



Standard Specification for Structural Film Adhesives for Honeycomb Sandwich Panels¹

This standard is issued under the fixed designation E 865; 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.

^{ε1} NOTE—The title of E 1826 was editorially corrected in August 2000.

1. Scope

1.1 This specification covers film adhesives for bonding of honeycomb sandwich panels. The adhesives are used for new production or depot repair. The adhesives shall be suitable for forming bonds that can withstand long exposures to temperatures from -55 to 93°C (-67 to 200°F) 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 facing to nonmetallic core, edge attachments, and other components of a 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.

2. Referenced Documents

2.1 ASTM Standards:

- B 117 Practice for Operating Salt Spray (Fog) Apparatus²
- C 297 Test Method for Tensile Strength of Flat Sandwich Constructions in Flatwise Plane³
- D 1002 Test Method for Apparent Shear Strength of Single-Lap-Joint Adhesively Bonded Metal Specimens by Tension Loading (Metal-to-Metal)⁴
- D 1781 Test Method for Climbing Drum Peel for Adhesives⁴
- D 2919 Test Method for Determining Durability of Adhesive Joints Stressed in Shear by Tension Loading⁴
- D 3167 Test Method for Floating Roller Peel Resistance of Adhesives⁴
- E 864 Practice for Surface Preparation of Aluminum Alloys to Be Adhesively Bonded in Honeycomb Shelter Panels⁵
- E 866 Specification for Corrosion-Inhibiting Adhesive Primer for Aluminum Alloys to Be Adhesively Bonded in

Honeycomb Shelter Panels⁵

- E 874 Practice for Adhesive Bonding of Aluminum Facings to Nonmetallic Honeycomb Core for Shelter Panels⁵
- E 1091 Specification for Nonmetallic Honeycomb Core for Use in Shelter Panels⁵
- E 1826 Specification for Low Volatile Organic Compound (VOC) Corrosion-Inhibiting Adhesive Primer for Aluminum Alloys to Be Adhesively Bonded⁵
- 2.2 *Federal Specifications:*⁶
 - MMM-A-132 Adhesive, Heat-Resistant, Airframe Structural, Metal-to-Metal
 - QQ-A-250/8d Aluminum Alloy 5052H34, Plate and Sheet
 - QQ-A-250/11d Aluminum Alloy 6061T6, Plate and Sheet

NOTE 1—Copies of specifications, standards, drawings, and publications required by suppliers in connection with specific purchases shall be obtained from the purchaser or as directed by his contracting officer.

3. Ordering Information

3.1 *Procurement Documents*—Purchasers shall select any of the desired options offered herein and the procurement documents shall specify the following:

- 3.1.1 Title, number, and date of this specification, E 865 – 99^{ε1}
- 3.1.2 Adhesive type and code number,
- 3.1.3 Amounts and unit quantities of adhesives required,
- 3.1.4 Length, width, and film weight of adhesive,
- 3.1.5 Curing conditions,
- 3.1.6 Level of packaging and packing required, and
- 3.1.7 Whether or not qualification (see 3.2) is necessary.

3.2 *Qualification*—In the case of adhesives for which the purchaser requires qualification, the procurement documents shall state that awards will be made only for adhesives that are, at the time set for opening of bids, qualified for inclusion in the applicable qualified products list.

4. Requirements

4.1 *Material*—The adhesive shall be thermosetting and, when tested using the tests described in Section 5, shall meet the strength and durability requirements of this specification. The adhesive shall not have a deleterious effect on the metal

⁶ Available from Standardization Documents Order Desk, Bldg. 4 Section D, 700 Robbins Ave., Philadelphia, PA 19111-5094, Attn: NPODS.

¹ This specification is under the jurisdiction of ASTM Committee E-6 on Performance of Buildings and is the direct responsibility of Subcommittee E06.53 on Materials and Processes for Durable Rigidwall Relocatable Structures.

Current edition approved Oct. 10, 1999. Published December 1999. Originally published as E 865 – 82. Last previous edition E 865 – 95.

² *Annual Book of ASTM Standards*, Vol 03.02.

³ *Annual Book of ASTM Standards*, Vol 15.03.

⁴ *Annual Book of ASTM Standards*, Vol 15.06.

⁵ *Annual Book of ASTM Standards*, Vol 04.11.

surfaces being bonded over the range of temperatures at which the adhesives will be used.

4.2 *Form and Film Weight*—The adhesive shall be film form and shall consist either entirely of adhesive or of a carrier impregnated with adhesive. The film weight shall be within the range specified in Table 1.

4.3 *Appearance*—The adhesive film shall be uniform in appearance. It shall be of a uniform coating that is free of streaks and color variations.

4.4 *Qualification*—At the option of the purchaser, the adhesive may be required to be a product (see 6.3) for listing on the applicable qualified products list at the time set for opening of bids. The qualification shall only apply to the formulation on which qualification tests have been made. Any changes by the manufacturer, such as the adding of fillers, changing the carrier, changing the method of manufacture, or changing the mass per unit area, shall be cause for designating the adhesive as a new product. The new product shall be given a new code number and shall not be approved until it has been shown to meet the requirements of the specification.

4.5 *Working Characteristics:*

4.5.1 *Application*—The adhesive shall be suitable for application to metal facings and core materials in accordance with the manufacturer's instructions at temperatures between 18 and 30°C (65 and 85°F) and at relative humidities of up to 50 %.

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

4.5.2.1 *Curing Time and Temperature*—The adhesive shall meet the requirements of this specification when cured for not longer than 1 h at a bond line temperature not exceeding 145°C (293°F).

4.5.2.2 *Curing Pressure*—In the preparation of specimens fabricated for qualification, the pressure required for curing the adhesive shall not be less than 140 kPa (20 psi) nor more than 350 kPa (50 psi).

4.6 *Storage Life*—The adhesive manufacturer shall deter-

mine the maximum temperature and the storage period at this temperature (from date of manufacture) for which the adhesive, when stored in airtight containers or wrapped in suitable vapor barriers, will retain its ability to meet the strength requirements specified in Table 1. These storage conditions shall be stated in the instruction sheet (see 6.3.1.1).

4.7 *Mechanical Properties*—The average mechanical properties of the adhesive shall meet the requirements of Table 1.

5. Test Methods

5.1 *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.

5.2 *Preparation of Test Specimens*—Prepare at least ten specimens for each separate test except as otherwise specified in the individual test methods. The metal bonded shall be 6061T6 or 5052H34 aluminum alloy (Federal Specification QQ-A-250/11d or QQ-A-250/8d, respectively) cleaned as described in Practice E 864 and at the purchasers option, primed in accordance with Specification E 866 or Specification E 1826. Time and temperature of curing of the adhesive shall be in accordance with the adhesive manufacturer's most recent recommendation. Test panels or specimens, or both, other than the breakaway type shall be cut in such a manner that minimum vibration or heat is generated during the cutting operation.

5.3 *Normal-Temperature Lap Shear*—Subject specimens to a lap shear test at normal temperature $25 \pm 3^\circ\text{C}$ ($77 \pm 5^\circ\text{F}$).

5.4 *High-Temperature Lap Shear*—Test specimens at $60 \pm 3^\circ\text{C}$ ($140 \pm 5^\circ\text{F}$) and $93 \pm 3^\circ\text{C}$ ($200 \pm 5^\circ\text{F}$). 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 the test temperature for 45 min prior to testing.

5.5 *Low-Temperature Lap Shear*—Test specimens at $-55 \pm 3^\circ\text{C}$ ($-67 \pm 5^\circ\text{F}$). 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 the test temperature for 45 min prior to testing.

5.6 *Humidity Exposure Lap Shear*—Test lap shear specimens at $93 \pm 3^\circ\text{C}$ ($200 \pm 5^\circ\text{F}$) after 2 weeks' exposure to $95 \pm 5\%$ relative humidity and $93 \pm 3^\circ\text{C}$ ($200^\circ\text{F} \pm 5^\circ\text{F}$). Bring the specimen to temperature as indicated by a thermocouple at the bond area and test within 2 min. The test chamber used to test the specimens shall be stabilized at the test temperature for at least 45 min prior to testing. Start the test of each humidity exposure lap shear test specimen no later than 30 min after removing it from the humidity chamber.

5.7 *Salt Spray Exposure Lap Shear*—Test specimens in accordance with the salt spray test of Test Method B 117 for 2 weeks' exposure to salt spray using 5 % NaCl solution at $35 \pm 3^\circ\text{C}$ ($95^\circ\text{F} \pm 5^\circ\text{F}$).

5.8 *Normal-Temperature Floating Roller Peel*—Test specimens at normal temperature $25 \pm 3^\circ\text{C}$ ($77 \pm 5^\circ\text{F}$) in accordance with Test Method D 3167.

5.9 *Low-Temperature Floating Roller Peel*—Test each specimen at $-55 \pm 3^\circ\text{C}$ ($-67^\circ\text{F} \pm 5^\circ\text{F}$). Bring the specimen to temperature as indicated by a thermocouple at the bond area and stabilize for 10 min just prior to testing. Stabilize the

TABLE 1 Physical Requirements for the Film Adhesive

Test	Requirement ^A
Film weight, kg/m ² (lb/ft ²)	0.405 to 0.480 (0.083 to 0.100)
Normal-temperature lap shear, MPa (psi)	20 (2903)
High-temperature lap shear, MPa (psi)	
60°C (140°F)	20 (2903)
93°C (199°F)	13 (1888)
Low-temperature lap shear, MPa (psi)	20 (2903)
Humidity exposure lap shear, MPa (psi)	5 (723)
Salt spray exposure lap shear, MPa (psi)	16 (2322)
Normal-temperature floating roller peel, N/m (lbf/in.)	4400 (25.1)
Low-temperature floating roller peel, N/m (lbf/in.)	2625 (15.0)
Dead load stress durability, h:	
40 % of 60°C (140°F) failure stress	40
30 % of 60°C (140°F) failure stress	540
20 % of 60°C (140°F) failure stress	1500
Normal-temperature climbing drum peel, N-m/m (lbf-in./in.)	36 (8)
High-temperature climbing drum peel, N-m/m (lbf-in./in.)	18 (4)
Flatwise tensile strength, MPa (psi)	2.1 (306)
Storage life test	^B

^AExcept for film weight, values stated are the minimal to be met by the averages of the results for the specimens tested.

^BThe storage life at the maximum recommended temperature and under the recommended storage conditions shall be stated in the instructions.