SEABOARD

CELTEC MARINEBOARD

Fabrication Guide

Introduction to Thermoplastics

The Seaboard™ family of products including Celtec Marine Board is thermoplastic. Thermoplastics behave differently compared to traditional boat building materials like wood, which is why Seaboard and Celtec Marine Board have grown in popularity replacing wood products. Seaboard and Celtec do not absorb water, they won't swell or crack in marine environments and they will not rot.

The following information is formatted to help the boat manufacturer work and design with Seaboard and Celtec Marine Board. First, two important factors must be taken into consideration when working with Seaboard or Celtec Marine Board; notch sensitivity and thermal expansion and contraction.

- **Notch Sensitivity**
  When machining or cutting thermoplastic materials, care should be taken to avoid notches, grooves, or scored lines in the sheet. It is important to cut the material with a radius to help disperse the inherent stresses in the corner of a fabricated item. Sharp angles should be avoided.
- **Thermal Expansion and Contraction**
  Seaboard is a High Density Polyethylene product, and Celtec Marine Board is a foam PVC. Common with all plastic materials, the sheet expands when warmed and contracts when cooled. This is a reversible phenomenon; when it returns to the original temperature, it will return to the exact size it was originally. This property is called linear thermal expansion and contraction.
  - Thermal Expansion Coefficient for Seaboard = 0.00006 in/in/ F
  - Thermal Expansion Coefficient for Celtec Marine Board = 0.00004 in/in/ F

FABRICATION GUIDE CONTENTS:

COMPRESSION POLYMERS CORP.

CPG Seaboard™ • Seaboard™ Supreme DS • Celtec® Marineboard
CPG Seaboard™ Grip X™ • Seaboard™ Utility Grade • Seaboard™ Lite

Machining

The machining characteristics of Seaboard™ and Celtec Marine Board are excellent, but like all plastics, router tool selection is critical. There is no substitute for selecting the right tool for your job.

Cutting

Seaboard and Celtec Marine Board can be cut with a table saw, radial arm saw, CNC router, band saw or panel saw. With any cutting process, the key is good sharp tools and adequate chip removal which helps eliminate heat build-up. A dull tool or improper feed rate can lead to rough edges and heat build-up to the point where the chips start to melt and refuse. Always cut a test piece prior to a production run.

Circular Saws – Generally, carbide tipped blades are recommended and the following settings are useful starting points;

a. Rake Angle 0 -15 degrees
b. Clearance angle – 10 – 20 degrees
c. Cutting speed – 8,000–12,000 ft/ min.
d. Feed rate – 70-90 feet/min.
e. Tooth pitch – 0.080" – 0.040"

Routing

Plastic materials can have a wide variety of machining characteristics ranging from flexible to rigid, soft to hard. During the routing process, hard plastic forms a splintered wedge or granulated chip, while soft plastic forms a curled chip. Seaboard tends to be soft and Celtec is harder. This represents a unique set of machining circumstances and tool selection opportunities.

Seaboard is a high-density polyethylene developed for the marine industry. It is available in a variety of colors. It is utilized in a flat sheet condition on CNC routers to machine to size, and produce parts and other marine designs. The material is available in 1/4" thru 1" inch thicknesses, and is easily routed and engraved when router tooling is selected with the proper geometry.

Tool Selection for General Routing

In the general machining of Seaboard and Celtec Marine Board, the right tool for the job involves the use of upcut spiral router bits to evacuate chip and maximize finish. The tools of choice include an Onsrud Cutter 52-080 (Figure 1) and 63-725 (Figure 2). These 1/4 inch diameter tools tested in 1/2 inch Seaboard provided an excellent finish in partial and full depth cuts. The 52-080 performed best in full depth cuts, while the 63-725 was quieter, which translates into less vibration and heat with increased tool life. The feed rate for the material was 100-200 inches per minute at 18,000 RPM, which reflects a chipload range of approximately 0.006 to 0.011. If the user were limited to a single tool selection, the 63-725 would represent the best all around tool for the job. Both of these router tools, unlike endmills, provide the necessary edge sharpness to alleviate the "fuzzing" or "hairing" sometimes associated with machining this material.

Pocketing and Recessed Cutting

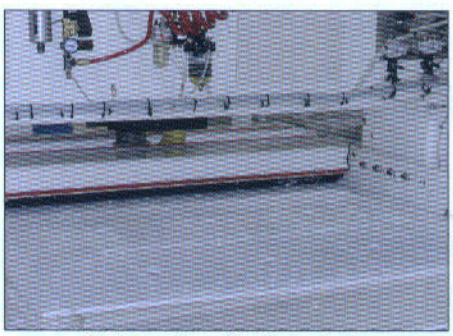
The major problem with this type of operation has been the difficulty in obtaining a smooth bottom surface. Even with relatively flat-pointed cutting tools, a series of swirl marks would be evident on the exposed inner material. These swirl marks were the result of raised ridges left by the router bit point, which required time consuming secondary finishing operations to remove. A new style of tool, the Bottom Surfacing Cutter developed by Onsrud Cutter, utilizes a nearly flat point with radiused corners to create a smooth bottom for this application that requires a high degree of aesthetic appeal in pocketing and recessed areas for hinges and hardware. (Figure 3)

Drilling

Drilling in plastic has always been a problem in the plastic industry because of chip wrap in soft plastics and crazing in hard materials. It is recommended that the point angle for Celtec is 90 – 110 degrees. Onsrud Cutter has developed a drill with a 60-degree point and a flat rake face providing the best plunge point in a wide variety of plastics including Seaboard. The point style creates a chip in soft plastics that is easily ejected and allows the use of normal drilling routines during programming. In the past, material such as polyethylene required a peck drilling cycle to prevent the formation of long chips that would wrap around the drill. The elimination of pecking drilling procedures in a program can lead to reduced cycle time and can increase cutter life significantly. (Figure 4)

Selecting the correct tool is the most important issue, but following some other guidelines can additionally enhance the machining of Seaboard and Celtec Marine Board. They include the following:

- Avoid straight plunge cuts into the material. Program the tool path to ramp into or enter the material from the side providing a path for the chips to be ejected.
- Select the shortest cutting edge possible to cover the material and achieve the cutting objective. Cutting edges that are too long for the application



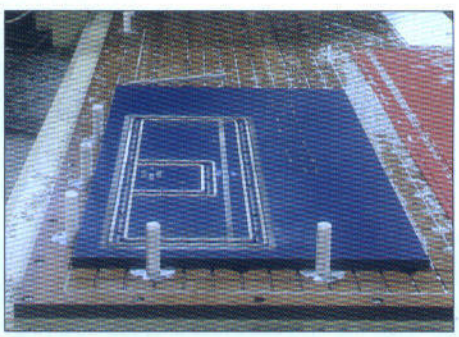


Photo courtesy of Jet Technologies

tend to cause vibration, which adversely effects part finish.

- As material thickness increases, so should the diameter of the tool. Larger diameters are less susceptible to vibration and afford better chip removal.
- Ensure part rigidity by following proper spoilboard techniques.
- Maximize dust collection to completely evacuate gummy chip produced by softer plastics.
- Properly maintain CNC routing equipment and give daily attention to collect and tool holding systems.

Figure 1

Figure 2

Figure 3

Figure 4

Fastening

There are many different methods of fastening Seaboard and Celtec Marine Board to various substrates. In the marine market, mechanical fastening using screws, nails or staples are common. However, adhesives can also be an effective bonding tool provided that the correct adhesive is chosen for the application.

Adhesives

Generally, Seaboard is a difficult product to adhere to itself or other substrates due to the low surface energy of HDPE. There are a couple of types of adhesive systems that are proven effective; two part epoxy and two part acrylic systems. Lap Shear strength values of greater than 1,000 psi have been achieved. Seaboard has been successfully bonded to itself, wood, aluminum, fiberglass and Gelcoat. See the adhesive manufacturing section.

Celtec Marine Board is a very easy product to bond to itself or other substrates. Celtec is a PVC based product, therefore, the solvent based PVC systems work well. Other adhesives such as Urethane, epoxy, and rubber based systems are also acceptable. Celtec can be bonded to other substrates like high pressure laminates, wood, aluminum, acrylic, polyester etc. In either case, a clean, dry and oil free surface is required for good bonding. Always follow the adhesive manufacturer's recommended procedures and test a small piece before starting production.

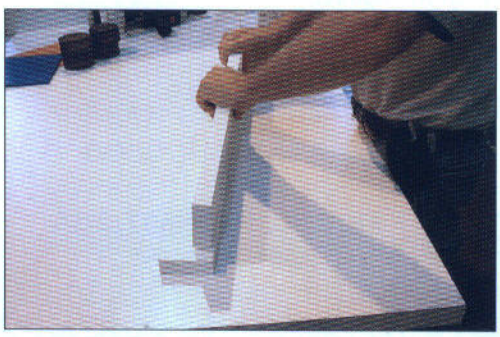
Product	Adhesive Name	Manufacturer
Seaboard	DP 8005	3M Adhesives
	DP 8010	3M Adhesives
	B45TH	Reltek LLC
Celtec Marine	Weld-ON®	IPS Corporation
	Scotch Weld 2216B/A	3M Adhesives
	Scotch Grip 4475	3M Adhesives
	Fast Bond 2000	3M Adhesives
	Lexel	Sashco
	Max Bond	TEC Specialty Products

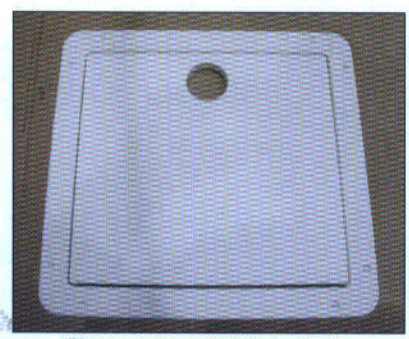
Screwing, Nailing, Stapling

Fastening of Seaboard and Celtec Marine Board can be accomplished using all types of screws. A coarse thread deck screw yields good holding power. Compression Polymers and Vycom have had Seaboard and Celtec Marine Board tested in accordance to ASTM 1761 by an outside laboratory.

PRODUCT	SCREW PULL in LBS.
Seaboard Premier	1134
Seaboard Lite	714
Seaboard Supreme DS	1008
Celtec Marine Board	680

Tool and adhesive supplier information can be found on the last page of this brochure.





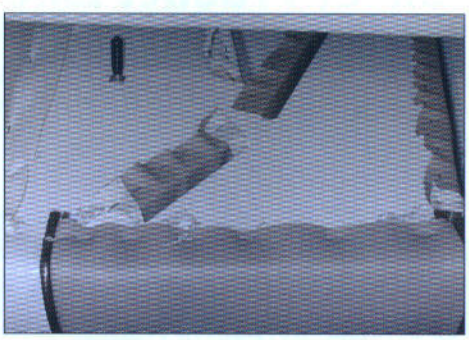


Photo courtesy of Jet Technologies

Thermal Expansion/Contraction Work Sheet

This work sheet is designed to aid you in determining what expansion and contraction your Seaboard or Celtec Marine Board part will experience.

CONTRACTION:

A = _____ °F. What is the approximate temperature at the time of fabrication?

B = _____ °F. What is the lowest temperature your part will experience in the place of services?

Subtract B from A.

This gives you the temperature difference for shrinkage due to cold.

EXPANSION:

A = _____ °F. What is the approximate temperature at the time of fabrication?

B = _____ °F. What is the highest temperature your part will experience in the place of service?

Subtract A from B.

This gives you the temperature difference for expansion due to heat.

Let's call the difference "D". D = _____ °F.

To calculate the amount your part will expand or contract, multiply the following:

D °F × L or W inches × .00006 or .00004 = E or C inches

D = temp. difference. **L or W** = length or width of part. **.00006** = coefficient of Seaboard expansion (Celtec MB = **.00004**).
E or C = amount of expansion or contraction.

Example: If a Seaboard part were being cut in a shop at 70°F and the highest temperature the part will experience is 100°F, the Temperature Difference (D) is 30. The part is 96 inches, so the expansion is:

30°F × 96" × .00006 = .173" or approx. 3/16"
(temp. difference) × (length of part) × (coefficient) = (expansion)

Thus at 100°F the part will be 96.173 "

Conversion Chart: Fractional Inches to Decimal Inches

1/32	=	.031
1/16	=	.062
3/32	=	.094
1/8	=	.125
5/32	=	.156
3/16	=	.188
7/32	=	.219
1/4	=	.25
9/32	=	.281
5/16	=	.313
11/32	=	.344
3/8	=	.375
13/32	=	.406
7/16	=	.438
15/32	=	.469
1/2	=	.5
17/32	=	.531
9/16	=	.563
19/32	=	.594
5/8	=	.625
21/32	=	.656
11/16	=	.688
23/32	=	.719
3/4	=	.75
25/32	=	.781
13/16	=	.813
27/32	=	.844
7/8	=	.875
29/32	=	.906
15/16	=	.938
31/32	=	.969
1/1	=	1.00

Associated Suppliers

These companies have tested Seaboard and/or Celtec Marine Board and have product recommendations.

Adhesive Manufactures

i. **IPS Corp.**, 455 W Victoria Street
Compton, CA 90220 . . . . . PH: 310-898-3300

ii. **3M Adhesives**, 3M Center, Bldg 220-8E-05
St Paul, MN 55144. . . . . PH: 800-362-3550

iii. **Reltek LLC**, 2345 Circadian Way
Santa Rosa, CA 95407 . . . . . PH: 707-284-8808

iv. **Sashco**, 10300 107th Place
Brighton, CO . . . . . PH: 800-289-7290

v. **TEC Specialty**, 315 S Hicks Road
Palatine, IL 60067 . . . . . PH: 847-358-9500

Tool and Equipment Suppliers

i. **Forrest Manufacturing**
457 River Rd
Clifton, NJ 07014 . . . . . PH: 973-473-5236

ii. **Hendrick/RWH Industries**
36 Commercial Street
Salem, MA 01970 . . . . . PH: 978-741-3600

iii. **Onsrud Cutter**
800 Liberty Drive
Libertyville, IL 60048,. . . . . PH: 800-234-1560

Sheet Product Line

Technical data and samples are available upon request.

CPG Seaboard™ • Seaboard™ Supreme DS • Celtec® Marineboard
CPG Seaboard™ Grip X™ • Seaboard™ Utility Grade • Seaboard™ Lite

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