About Balsa

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http://www.sigmfg.com/cgi-bin/dpsmart.exe/InformBalsaJV5.html?L+Sig+kerg4101

Model airplanes are no different than any other type of flying machine, large or small -

The Lighter it's built, the Better it'll Fly!

With that in mind, it is easy to understand why balsa wood has been the standard material for model airplane construction since it first became readily available in the U.S. in the late 1920's. It's outstanding strength-to-weight ratio enables hobbyists to construct durable models that fly in a totally realistic manner. Balsa also absorbs shock and vibration well and can be easily cut, shaped, and glued with simple hand tools.

Where Does Balsa Wood Come From?

Balsa trees grow naturally in the humid rain forests of Central and South America. It's natural range extends south from Guatemala, through Central America, to the north and west coast of South America as far as Bolivia. However, the small country of Ecquador on the western coast of South America, is the primary source of model aircraft grade blasa in the world.

Balsa needs a warm climate with plenty of rainfall and good drainage. For that reason, the best stands of balsa usually appear on the high ground between tropical rivers. Ecquador has the ideal geography and climate for growing balsa trees.

The scientific name for balsa wood is ochroma lagopus. The word balsa itself is Spanish meaning raft, in reference to its excellent floatation qualities. In Ecquador it is known as Soya, meaning buoy.

One year old balsa tree

How Does Balsa Wood Grow?

There is no such thing as entire forests of balsa trees. They grow singly or in very small, widely scattered groups in the jungle. For hundreds of years, balsa was actually considered a weed tree.

They reproduce by growing hundreds of long seed pods, which eventually open up and, with the help of the wind, scatter thousands of new seeds over a large area of the jungle.

Each seed is airborne on its own small wisp of down, similar to the way dandelion seeds spread. The seeds eventually fall to the ground and are covered by the litter of the jungle. There they lay and accumulate until one day there is an opening in the jungle canopy large enough for the sun's rays to strike the jungle floor and start the seeds growing.

A stand of young balsa trees.

Wherever there is an opening, made either by a farmer or by another tree dying, balsa will spring up as thick as grass. A farmer is often hard put to keep his food plot clear of balsa. As the new balsa trees grow, the strongest will become predominate and the weaker trees will die.

How Long Does It Take A Balsa Tree To Grow?

Balsa trees grow very rapidly (like all pesky weeds). Six months after germination, the tree is about 1-1/2 inches in diameter and 10 - 12 feet tall. In 6 to 10 years the tree is ready for

cutting, having reached a height of 60 to 90 feet tall and a diameter of 12 to 45 inches.


Balsa tree leaves

If left to continue growing, the new wood being grown on the outside layers becomes very hard and the tree begins to rot in the center. Unharvested, a balsa tree may grow to a diameter of 6 feet or more, but very little usable lumber can be obtained from a tree of this size.

The balsa leaf is similar in shape to a grape leaf, only a lot bigger. When the tree is young, these leaves measure a much as four feet across. They become progressively smaller as the tree grows older, until they are about 8 - 10 inches across. Balsa is one of the few trees in the jungle which has a simple leaf shape. This fact alone makes the balsa tree stand out in the jungle.

The Perfect Nurse!

Nature evidently designed the balsa tree to be a "nurse tree" which would protect the slower-growing species of trees from the scorching jungle sun during their critical early years. For instance, in an area of the jungle that has been ravaged by a tropical storm or other natural disaster, the balsa trees will quickly sprout and begin to shoot up to impressive heights in a very short time. Their fast growth, and the extra large leaves they have in their early years, provide shade to the young seedlings of the slower-growing forest giants. By the time the seedlings are established enough to take care of themselves, the balsa tree is beginning to die. Undoubtably, the balsa tree's rapid growth, fast spreading crown of first very large and gradually smaller leaves, and it's relatively short life span were intended to make it the "perfect nurse" in the jungle ecosystem.


Nature's "Nurse Tree"

How Are Balsa Trees Harvested?

While nature intended the balsa tree to be a short lived nursemaid, mankind eventually discovered that it was an extremely useful resource. The real start of the basa business was during World War I, when the allies were in need of a plentiful substitute for cork.

Raw balsa logs at the sawmill

The only drawback to using balsa was, and still is, the back breaking work that is necessary to get it out of the jungle. Because of the way the individual balsa trees are scattered throughtout the jungles, it has never been possible to use mass production logging procedures and equipment.

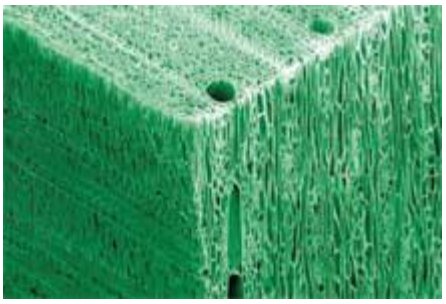
The best way to log balsa trees is to go back to the methods of Paul Bunyan -- chop them down with an axe, haul them to the nearest river by ox team, tie them together into rafts, and then float the rafts of balsa logs down the river to the saw mill.

At the saw mill the raw balsa is first rough cut into large boards, then carefully kiln dried, and finally packed into bales for shipment to the U.S. via ocean freighter.

Final cutting and finishing of our model aircraft balsa is done right here at the SIG factory. As a result of the balsa tree's fast growth cycle, both the quality and lightness of the lumber obtained from a balsa tree can vary enormously depending upon the tree's age at the time of cutting.

Rough cut balsa boards at the sawmill

Why Is Balsa Wood So Light?



Balsa cell structure seen under a microscope

The secret to balsa wood's lightness can only be seen with a microscope. The cells are big and very thin walled, so that the ratio of solid matter to open space is as small as possible. Most woods have gobs of heavy, plastic-like cement, called lignin, holding the cells together. In balsa, lignin is at a minimum. Only about 40% of the volume of a piece of balsa is solid substance. To give a balsa tree the strength it needs to stand in the jungle, nature pumps each balsa cell full of water until they become rigid - like a car tire full of air.

Green balsa wood typically contains five times as much water by weight as it has actual wood substance, compared to most hardwoods which contain very little water in relation to wood substance. Green balsa wood must therefore be carefully kiln dried to remove most of the water before it can be sold. Kiln drying is a tedious two week process that carefully removes the excess water until the moisture content is only 6%. Kiln drying also kills any bacteria, fungi, and insects that may have been in the raw balsa wood.

How Light Is Kiln Dried Balsa Wood?

Finished balsa wood, like you find in model airplane kits, varies widely in weight. Balsa is

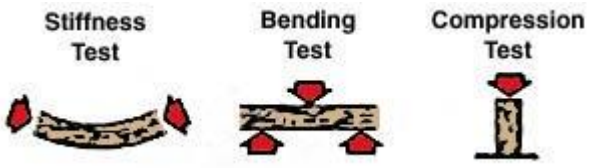
occasionally found weighing as little as 4 lbs. per cu. ft. On the other hand, you can also find balsa which will weigh 24 lbs or more per cu. ft. However, the general run of commercial balsa for model airplanes will weigh between 6 and 18 pounds per cu. ft. Eight to twelve pound balsa is considered medium or average weight, and is the most plentiful. Six pound or less is considered "contest grade" which is very rare and sometimes even impossible to obtain.

Is Balsa The Lightest Wood In The World?

No!

Most people are surprised to hear that botanically, balsa wood is only about the third or fourth lightest wood in the world. However, all the woods which are lighter than balsa are terribly weak and unsuitable for any practical use. The very lightest varieties don't really resemble wood at all, as we commonly think of it, but are more like a tree-like vegetable that grows in rings, similar in texture to an onion.

It is not until balsa is reached that there is any sign of real strength combined with lightness. In fact, balsa wood is often considered the strongest wood for its weight in the world. Pound for pound it is stronger in some respects than pine, hickory, or even oak. Refer to the chart for a comparison.



Species	Weight lb/ft^3	Stiffness Strength	Bending Strength	Compression Strength
Balsa	8	72	70	75
Balsa	10	100	100	100
Balsa	14	156	161	149
Spruce	28	230	260	289
Yellow Pine	28	222	277	288
Douglas Fir	30	241	291	341
Hickory	50	379	638	514
Oak	48	295	430	366
Basswood	26	261	288	288
Black Walnut	37	301	506	512

About the Chart:
The strength of balsa varies in direct relation to its density or weight - the heavier the wood, the stronger it is. The above chart was designed with 10 lb./cu. ft. balsa as the median. In other words, balsa at 10 lbs./cu. ft. has been tested given a value of 100. The other woods were then tested in the same way and given a figure that is numerically in proportion. By comparing the relative strength figures in the chart, it will be seen that balsa is as strong or stronger, pound for pound, than most of the species shown.

Selecting Balsa For Model Building

Because of the nature of balsa, two pieces of wood with the exact same dimensions may vary quite a bit in weight. When you select the pieces you want for our project, you should keep their final use in mind. Logically one should select the lightest grades for the lightly stressed parts of the model (nose blocks, wingtip blocks, fill-ins, etc.), and the heavier grades for important load bearing parts of the structure (spars, fuselage stringers, etc.).

When describing the weight of balsa wood, the

SIG Mfg. Co. has been producing model grade balsa wood since 1951. In this early photo founder Glen Sigafoose (left) inspects and grades finished balsa sheets.

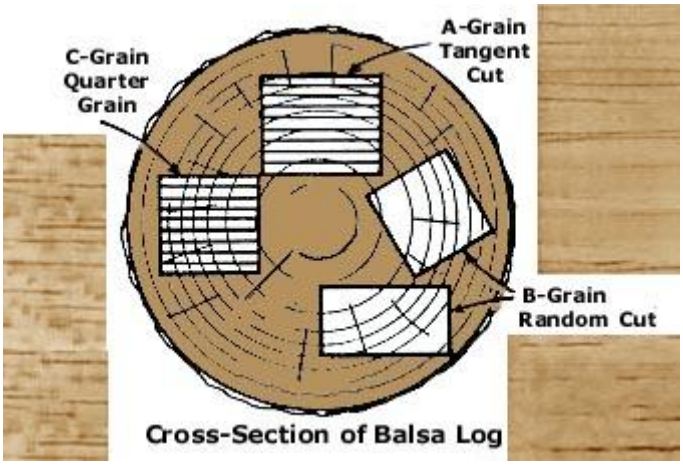
standard unit of measure is POUNDS PER CUBIC FOOT (lbs./cu.ft).

To give you an idea how much common sizes of balsa can vary in weight depending upon the density of raw stock it was cut from, the following three charts have been developed. They show the actual weight in ounces of each size piece when it is cut from 6, 8, 10, 12, 14, or 16 lb./cu. ft. stock. For example, in the first chart for BALSA SHEETS we see that a 1/16" x3" x 36" sheet cut from 10 lbs./cu. ft. stock will weigh approximately .625 ounces. The same size sheet cut from 14 lbs./cu.ft. stock will weigh about .875 ounces.

Balsa Grain I.D.

In selecting balsa sheets for use in your model, it is important to consider the way the grain runs through the sheet as well as the weight of the sheet. The grain direction actually controls the rigidity or flexibility of a balsa sheet more than the density does.

For example, if the sheet is cut from the log so that the tree's annular rings run across the thickness of the sheet (A-grain, tangent cut), then the sheet will be fairly flexible edge to edge. In fact, after soaking in water some tangent cut sheets can be completely rolled into a tube shape without splitting.



If on the other hand the sheet is cut with the annular rings running through the thickness of the sheet (C-grain, quarter grain), the sheet will be very rigid edge to edge and cannot be bent without splitting. When the grain direction is less clearly defined (B-grain, random cut), the sheet will have most intermediate properties between A and C grain.

Naturally, B-grain is the most common and is suitable for most jobs. The point to bear in mind is that whenever you come across pure A-grain or C-grain sheets, learn where to use them to take best advantage of their special characteristics.

A-GRAIN sheet balsa has long fibers that show up as long grain lines. It is very flexible across the sheet and bends around curves easily. Also warps easily. Sometimes called "tangent cut." DO use for sheet covering rounded fuselages and wing leading edges, planking fuselages, forming tubes, strong flexible spars, HL glider fuselages. DON'T use for sheet balsa wings or tail surfaces, flat fuselage sides, ribs, or formers.

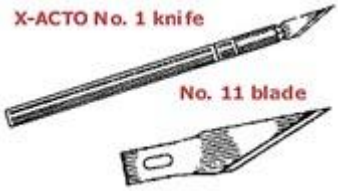
B-GRAIN sheet balsa has some of the qualities of both type A and type C. Grain lines are shorter than type A, and it feels stiffer across the sheet. It is a general purpose sheet and can be used for many jobs. Sometimes called "random cut." DO use for flat fuselage sides, trailing edges, wing ribs, formers, planking gradual curves, wing leading edge sheeting. DON'T use where type A or type C will do a significantly better job.

C-GRAIN sheet balsa has a beautiful mottled appearance. It is very stiff across the sheet and spits easily. But when used properly, it helps to build the lightest, strongest models. Most warp resistant type. Sometimes called "quarter grain." DO use for sheet balsa wings and tails, flat fuselage sides, wing ribs, formers, trailing edges. Best type for HL glider wings and tails. DON'T use for curved planking, rounded fuselages, round tubes, HL glider fuselages, or wing spars.

Cutting & Shaping Balsa Wood

Balsa is a very "friendly" wood to work with - so light, so soft, so easily worked into so many things. You don't need heavy-duty power saws and sanders like you would if working with a hardwood. In fact, even with an extensive power shop at their disposal, the professional model builders here at the SIG factory find that they still rely primarily on 4 or 5 simple hand tools for the majority of their work. If you are just starting out in the model airplane hobby, here are the tools that they recommend you get:

X-ACTO No. 1 knife with No. 11 blade for general cutting

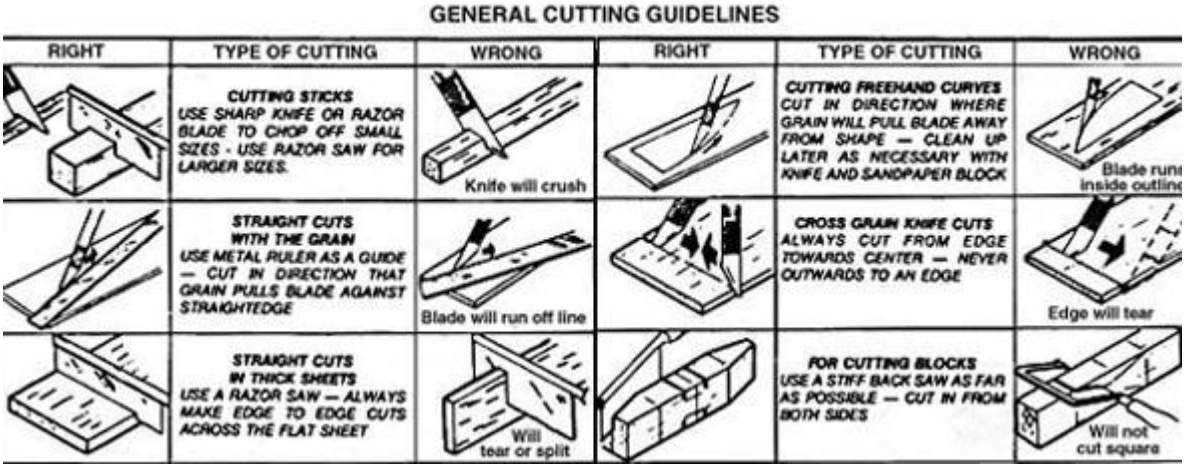


X-ACTO No. 2 knife with No. 26 blade for carving

Razor saw for cutting thick sizes of wood

Razor plane for shaping

A knife or razor blade will work well for cutting balsa sheets and sticks up to 3/16". Always keep replacement blades on hand - blades do wear our and a dull blade can make it impossible to do a good job.

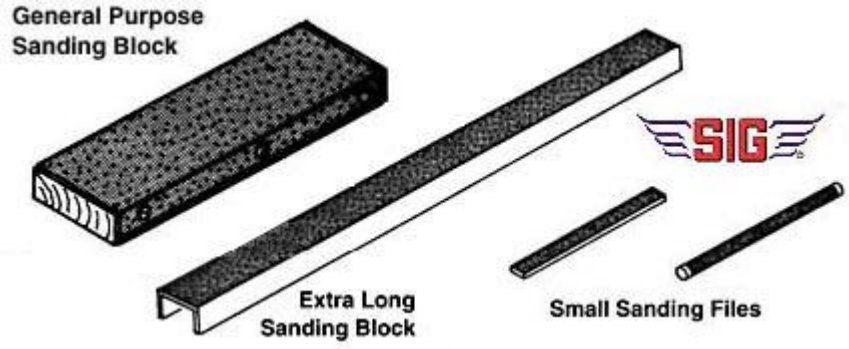


Sanding Balsa Wood

In addition to the cutting tools, you will need an assortment of different size sanding blocks. These are indispenable tools for model construction. You can buy ready-made sanding blocks or make your own. The most often used general-purpose sanding block in our model shop is made simply by wrapping a full 9" x 11" sheet of sandpaper around a 3/4" x 3" x 11" hardwood or plywood block. Use three screws along one edge to hold the overlapped ends of the sandpaper in place. Use 80 grit garnet sandpaper on the block during general construction.

Another handy sanding block to have can be made by gluing 80 grit garnet sandpaper onto a 24" or 36" long piece of aluminum channel stock. Most hardware stores carry a rack of aluminum in various sizes and shapes. This long sanding block is very helpful for shaping leading and trailing edges, and other large pieces, accurately.

Last but not least, glue sandpaper onto different sizes of scrap plywood sticks and round hardwood dowels. These are handy for working in tight places and for careful shaping where a big sanding block is too hard to control.



Weight Chart on next page

Balsa Weight Chart

Balsa SHEETS: Weight in Ounces and Stock Density in Pounds per Cubic Foot

Size x36"	6	8	10	12	14	16	Size x36"	6	8	10	12	14	16
1/32"x2"	.125	.167	.211	.250	.291	.333	1/16"x2"	.250	.333	.417	.500	.583	.667
1/32"x3"	.1875	.250	.3125	.375	.4375	.500	1/16"x3"	.375	.500	.625	.750	.875	1.000
1/32"x4"	.250	.333	.417	.500	.583	.667	1/16"x4"	.500	.667	.833	1.000	1.167	1.333
3/32"x2"	.375	.500	.625	.750	.875	1.000	1/8"x2"	.500	.667	.833	1.000	1.167	1.333
3/32"x3"	.5625	.750	.9375	1.125	1.3125	1.500	1/8"x3"	.750	1.000	1.250	1.500	1.750	2.000
3/32"x4"	.750	1.000	1.125	1.500	1.750	2.000	1/8"x4"	1.000	1.333	1.667	2.000	2.333	2.667
3/16"x2"	.750	1.000	1.250	1.500	1.750	2.000	1/4"x2"	1.000	1.333	1.667	2.000	2.333	2.667
3/16"x3"	1.125	1.500	1.875	2.250	2.625	3.000	1/4"x3"	1.500	2.000	2.500	3.000	3.500	4.000
3/16"x4"	1.500	2.000	2.500	3.000	3.500	4.000	1/4"x4"	2.000	2.667	3.333	4.000	4.667	5.333
3/8"x2"	1.500	2.000	2.500	3.000	3.500	4.000	1/2"x2"	2.000	2.667	3.333	4.000	4.667	5.333
3/8"x3"	2.250	3.000	3.750	4.500	5.250	6.000	1/2"x3"	3.000	4.000	5.000	6.000	7.000	8.000
3/8"x4"	3.000	4.000	5.000	6.000	7.000	8.000	1/2"x4"	4.000	5.333	6.667	8.000	9.333	10.667

Balsa BLOCKS: Weight in Ounces and Stock Density in Pounds per Cubic Foot

Size x36"	6	8	10	12	14	16	Size x36"	6	8	10	12	14	16
1"x1"	2.0	2.667	3.333	4.0	4.667	5.333	1½"x1½"	4.50	6.0	7.5	9.0	10.5	12.0
1"x1½"	3.0	4.0	5.0	6.0	7.0	8.0	1½"x2"	6.0	8.0	10.0	12.0	14.0	16.0
1"x2"	4.0	5.333	6.667	8.0	9.333	10.667	1½"x2½"	7.5	10.0	12.5	15.0	17.5	20.0
1"x2½"	5.0	6.667	8.333	10.0	11.667	13.333							
1"x3"	6.0	8.0	10.0	12.0	14.0	16.0							
2"x2"	8.0	10.666	13.333	16.0	18.667	21.333	2½"x2½"	12.5	16.667	20.833	25.0	29.166	33.333
2"x2½"	10.0	13.333	16.667	20.0	23.333	26.667	2½"x3	15.0	20.0	25.0	30.0	35.0	40.0
2"x3"	12.0	16.0	20.0	24.0	28.0	32.0							
3"x3"	18.0	24.0	30.0	36.0	42.0	48.0							
3"x4"	24.0	32.0	40.0	48.0	56.0	64.0							

Balsa STICKS: Weight in Ounces and Stock Density in Pounds per Cubic Foot

Size x36"	Pcs	6	8	10	12	14	16	Size x36"	Pcs	6	8	10	12	14	16
1/16"x1/16"	16	.125	.167	.208	.250	.292	.333	3/32"x3/32"	8	.141	.188	.234	.281	.326	.375
1/16"x3/32"	16	.188	.250	.312	.375	.438	.500	3/32"x1/8"	8	.188	.250	.312	.375	.438	.500
1/16"x1/8"	8	.125	.167	.208	.250	.292	.333	3/32"x3/16"	4	.141	.188	.234	.281	.326	.375
1/16"x3/16"	8	.188	.250	.312	.375	.438	.500	3/32"x1/4"	4	.188	.250	.312	.375	.438	.500
1/16"x1/4"	4	.125	.167	.208	.250	.292	.333	3/32"x3/8"	2	.141	.188	.234	.281	.326	.375
1/16"x3/8"	4	.188	.250	.312	.375	.438	.500	3/32"x1/2"	2	.188	.250	.312	.375	.438	.500
1/16"x1/2"	2	.125	.167	.208	.250	.292	.333								
1/8"x1/8"	4	.125	.167	.208	.250	.292	.333	3/16"x3/16"	2	.141	.188	.234	.281	.326	.375
1/8"x3/16"	4	.188	.250	.312	.375	.438	.500	3/16"x1/4"	2	.188	.250	.312	.375	.438	.500
1/8"x1/4"	4	.250	.333	.416	.500	.538	.667	3/16"x3/8"	2	.281	.375	.469	.563	.656	.750
1/8"x3/8"	2	.188	.250	.312	.375	.438	.500	3/16"x1/2"	1	.188	.250	.312	.375	.438	.500
1/8""x1/2"	1	.125	.167	.208	.250	.292	.333	3/16"x3/4"	1	.281	.375	.469	.563	.656	.750
								3/16"x1"	1	.375	.500	.625	.750	.876	1.00
1/4"x1/4"	1	.125	.167	.208	.250	.292	.333	3/8"x3/8"	1	.281	.375	.469	.563	.656	.750
1/4"x3/8"	1	.188	.250	.312	.375	.438	.500	3/8"x1/2"	1	.375	.500	.625	.750	.876	1.00
1/4"x1/2"	1	.250	.333	.416	.500	.583	.667								
1/4"x3/4"	1	.375	.500	.625	.750	.876	1.00								
1/4"x1"	1	.500	.667	.832	1.00	1.166	1.333								
1/2"x1/2"	1	.500	.667	.832	1.00	1.166	.1333	3/4"x3/4"	1	1.125	1.500	1.875	2.250	2.625	3.00
1/2"x1"	1	1.00	1.333	1.666	2.00	2.333	2.667								