



HexWeb® CR-PAA™

Phosphoric Acid Anodized Aluminum Honeycomb

Product Data

Description

The life cycle of aluminum honeycomb sandwich structures in a given application can be directly related to the quality of the bond between the face sheets that carry bending loads and the honeycomb that carries the shear loads. The adhesive is the interface between the facing and the core in the same way that the oxide on the aluminum and the primer that has been applied to it is the interface between the honeycomb substrate material and the bonding adhesive. This interface is critical to the performance of honeycomb bonded assemblies.

Figure 1 and Figure 2 show how the filleting adhesive works with the phosphoric acid anodized foil. This results in an aluminum honeycomb with improved long-term bond durability in hot/wet environments.

Features

- Superior corrosion protection over standard aluminum cores
- Enhanced bond strength and durability
- Improved bonded assembly part life

Applications

HexWeb® CR-PAA™ is designed for aircraft structures that are exposed to demanding environmental conditions. HexWeb® CR-PAA™ outperforms standard MIL-C-7438 core in salt spray and HexWeb® crack propagation tests.

Type Designation

Hexcel HexWeb® CR-PAA™ aluminum honeycomb is designated as follows:

Material – Cell Size – Alloy – Foil Gauge – Core Density

Example: **HexWeb® CR-PAA™ – 1/4 – 5052 – .002 – 4.3**

HexWeb® CR-PAA™ – Phosphoric acid anodized

- 1/4** – Cell size in inches
- 5052** – Aluminum alloy
- .002** – Nominal foil thickness
- 4.3** – Nominal density in pounds per cubic foot (pcf)
- N** – Indicates the cell walls are not perforated. (P indicates perforated, and is available on special orders)

Figure 1

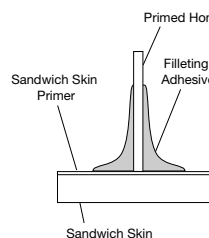


Figure 2

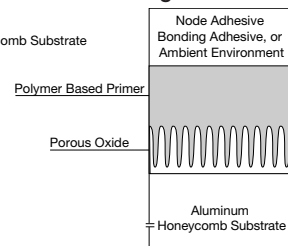
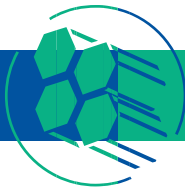


Figure 1 shows a cross section of an adhesive fillet that bonds the sandwich skin to the honeycomb substrate material. Note: Both the skin and substrate material are primed before bonding.

Figure 2 is a schematic of the interface between the filleting adhesive and the underlying honeycomb substrate material.

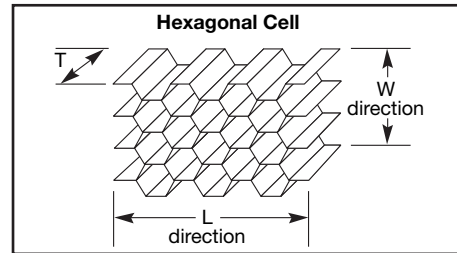
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Dimensional Nomenclature

- T** = Thickness, or cell depth
- L** = Ribbon, or longitudinal direction
- W** = Transverse direction, or direction perpendicular to the ribbon



Availability

The required lead time varies with the honeycomb type and delivered form. Please contact the nearest Hexcel Sales Office or Hexcel Customer Service for price and delivery information.

Honeycomb Manufacturing Using Phosphoric Acid Anodizing

It should be noted that the environmental durability of HexWeb® CR-PAA™ is not a result of the anodic oxide alone. It is the combination of the structure of the oxide, with its stability in a hot/wet environment, and the area of contact between the oxide and the primer, which results in a material system with improved bond durability.

As part of a single, continuous process, a proprietary engineered anodizer enables Hexcel to grow uniform oxide on both sides of a substrate traveling through the entire process line. While this particular technology facilitates economic line speeds, it also minimizes burns, blemishes, and pinholes that can occur when using older methods of anodizing. After the substrate passed through the anodizer, it is rinsed with high-purity water, dried, and then passes immediately into the primer applicator.

By eliminating the delay between anodizing and priming, Hexcel has engineered a process line that ensures the highest quality bond between the foil surface and the primer. The remainder of the honeycomb manufacturing process is similar to Hexcel's standard core manufacturing operations.

Important Properties of Phosphoric Acid Anodized Aluminum Core

Although many tests are used to determine the design properties of aluminum honeycomb, one of the most important properties is how well a honeycomb sandwich structure stands up to its operating environment. In particular, when a sandwich structure is used in a hot/wet environment, it is important to assess the effects of that environment on the performance of the part.

Environmental Peel

For comparison purposes, Hexcel fabricated a number of environmental peel specimens using HexWeb® CR-PAA™ – 3/16 – 5052 – .002 – 5.7 (phosphoric acid anodized aluminum honeycomb, 3/16 inch cell size, 5.7 pounds per cubic foot core density) and compared them with MIL-C-7438 3/16 – 5052 – .002 – 5.7 core. The sandwich specimen face sheets were perforated on the nonpeel side and hung vertically in a 100% humidity chamber set to 140°F for up to 30 days. After 0, 9, 20, and 30 days, sets of the specimens were removed from the humidity chamber and their residual peel strengths were measured. The results of this comparative testing are shown in the following chart.

Residual peel strengths (in-lb/3 in. width)

During the post test analysis of these specimens, it was observed that the phosphoric acid anodized specimens failed cohesively throughout the 30 days of testing. The MIL-C-7438 cores, on the other hand, began to show evidence of adhesive failure after 9 days in condensing humidity. The observance of such a dramatic difference in the performance of these two core types in this particular environment illustrates how phosphoric acid anodized core extends component part life.

Days	Hexcel CR-PAA	MIL-C-7438 Core
0	79.0*	64.7*
9	74.5*	56.8**
20	68.6*	25.6**
30	66.6*	15.8**

* Failure mode = Cohesive
 ** Failure mode = Adhesive

Mechanical Properties

Hexcel Honeycomb Designation Cell Size – Alloy – Foil Gauge	Nominal Density pcf	Compressive					crush Strength psi	Plate Shear					
		Bare		Stabilized				L Direction			W Direction		
		Strength psi		Strength psi		Modulus ksi		Strength psi		Modulus ksi	Strength psi		Modulus ksi
1/8 – 5052 – .001	4.5	typ	min	typ	min	typ	typ	typ	min	typ	typ	min	typ
1/8 – 5052 – .0015	6.1	550	375	570	405	150	260	340	285	70.0	220	168	31.0
1/8 – 5052 – .002	8.1	980	650	1020	680	240	450	560	455	98.0	340	272	41.0
1/8 – 5052 – .002	8.1	1500	1000	1560	1100	350	750	800	670	135.0	470	400	54.0
1/8 – 5052 – .0037	12.0	2700	2100	2900	2200	900	–	1940I	1250I	–	1430I	1000I	–
5/32 – 5052 – .001	3.8	395	285	410	300	110	185	270	215	56.0	165	125	26.4
5/32 – 5052 – .0015	5.3	690	490	720	535	195	340	420	370	84.0	270	215	36.0
5/32 – 5052 – .002	6.9	1080	770	1130	800	285	575	590	540	114.0	375	328	46.4
3/16 – 5052 – .001	3.1	290	200	335	215	75	130	210	155	45.0	125	90	22.0
3/16 – 5052 – .0015	4.4	520	360	550	385	145	250	330	280	68.0	215	160	30.0
3/16 – 5052 – .002	5.7	820	560	860	600	220	390	460	410	90.0	300	244	38.5
3/16 – 5052 – .0025	6.9	1120	770	1175	800	285	575	590	540	114.0	375	328	46.4
3/16 – 5052 – .003	8.1	1600	1000	1720	1100	350	750	725	670	135.0	480	400	54.0
1/4 – 5052 – .001	2.3	190	120	210	130	45	75	140	100	32.0	85	57	16.2
1/4 – 5052 – .0015	3.4	340	240	370	250	90	150	230	180	50.0	140	105	24.0
1/4 – 5052 – .002	4.3	500	350	540	370	140	230	320	265	66.0	200	155	29.8
1/4 – 5052 – .0025	5.2	690	500	760	510	190	335	410	360	82.0	265	200	35.4
1/4 – 5052 – .003	6.0	990	630	1100	660	235	430	530	445	96.0	340	265	40.5
1/4 – 5052 – .004	7.9	1420	970	1490	1050	340	725	700	650	130.0	440	390	52.8
3/8 – 5052 – .001	1.6	90	60	95	70	20	40	85	60	21.0	50	32	11.0
3/8 – 5052 – .0015	2.3	190	120	200	130	45	75	135	100	32.0	80	57	16.2
3/8 – 5052 – .002	3.0	285	190	310	200	70	120	200	145	43.0	125	85	21.2
3/8 – 5052 – .0025	3.7	370	270	410	285	105	180	250	200	55.0	160	115	26.0
3/8 – 5052 – .003	4.2	520	335	560	355	135	220	310	255	65.0	200	150	29.0
3/8 – 5052 – .004	5.4	740	500	800	535	200	360	430	380	86.0	280	228	36.8
3/8 – 5052 – .005	6.5	950	700	1000	750	265	505	545	500	105.0	350	300	43.5
1/8 – 5056 – .001	4.5	630	475	690	500	185	320	440	350	70.0	255	205	28.0
1/8 – 5056 – .0015	6.1	1120	760	1200	825	295	535	690	525	102.0	400	305	38.0
1/8 – 5056 – .002	8.1	1750	1200	1900	1300	435	810	945	740	143.0	560	440	51.0
5/32 – 5056 – .001	3.8	450	360	500	375	140	235	335	272	57.0	195	155	24.0
5/32 – 5056 – .0015	5.3	820	615	865	650	240	420	550	435	85.0	325	250	33.0
5/32 – 5056 – .002	6.9	1220	920	1340	1000	350	650	760	610	118.0	430	360	43.0
3/16 – 5056 – .001	3.1	380	250	410	260	97	170	265	200	45.0	150	110	20.0
3/16 – 5056 – .0015	4.4	620	460	670	490	180	310	425	340	68.0	245	198	27.0
3/16 – 5056 – .002	5.7	920	685	1000	735	270	480	565	480	94.0	330	280	36.0
1/4 – 5056 – .001	2.3	240	145	265	155	58	100	180	130	32.0	100	62	15.0
1/4 – 5056 – .0015	3.4	400	300	480	315	115	200	290	230	50.0	175	130	22.0
1/4 – 5056 – .002	4.3	580	440	620	465	172	300	400	325	67.0	230	190	27.0
1/4 – 5056 – .0025	5.2	790	600	820	645	230	410	490	425	84.0	300	245	32.0
3/8 – 5056 – .001	1.6	100	75	110	80	30	50	90	78	20.0	60	38	10.5
3/8 – 5056 – .0015	2.3	215	155	225	155	58	100	170	130	32.0	95	62	15.0
3/8 – 5056 – .002	3.0	320	240	340	260	92	160	245	190	43.0	145	100	19.0

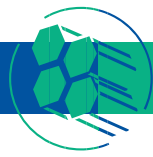
Test data obtained at 0.625 inch thickness.

I = Beam shear for 12.0 pcf products.

The product forms listed above have been provided for informational purposes only. Additional configuration and densities are available.

Please contact the nearest Hexcel Sales Office with your requirements.





Important Properties of Phosphoric Acid Anodized Aluminum Core (continued)

Acidified Salt Spray Corrosion Testing

Samples of standard MIL-C-7438 core and the phosphoric acid anodized and primed core were exposed to a sulfuric acid salt spray for 5 days and for 10 days. At the end of the exposure period, the samples were cleaned in a special acid solution that removes corrosion products without attacking the underlying base metal. By weighing the samples before and after acid digestion, the corrosion product weight loss could be quantified.

Weight loss (oz/ft²)

It should be noted that the MIL-C-7438 cores contain a special corrosion-inhibiting compound while the primer on the phosphoric acid anodized core does not. The polymer-based primer on the phosphoric acid anodized core is thicker than the corrosion-resistant coating on the MIL-C-7438 core. The combination of the increased thickness and the integrity of the primer coating contributes to better corrosion resistance of the phosphoric acid anodized core than is inherent with the MIL-C-7438 core. This is significant because the tensile stresses imposed on the primer coating during core expansion have not cracked the specially engineered polymer coating, and its integrity is sufficient to result in excellent corrosion resistance.

Days	Hexcel CR-PAA™	MIL-C-7438 Core
5	.0146	.0351
15	.0490	.0825
30	.0909	.1113

Concluding Comments

The combination of the hydrolytically stable, high-surface area anodic oxide with Hexcel's proprietary organic polymer-based primer results in an interface between core and bonding adhesive that is very durable in demanding hot/wet service environments.

The Hexcel phosphoric acid anodizing and priming process line has been designed to absolutely minimize the delay between anodizing and priming, thereby reducing the risk that the oxide is contaminated and the service durability of the customer's part is brought into question.

Important

Hexcel Corporation believes, in good faith, that the technical data and other information provided herein is materially accurate as of the date this document is prepared. Hexcel reserves the right to modify such information at any time. The performance values in this data sheet are considered representative but do not and should not constitute specification minima. The only obligations of Hexcel, including warranties, if any, will be set forth in a contract signed by Hexcel or in Hexcel's then current standard Terms and Conditions of Sale as set forth on the back of Hexcel's Order Acknowledgement.

For more information

Hexcel is a leading worldwide supplier of composite materials to aerospace and other demanding industries. Our comprehensive product range includes:

- Carbon Fiber
- RTM Materials
- Honeycomb Cores
- Continuous Fiber Reinforced Thermoplastics
- Carbon, Glass, Aramid and Hybrid Prepregs
- Structural Film Adhesives
- Honeycomb Sandwich Panels
- Special Process Honeycombs
- Reinforced Fabrics

For US quotes, orders and product information call toll-free 1-800-688-7734. For other worldwide sales office telephone numbers and a full address list please click here: <http://www.hexcel.com/contact/salesoffices>.