



Designation: E 1794 – 03

# Standard Specification for Adhesive for Bonding Foam Cored Sandwich Panels (200°F Elevated Humidity Service), Type II Panels<sup>1</sup>

This standard is issued under the fixed designation E 1794; 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 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 to 93°C (–67 to 200°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, edge attachments, 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 English units; where English units are given first followed by SI units, the English 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 and health practices and determine the applicability of regulatory limitations prior to use.*

## 2. Referenced Documents

### 2.1 ASTM Standards:

**B 209** Specification for Aluminum and Aluminum-Alloy Sheet and Plate<sup>2</sup>

**D 1002** Test Method for Apparent Shear Strength of Single-Lap-Joint Adhesively Bonded Metal Specimens by Tension Loading (Metal-to-Metal)<sup>3</sup>

**E 864** Practice for Surface Preparation of Aluminum Alloys to be Adhesively Bonded in Honeycomb Shelter Panels<sup>4</sup>

**E 1749** Terminology of Rigid Wall Relocatable Shelters<sup>4</sup>

### 2.2 Military Standard:

**MIL-STD-202F** Test Methods for Electronic and Electrical Component Parts<sup>5</sup>

### 2.3 Federal Specification:

QQ-A-250/11d Aluminum Alloy 6061T6, Plate and Sheet<sup>5</sup>

## 3. Terminology

3.1 **Definitions**—See Terminology **E 1749** for definitions of terms used in this specification.

### 3.2 Definitions of Terms Specific to This Standard:

3.2.1 **adhesive life**—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 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 ± 14 kPa (8.0 ± 1.0 psi). No more than 2 h at 25°C (77°F) shall elapse

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<sup>2</sup> *Annual Book of ASTM Standards*, Vol 02.02.

<sup>3</sup> *Annual Book of ASTM Standards*, Vol 15.06.

<sup>4</sup> *Annual Book of ASTM Standards*, Vol 04.11.

<sup>5</sup> Available from Standardization Documents Order Desk, Bldg. 4 Section D, 700 Robbins Ave., Philadelphia, PA 19111-5094, Attn: NPODS.

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 Life*—The adhesive life of one quart of the mixed adhesive at 25°C (77°F) shall not be less than 120 min (2 h), at which time the adhesive 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 D 1002 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 (Federal Specification QQ-A-250/11d or Specification B 209) and cleaned as specified in Practice E 864. Time, temperature, and pressure for curing the adhesive shall be as specified in 5.3.2.1 and 5.3.2.2.

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

6.4 *Low Temperature Shear*—Test specimens at –54 ± 3°C (–65 ± 5°F). Bring the specimens to temperature as indicated by a thermocouple at the bond area and stabilize for 10 ± 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 + 0, –3°C (200 + 0, –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 ± 3°C (200 ± 5°F) after 2 weeks exposure to 100 % relative humidity and 93 ± 3°C (200 ± 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 ± 6°C (80 ± 10°F) after exposure to the salt spray test of MIL-STD-202F using a 20 % NaCl solution at 35 ± 3°C (95 ± 5°F). 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.

7.1.1.1 *Instruction Sheet*—A dated, coded, and titled instruction sheet that outlines instruction for use of the adhesive on bonding metal facings to foam core and metal components shall be supplied by the manufacturer. These instructions shall be forwarded with the test report when requesting qualification. In addition, a copy of the instruction sheet shall accompany each shipment of the adhesive.

7.1.2 *Reevaluation Procedure*—In the event that two or more test results should fall below the minimum specified for any of the qualification tests, the submitted product shall be considered to have failed qualification testing. In this case, the lot along with two additional lots may be retested for that test. If all of these pass, the product will be considered as being qualified.

7.2 *Quality Conformance Inspection*—The number of test specimens for conformance testing shall be five. The test procedure, cure of the adhesive, and surface preparation shall be in accordance with 6.2.

7.2.1 *Tests*—Samples of each lot of adhesive delivered on contract of order shall be subjected to the following quality conformance tests. Test reports, in duplicate, shall be furnished for all quality conformance tests specified in this specification, and shall be signed by an authorized representative of the laboratory making the tests. Acceptance or approval of materials during the course of manufacture shall not be construed as a guarantee of acceptance of the finished product.

7.2.2 *Room Temperature Shear (Acceptance)*—The room temperature shear strength test shall be conducted in accordance with 6.3 using 6061-T6 aluminum alloy.

7.2.3 *High Temperature Shear (Acceptance)*—The high temperature shear test shall be conducted in accordance with 6.3 using 6061-T6 aluminum alloy.

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