temperature, shear	2000 psi, min, 13.8 MPa
Low temperature, shear	2000 psi, min, 13.8 MPa
High temperature, shear	1500 psi, min, 10.3 MPa
Humidity exposure, shear, hot	1500 psi, min, 10.3 MPa
Salt spray exposure, shear, RT	2000 psi, min, 13.8 MPa