



Standard Specification for Nonmetallic Honeycomb Core for Use in Shelter Panels¹

This standard is issued under the fixed designation E 1091; 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.

1. Scope

1.1 This specification is for nonmetallic honeycomb core used in the manufacture of adhesively bonded sandwich panels for tactical shelters. The materials are intended for adhesive bonding to aluminum facings using materials and processes defined by Practices E 864 and E 874 and Specifications E 865, E 866, and E 990. This specification covers five main types of honeycomb for use in sandwich panels, Types I, II, III, IV, and V. Types I, II, and III honeycombs correspond to three honeycomb densities. Types IV and V are similar to Types II and III, respectively, but have lower performance requirements.

1.2 The values stated in inch-pound units are to be regarded as the standard. The SI units in parentheses are provided for information only. For conversion of quantities in various systems of measurement to SI units, refer to Practice E 380.

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 Plate²
- C 177 Test Method for Steady-State Heat Flux Measurements and Thermal Transmission Properties by Means of the Guarded-Hot-Plate Apparatus³
- C 366 Test Methods for Measurement of Thickness of Sandwich Cores⁴
- C 481 Test Method for Laboratory Aging of Sandwich Constructions⁴
- C 518 Test Method for Steady-State Heat Flux Measurements and Thermal Transmission Properties by Means of

- the Heat Flow Meter Apparatus³
- D 3951 Practice for Commercial Packaging⁵
- E 380 Practice for Use of the International System of Units (SI) (the Modernized Metric System)⁶
- E 864 Practice for Surface Preparation of Aluminum Alloys to be Adhesively Bonded in Honeycomb Shelter Panels⁷
- E 865 Specification for Structural Film Adhesives for Honeycomb Sandwich Panels⁶
- E 866 Specification for Corrosion-Inhibiting Adhesive Primer for Aluminum Alloys to be Adhesively Bonded in Honeycomb Shelter Panels⁷
- E 874 Practice for Adhesive Bonding of Aluminum Facings to Nonmetallic Honeycomb Core for Shelter Panels⁷
- E 990 Specification for Core-Splice Adhesive for Honeycomb Sandwich Shelter Panels⁷
- E 1749 Terminology of Rigid Wall Relocatable Shelters⁷
- F 501 Test Method for Aerospace Materials Response to Flame, with Vertical Test Specimen (For Aerospace Vehicles Standard Conditions)⁸
- 2.2 *Federal Aviation Regulation:*
 - FAR 25.853(a) Compartment Interiors⁹
- 2.3 *Federal Standards:*
 - FED-STD-191A Textile Test Methods¹⁰
 - QQ-A-250/8 Aluminum Alloy 5052, Plate and Sheet¹⁰
 - QQ-A-250/11 Aluminum Alloy 6061, Plate and Sheet¹⁰
- 2.4 *Military Standards:*
 - MIL-STD-105 Sampling Procedures and Tables for Inspection by Attributes¹⁰
 - MIL-STD-129 Marking for Shipment and Storage¹⁰
 - MIL-STD-401 Sandwich Constructions and Core Materials; General Test Methods¹⁰
- 2.5 *TAPPI Standard:*
 - T 435-SU-68 Test Method for Hydrogen Ion Concentration of Paper Extracts, Hot Extraction Method¹¹
- 2.6 *Other Publications:*

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

Current edition approved April 10, 2003. Published May 2003. Originally approved in 1986. Last previous edition approved in 1998 as E 1091 – 98.

² *Annual Book of ASTM Standards*, Vol 02.02.

³ *Annual Book of ASTM Standards*, Vol 04.06.

⁴ *Annual Book of ASTM Standards*, Vol 15.03.

⁵ *Annual Book of ASTM Standards*, Vol 15.09.

⁶ *Annual Book of ASTM Standards*, Vol 14.02.

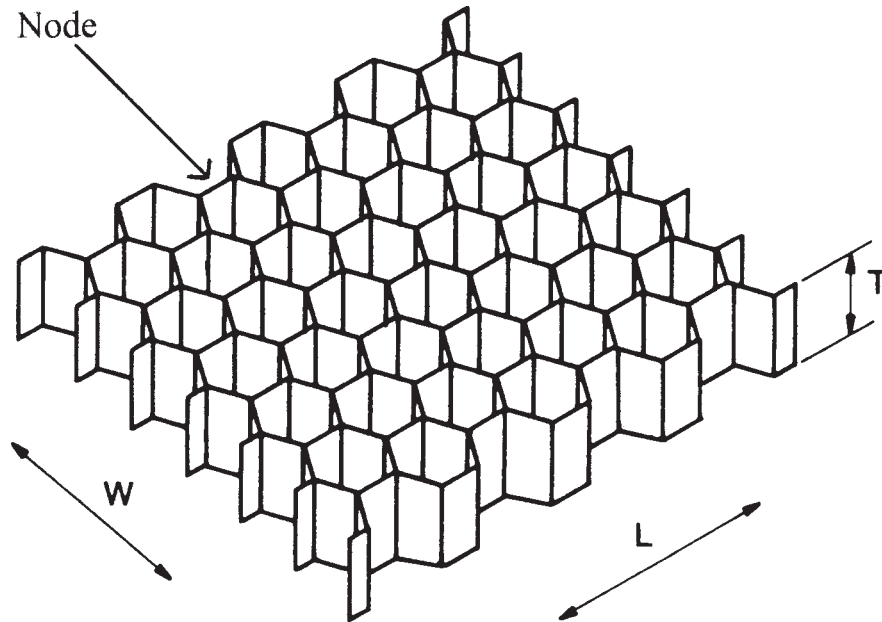
⁷ *Annual Book of ASTM Standards*, Vol 04.11.

⁸ *Annual Book of ASTM Standards*, Vol 04.07.

⁹ Available from Federal Aviation Agency, Office of Aviation Safety, 800 Independence Ave., SW, Washington, DC 20591.

¹⁰ Available from Standardization Documents Order Desk, Bldg. 4 Section D, 700 Robbins Ave., Philadelphia, PA 19111-5094, Attn: NPODS.

¹¹ Available from the Technical Association of the Pulp and Paper Industry, 1 Dunwoody Park, Atlanta, GA 30341.



L—Ribbon direction or longitudinal direction of core
W—Expanded direction or transverse direction of core
T—Core thickness or depth
N—Node is the bonded portion of the honeycomb flat sheet material; the honeycomb cell's double wall

FIG. 1 Orientation of Cells in Honeycomb-Core Material

Uniform Freight Classification¹²
 National Motor Freight Classification¹³
 ANSI/ASQC Z1.4 – 1993, Sampling Procedures and Tables
 for Inspection by Attributes¹⁴

3. Terminology

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

3.2 *Descriptions of Terms Specific To This Standard:*

3.2.1 *block, n*—a single production unit of honeycomb before slicing.

3.2.2 *cell size, n*—the average distance between node bonds, measured along the *W* direction (Fig. 1), for at least 60 cells, selected at random in groups containing 10 adjacent cells.

3.2.3 *core material, n*—a slice or sheet cut from a production block that is used in a honeycomb sandwich panel. The orientation of the cells in the honeycomb core material as produced is shown in Fig. 1. The honeycomb core materials exhibit anisotropic behavior, therefore the following notation is used:

L = ribbon direction or longitudinal direction of core,
W = expanded direction or transverse direction of core, and
T = core thickness or depth, and
N = bonded portion of the honeycomb flat sheet material; the honeycomb cell's double wall.

3.2.4 *first article, n*—a sample sheet of honeycomb from the first lot produced.

3.2.5 *lot, n*—1000 ft³ (28.3 m³) or less of honeycomb of the same type produced during consecutive operating or working days using the same basic materials and operating conditions.

3.2.6 *sheet, n*—a slice of honeycomb cut from a production block.

4. Classification

4.1 Five types of nonmetallic honeycomb material are specified. Their required properties are given in Section 6 and in Table 1.

4.1.1 *Type I*—honeycomb for use in panels which are required to have a high load-carrying capability that could not be adequately met using any of the other types.

4.1.2 *Type II*—honeycomb for use in panels which are required to have a load-carrying capability that could not be adequately met by using materials of any of Types III, IV, or V.

4.1.3 *Type III*—honeycomb for general use in panels where the higher performances of Types I, II, and IV materials are not required.

4.1.4 *Type IV*—honeycomb similar to Type II but with slightly lower performance.

4.1.5 *Type V*—honeycomb similar to Type III but with slightly lower performance.

5. Ordering Information

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

5.1.1 Title, number, and date of this specification.

5.1.2 Type of honeycomb required (see Section 4).

¹² Available from the Uniform Classification Committee, Room 1106, 222 S. Riverside Plaza, Chicago, IL 60606.

¹³ Available from the American Trucking Associations, Inc., Traffic Department, 1616 P St., NW, Washington, DC 20036.

¹⁴ Available from the American Society for Quality Control, 611 E. Wisconsin Ave., Milwaukee, WI 53202.

TABLE 1 Honeycomb-Core Material Properties

| Type | Type I | Type II | Type III | Type IV | Type V |
|--|------------|------------|---------------------------|------------|------------|
| Maximum density, lb/ft ³ (kg/m ³) | 5.5 (88) | 4.4 (70) | 3.3 (53) | 4.4 (70) | 3.3 (53) |
| pH, pH units | 7.0 ± 0.5 | 7.0 ± 0.5 | 7.0 ± 0.5 | 6.0 ± 0.5 | 6.0 ± 0.5 |
| Compressive strength, ^A psi (MPa): | | | | | |
| Dry, min ^B | 464 (3.20) | 464 (3.20) | 232 (1.60) | 404 (2.79) | 198 (1.37) |
| Wet, min ^C | 406 (2.80) | 232 (1.60) | 116 (0.80) | 163 (1.13) | 98 (0.68) |
| At elevated temperature ^D | 394 (2.72) | 278 (1.92) | 139 (0.96) | 185 (1.28) | 115 (0.79) |
| Cyclic aging, minimum | 363 (2.50) | 190 (1.31) | 104 (0.72) | 119 (0.82) | 62 (0.43) |
| After fungus test ^E | | | See footnote ^F | | |
| Shear strength, ^A psi (MPa): | | | | | |
| Dry, min | | | | | |
| TL core orientation ^B | 218 (1.50) | 218 (1.50) | 116 (0.80) | 180 (1.24) | 85 (0.59) |
| TW core orientation ^B | 130 (0.90) | 116 (0.80) | 65 (0.45) | 113 (0.78) | 57 (0.39) |
| Wet, min | | | | | |
| TL core orientation ^C | 203 (1.40) | 109 (0.75) | 58 (0.40) | 86 (0.59) | 53 (0.37) |
| TW core orientation ^C | 116 (0.80) | 58 (0.40) | 33 (0.23) | 58 (0.40) | 32 (0.22) |
| Flatwise tensile strength, min, ^F psi (MPa) | 406 (2.80) | 406 (2.80) | 231 (1.60) | 306 (2.11) | 231 (1.60) |
| Brittleness/Impact: | | | | | |
| Drop height, min, in (mm) | 40 (1016) | 30 (762) | 20 (508) | 30 (762) | 20 (508) |
| Water migration resistance: | | | | | |
| 24 h, max, number of cells | 3 | 3 | 3 | 3 | 3 |

^A Two-inch (51-mm) thick core with 0.05-in (1.3-mm) facings, tested at 73 ± 2°F (23 ± 1°C) unless otherwise stated herein. Shear tests shall be conducted with the core oriented in the TL and TW planes (Fig. 1).

^B At equilibrium with 73 ± 2°F (23 ± 1°C), and 50 ± 4 % RH.

^C After soaking in water at 70 ± 5°F (21.1 ± 3°C) for 48 h with perforated facings.

^D After heating for 30 min at, and tested at, 176 ± 5°F (80 ± 3°C).

^E Values for compressive strength shall be not less than 85 % of the dry compressive strength values for Types I, II, and III and 80 % for Types IV and V.

^F Tested at 73 ± 2°F (23 ± 1°C) with loading blocks bonded directly to each side of core specimen having a minimum area of 9 in.²(5806 mm²).

5.1.3 Dimensions required (see 6.4).

5.1.4 Cell size required (see 6.2 and 6.4).

5.1.5 Whether a first article sample is required (see 3.3).

5.1.6 Whether qualification is necessary (see 8.2.2).

5.2 When a first article sample is required, specific instructions shall be given regarding arrangements for examination, test, and approval of the first article.

6. Materials and Manufacture

6.1 *Materials*—Materials shall be as specified herein for the type ordered and shall comply with all provisions of this specification for this type.

6.2 *Configuration*—The honeycomb material (see Fig. 1) shall consist of a nonmetallic web material, suitably bonded so that in its final expanded form, a reasonably uniform cellular shape is developed. Unless otherwise specified, the cell size shall not exceed 0.5 in (12.5 mm).

6.3 *Flame Resistance*—The honeycomb core material shall meet the following requirements when tested as specified:

6.3.1 Average burn rate shall not exceed 4 in/min.

6.3.2 Self extinguishment within 15 s after removal of the 60-s applied flame.

6.3.3 Burning without flame shall not extend into undamaged area of core material.

6.4 *Dimensions*—Using the methods specified in 7.15, the length, width, and thickness dimensions of the honeycomb core (see Fig. 1) and the cell size shall be as specified.

6.5 *Dimensional Tolerances*—Unless otherwise specified, the dimensional tolerances of the honeycomb core material shall be as specified in Table 2. The cell size shall not vary more than 10 % from the specified dimension within any lot.

6.6 *Unbonded Nodes*—There shall be no more than one unbonded node within any 10 by 10-in (250 by 250-mm) area of the honeycomb core.

TABLE 2 Dimensional Tolerances

| Dimensions | Tolerance, in (mm) | |
|------------|--------------------|---------------|
| | plus | minus |
| Length | 2.0 (50.8) | 0 (0) |
| Width | 1.0 (25.4) | 0 (0) |
| Thickness | 0.010 (0.254) | 0.010 (0.254) |

6.7 Honeycomb Properties:

6.7.1 *Physical and Mechanical*—The physical and mechanical properties of the honeycomb material shall meet the requirements listed in Table 1 when tested using the methods specified.

6.7.2 *pH*—When tested as specified, the pH of the honeycomb material shall meet the requirements listed in Table 1.

6.7.3 *Fungus Resistance*—When the fungus resistance is determined as specified, the compressive strength of the honeycomb shall meet the requirements listed in Table 1.

6.8 *Density*—The density of the honeycomb material, determined as specified, shall not exceed the values shown in Table 1 and shall be within ±10 % of the manufacturer's specified density.

6.9 *Workmanship*—The honeycomb core material shall be free of excess resin accumulations (for example, runs and sags), starved areas (for example, lack of resin) and foreign materials. The cell wall edges of the core shall be clean cut with no broken edges.

6.10 *Thermal Resistance*—At the request of the purchaser, the thermal resistance, determined as specified, shall be reported.

6.11 *Shear Modulus and Compressive Modulus*—At the request of the purchaser, the honeycomb shear modulus and compressive modulus, determined as specified, shall be reported.

7. Test Methods

7.1 *Test Specimens*—Unless otherwise specified, test specimens shall be bonded at the same temperature, cure time, and pressure profiles as used in actual shelter panel manufacture and conditioned and tested under standard conditions of $73 \pm 2^\circ\text{F}$ ($23 \pm 1^\circ\text{C}$) and $50 \pm 4\%$ relative humidity (RH). (See Specification E 865.)

7.2 *Density*—Test the density of the honeycomb material for compliance with the requirements given in Table 1. Determine the density using the core density method of MIL-STD-401 using two specimens, each at least 2.2 ft² (0.2 m²) in area. Condition the specimens as specified for at least 48 h. Record each individual density value. Determine the average density value of the two specimens. The test is failed if any average density value does not meet the requirements of Table 1 and 6.8.

7.3 *Honeycomb Core Shear*—The *L* by *W* by *I* dimensions of the bonded sandwich specimens shall be 15 by 3 by 2 in (380 by 75 by 50 mm). The skin shall consist of 0.05-in (1.3-mm) thick perforated sheet of 5052H34 or 6061T6 aluminum alloy. The perforated holes shall be 0.13 in (3.2 mm) in diameter with 0.19 in (4.8 mm) staggered centers. The adhesive used for bonding the specimen shall conform to Specification E 865.

7.3.1 *Wet*—Soak twelve specimens under a 12-in (3.0 kPa) head of water at $70 \pm 5^\circ\text{F}$ ($21 \pm 3^\circ\text{C}$) for at least 48 h. When perforated skins are bonded to the core, clear the perforations of adhesive so that there is at least one hole into each cell through each skin. After removal from the water, shake the bonded specimens to remove excess water. Then test the bonded specimens in accordance with the Sandwich Flexure test method of MIL-STD-401 using a 12-in (305-mm) span, 2-point loading system consisting of 2 by 3 by 0.25 in (50 by 75 by 6 mm) loading blocks on $\frac{1}{3}$ span. Test six bonded specimens with the core oriented in the TL plane (Fig. 1) and six with the core oriented in the TW plane (Fig. 1). Record all individual shear strength values for each plane. The test is failed if two or more of the six values of each plane do not meet the requirements of Table 1 or the average value is below Table 1.

7.3.2 *Dry*—Condition twelve specimens as specified in 7.1 for at least 48 h, then test as described in 7.3.1. At the option of the supplier, the skins specified in 7.3 do not necessarily have to be perforated. Record all individual shear strength values for each plane. The test is failed if two or more of the six values for each plane do not meet the requirements of Table 1 or the average value is below Table 1.

7.4 *Honeycomb Core Compression*—The *L* by *W* by *T* dimensions of the bonded sandwich specimens shall be 4 by 4 by 2 in (100 by 100 by 50 mm). The skin shall consist of 0.05-in (1.3-mm) thick perforated sheet of 5052H34 or 6061T6 aluminum alloy (Federal Specification QQ-A-250/8d Aluminum Alloy or QQ-A 250/11d) or (Specification B 209). The perforated holes shall be 0.13 in (3.2 mm) in diameter with 0.19 in (4.8 mm) staggered centers. The adhesive used for bonding the specimen shall conform to Specification E 865.

7.4.1 *Wet*—Soak six specimens under a 12-in (3.0 kPa) head of water at $70 \pm 5^\circ\text{F}$ ($21 \pm 3^\circ\text{C}$) for at least 48 h. When

perforated skins are bonded to the core, clear the perforations of adhesive so that there is at least one hole into each cell through each skin. After removal from the water, shake the bonded specimens to remove excess water. Then test the bonded specimens in accordance with the Core Compression Test Method of MIL-STD-401. Record all individual compressive strength values. The test is failed if two or more of the six values do not meet the requirements of Table 1 or the average value is below the value given in Table 1.

7.4.2 *Dry*—Condition six specimens as specified in 7.1 for at least 48 h. Then test in accordance with the Core Compression Test Method of MIL-STD-401. At the option of the supplier, the skins specified do not necessarily have to be perforated. Record all individual compressive strength values. The test is failed if two or more of the six values do not meet the requirements of Table 1 or the average value is below Table 1.

7.4.3 *Elevated Temperature*—Heat six specimens to $176 \pm 5^\circ\text{F}$ ($80 \pm 3^\circ\text{C}$) for a duration of 30 min and test immediately at that temperature. The test procedure shall be in accordance with the Core Compression Test Method of MIL-STD-401. At the option of the supplier, the skins do not necessarily have to be perforated. Record all individual compressive strength values. The test is failed if two or more of the six values do not meet the requirements of Table 1 or the average value is below the value given in Table 1.

7.5 *Honeycomb Core Cyclic Aging*—Specimens shall be as specified in 7.4. When perforated skins are bonded to the core, clear the perforations of adhesive so that there is at least one hole into each cell through each skin. Test six specimens by the Cycle A Aging Test Procedure of Test Method C 481. Subject each specimen to ten complete cycles of laboratory aging except that the “heat” and “heat in dry air” procedures do not apply, and the time for cold storage may be reduced from 20 h to 17 h. Upon completion of the tenth cycle, shake the bonded specimens to remove excess water, store at $73 \pm 2^\circ\text{F}$ ($23 \pm 1^\circ\text{C}$) for 60 min. Then test in accordance with the Core Compression Test Method of MIL-STD-401. Record all individual compressive strength values. The test is failed if two or more of the six values do not meet the requirements of Table 1 or the average value is below the value given in Table 1.

7.6 *Honeycomb Core Brittleness Impact*—The *L* by *W* by *T* dimensions of the specimens, cut from a bonded sandwich sheet, shall be 24 by 24 by 2 in (610 by 610 by 50 mm). The adhesive used for bonding the specimen shall conform to Specification E 865. The skins shall consist of 0.05 in (1.3 mm) thick sheet of 5052H34 or 6061T6 aluminum alloy (Federal Specification QQ-A-250/8d Aluminum Alloy or QQ-A 250/11d) or (Specification B 209). Condition the specimen as specified in 7.1 for at least 48 h. Support the bonded specimen by, but not rigidly fixed to, a nominal 2 by 4-in (50 by 100-mm) softwood frame resting on a flat concrete floor. Drop a steel cylinder weight, 70 lb (31.8 kg) with 3-in (76-mm) diameter hemispherical striking surface, the distance listed in Table 1 onto the approximate center of the supported bonded specimen. Cross section the bonded test specimen through the impact area and visually examine. Any of the following shall constitute failure of this test (see Fig. 2):

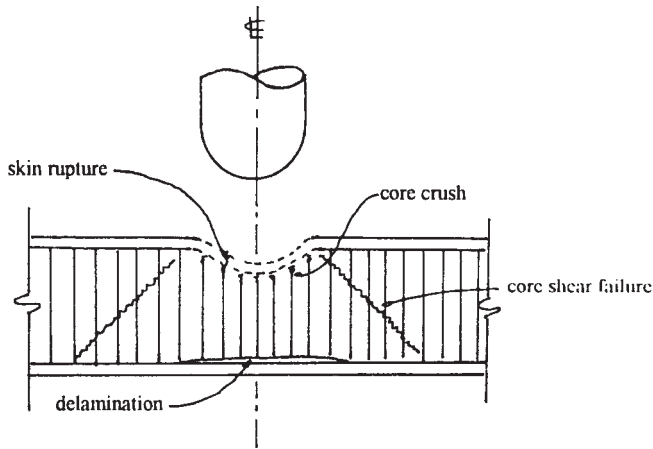


FIG. 2 Brittleness/Impact Test Failure Modes

7.6.1 Rupture of impacted or opposite skin, or both.

7.6.2 Delamination of the opposite skin to core.

7.6.3 Delamination of impacted skin to core or any crushing/collapsing of the core, or both, outside a 3 in (76 mm) radius from the center of impact (which shall coincide with the approximate center of the test panel specimen).

7.6.4 Core shear failure outside a 5 in (127 mm) radius from the center of impact (which shall coincide with the approximate center of the test specimen).

7.7 *Flatwise Tensile*—Prepare six specimens, 2 in (50 mm) thick, each having minimum dimensions of 3 by 3 in (75 by 75 mm), for testing by bonding loading blocks directly to each side of the core. The adhesive used shall have sufficient bonding strength to ensure failure in the core and not between the core and block. The bonding technique shall be such that it does not affect the characteristics of the core (Note 1). Condition the bonded specimen as specified in 7.1 for at least 48 h. Then test the bonded specimens in accordance with the Sandwich Tension Test Method of MIL-STD-401. Record all individual tensile strength values. The test is failed if two or more of the six values do not meet the requirements of Table 1 or the average value is below the value given in Table 1.

NOTE 1—Epoxy resin adhesives have been found useful for bonding the loading blocks at room temperature or at slightly elevated temperature.

7.8 *pH*—The pH of the honeycomb material shall be determined by TAPPI Method T 435-SU-68.

7.9 *Fungus Resistance*:

7.9.1 Twenty specimens of bare honeycomb material are required. The *L* by *W* by *T* dimensions of the specimens shall be 4 by 4 by 2 in (100 by 100 by 50 mm). All twenty specimens shall have the cell ends reinforced in accordance with the specimen preparation procedures of the Core Compression Test Method of MIL-STD-401. Retain ten of these specimens as control specimens and expose ten to the Mildew Resistance, Soil Burial Test Method 5762 of FED-STD-191A for a period of 28 days except as follows:

7.9.1.1 The number of specimens shall be ten.

7.9.1.2 The specimens shall be buried in the soil with the honeycomb cells perpendicular to the surface such that the cells are filled with soil.

7.9.2 After exposure, condition the ten fungus test specimens, as well as the ten control specimens, as specified in 7.1 for at least 48 h. Then test in accordance with the Core Compression Test Method of MIL-STD-401. At least nine compressive strength values for the ten control specimens and the average compressive strength of all specimens shall meet the dry compression values shown in Table 1. At least seven of the ten specimens subjected to the fungus test shall meet 85 % of the average compressive strength values obtained from the Type I, II, or III control specimens but 80 % of the average compressive strength values obtained from Type IV and V control specimens.

7.10 *Thermal Resistance*—Test three full-use thickness (*T* dimension) of the bare honeycomb material for thermal resistance in accordance with Test Methods C 518 or C 177 and record the results as specified.

7.11 *Shear Modulus*—Test three dry specimens of honeycomb material with the core oriented in each of the TL and TW planes (Fig. 1) for shear modulus. Determine the shear modulus in accordance with the Core Shear Test Method of MIL-STD-401 and record as specified.

7.12 *Core Compressive Modulus*—Test three dry specimens of honeycomb material for compressive modulus. Determine the compressive modulus in accordance with the Core Compression Test Method of MIL-STD-401 and record as specified.

7.13 *Water Migration Resistance*—Evaluate a minimum of two specimens of the honeycomb material for water migration properties in accordance with the Core Water Migration Test Method of MIL-STD-401. Express the water migration as the average number of cells filled in 24 h. The test is failed if any individual value exceeds the requirements of Table 1.

7.14 *Flame Resistance*—Evaluate the specimens for flame resistance (Note 2) using test procedures and apparatus generally as described in Test Method F 501 (and a similar test in FAR 25.853 Appendix F) but with the following variations:

NOTE 2—The flame resistance test is included as a necessary test to ensure that the honeycomb core within the panel composite has a certain degree of flame resistance. This test shall not be used to describe or appraise the fire hazard or fire risk of full-scale panels or shelters.

7.14.1 *Test Specimen*—Three bonded sandwich specimens are required. The *L* by *W* by *T* dimensions of the specimens shall be 4.5 by 12.5 by 2 in (115 by 320 by 50 mm). The skins shall consist of 0.05-in (1.3-mm) thick sheet 5052H34 aluminum alloy. The adhesive used for bonding the specimen shall conform to Specification E 865.

7.14.2 *Test Environment*—Conduct tests in a draft-free sheet metal cabinet having a door with a glass insert for observation purposes. Baffled holes in the top or bottom of the cabinet are not permitted. Use a bunsen or Terrill burner with a nominal 0.38-in (9.5-mm) diameter tube adjusted to produce a 1.5-in (38.1-mm) flame of a temperature of $1550 \pm 50^\circ\text{F}$ ($843 \pm 28^\circ\text{C}$). Position the lower edge of the specimen being tested 0.75 in (19.1 mm) away from the flame.

7.14.3 *Test Setup*—Clamp the specimen securely so that the exposed edge area is a minimum of 4 in (100 mm) wide and 11.5 in (292 mm) long in a vertical position.

7.14.4 *Procedure*—Draw lines 1.5 in (38.1 mm) and 11.5 in (292 mm) from one end of the specimen to indicate the area to

be used as the timing zone for determining burn rate. Condition specimens as specified in 7.1 for at least 40 h. Mount specimen in a metal holder and install in the metal cabinet in the vertical position so oriented that the center line of the burner is in line with the face skin aluminum surface and the center of the specimen edge. Apply the flame for a period of 60 s, then remove.

7.14.5 *Burn Rate*—Determine the burn rate by using a minimum of 10 in (254 mm) of the specimen for timing purposes. Approximately 1.5 in (38 mm) must burn before the burning front reaches the timing zone. The average burn rate shall not exceed 4 in (100 mm)/min. In addition, flaming of core material shall extinguish itself within 15 s after removal of the 60-s applied flame, and burning without flame shall not extend into undamaged area of core material.

7.15 *Dimensional Examination*—Make a dimensional examination to determine conformance with the requirements specified herein. Measure the length, width, and thickness dimensions of each sheet of honeycomb selected for inspection. Measure the thickness in accordance with Test Method C 366, Method B. Determine cell size by taking the average distance between node bonds along the *W* direction (Fig. 1) for at least 60 cells, selected at random in groups containing 10 adjacent cells.

8. Inspection

8.1 *Responsibility for Inspection*—Unless otherwise specified in the contract, the supplier is responsible for the performance of all inspections specified herein. Unless otherwise specified in the contract, the supplier may use his own or any other suitable facilities for the performance of the specified inspections. The purchaser reserves the right to perform any of the specified inspections.

8.1.1 *Certificate of Compliance*—Where certificates of compliance are submitted, the purchaser reserves the right to check test such items to determine the validity of the certification.

8.2 *Classification of Inspection*—The inspection requirements specified herein are classified as follows:

- 8.2.1 First article inspection (see 8.3).
- 8.2.2 Qualification inspection (see 8.4).
- 8.2.3 Quality conformance inspection (see 8.5).

8.3 *First Article Inspection*—When a first article is required (see 5.2), the first article shall be examined for the defects listed in Table 3 and tested for the requirements in Table 1 in accordance with the procedures specified.

8.3.1 *Sampling*—Sample sheets for the first article shall be taken at random from one of the first ten blocks of the first lot produced.

TABLE 3 Defects

| Examine | Defect |
|--------------------|--|
| Dimensions Bond | One or more dimensions outside the specified tolerances More than one unbonded node within a specified area of the honeycomb core |
| Workmanship | Excess resin accumulation, for example, runs or sags Starved area, for example, lack of resin. Presence of foreign material Cell wall edge of the core is not clean cut or has broken edges |

8.4 *Qualification Inspection:*

8.4.1 *Qualification Test*—Unless otherwise specified by the purchaser, honeycomb core that has not passed the tests specified in Section 7, or that has previously passed the test but has subsequently been modified in any manner, must be tested against this specification and shown to meet its requirements.

8.4.2 *Test Report*—In addition to the test specimens cited herein, the manufacturer shall furnish a dated and numbered report, certified by notarized affidavit, giving the results of all tests listed in Section 7. The individual and average values for the tests shall be reported. The test report shall cover all requirements of Section 6. Exact information as to how the individual specimens are fabricated including component materials, component material preparation and their processing into specimens, as well as complete testing information for each test such as test apparatus, crosshead speeds, and so forth, shall be reported.

8.5 *Quality Conformance Inspection*—Except as otherwise specified herein, sampling for inspection shall be performed in accordance with MIL-STD-105.

8.5.1 *Component and Material Inspection*—Unless otherwise specified, components and materials shall be inspected in accordance with all the requirements of the referenced specifications, drawings, and standards.

8.5.2 *End Item Inspection*—End item inspection shall consist of visual and dimensional examinations. The sample unit for end item inspection shall be one honeycomb sheet taken from every 100 ft³ (2.8 m³) of a production lot.

8.5.2.1 *Visual Examination*—A visual examination shall be made for the defects listed in Table 3. The inspection level shall be II and the AQL, expressed in terms of defects per hundred units, shall be 2.5.

8.5.2.2 *Dimensional Examination*—A dimensional examination shall be made to determine conformance with the requirements specified in 6.5. The length, width, and thickness dimensions of each sheet of honeycomb material selected for inspection shall be determined as specified in 7.15. The inspection level shall be S-1 and the AQL, expressed in terms of defects per hundred units, shall be 2.5.

8.5.3 *End Item Testing*—End item testing shall be performed as specified in 7.2, 7.3.2, 7.4, 7.6 (except test only one specimen), and 7.13 for every production lot. The test specimen shall be one sheet of honeycomb 2 in (50 mm) thick cut from the production lot. Cut specimens for testing from the honeycomb core sheet. Any failed testing as defined in 7.2, 7.3.2, 7.4, 7.6 (except test only one specimen), and 7.13 shall be cause for rejection of the lot represented by the specimens.

8.5.4 *Packaging Inspection*—An examination shall be made to determine that packaging, packing, and marking comply with the applicable requirements. Defects sought shall be those indicated in Table 4. The sample unit shall be one shipping container fully prepared for delivery. The lot shall be the number of shipping containers offered for inspection at one

TABLE 4 Packaging Inspection

| Examine | Defect |
|-------------------------|--|
| Markings Workmanship | Missing, incorrect, or illegible markings. Bulged or distorted container. |

time. The inspection level shall be S-2 and the AQL, expressed in terms of defects per hundred units, shall be 2.5.

9. Packaging, Packing, and Marking

9.1 *Packaging*—Honeycomb material shall be packaged so as to afford adequate protection against physical damage during shipment. The package and the quantity per package shall be the same as that normally used by the supplier for retail distribution.

9.2 *Packing*—Honeycomb material, packaged as specified, shall be packed to ensure carrier acceptance and safe delivery at destination at the lowest transportation rate for such supplies. The quantity per shipping container shall be the same as that normally used by the supplier for retail distribution. Containers shall comply with the uniform Freight Classification or the National Motor Freight Classification, as appropriate.

9.3 *Marking*—In addition to any special marking specified in the contract, interior package and shipping containers shall be marked in accordance with MIL-STD-129. Each shipping container shall be marked with the following information:

- 9.3.1 Manufacturer's name and trademark,
- 9.3.2 Specification number,
- 9.3.3 Type, density, and cell size,
- 9.3.4 Core cell orientation (*L*, *W*, and *T*),
- 9.3.5 Dimensions,
- 9.3.6 Date of production, and
- 9.3.7 Lot number.

10. Keywords

10.1 adhesive bond; aluminum facing; honeycomb; honeycomb sandwich panels; nonmetallic honeycomb core; relocatable shelters

ASTM International takes no position respecting the validity of any patent rights asserted in connection with any item mentioned in this standard. Users of this standard are expressly advised that determination of the validity of any such patent rights, and the risk of infringement of such rights, are entirely their own responsibility.

This standard is subject to revision at any time by the responsible technical committee and must be reviewed every five years and if not revised, either reapproved or withdrawn. Your comments are invited either for revision of this standard or for additional standards and should be addressed to ASTM International Headquarters. Your comments will receive careful consideration at a meeting of the responsible technical committee, which you may attend. If you feel that your comments have not received a fair hearing you should make your views known to the ASTM Committee on Standards, at the address shown below.

This standard is copyrighted by ASTM International, 100 Barr Harbor Drive, PO Box C700, West Conshohocken, PA 19428-2959, United States. Individual reprints (single or multiple copies) of this standard may be obtained by contacting ASTM at the above address or at 610-832-9585 (phone), 610-832-9555 (fax), or service@astm.org (e-mail); or through the ASTM website (www.astm.org).