Forward

As is always the case with anything worthwhile, this work is the sum of the work of many people. Eric Grant is the one who generated the idea for a fabric calculator and lobbied for its creation and Eric has been the one driving our continuous improvement of construction techniques. Of course Angela Enright, who actually tested everything (including many discarded ideas), deserves a good deal of credit as well. And these two are also responsible for all the videos. Finally, the ultimate quality of everything Sailrite does is in the hands of Matt Grant who oversees everything. We all complain a lot about how much Matt slows us down with his nitpicking, but in the end we all recognize the importance of his contribution.

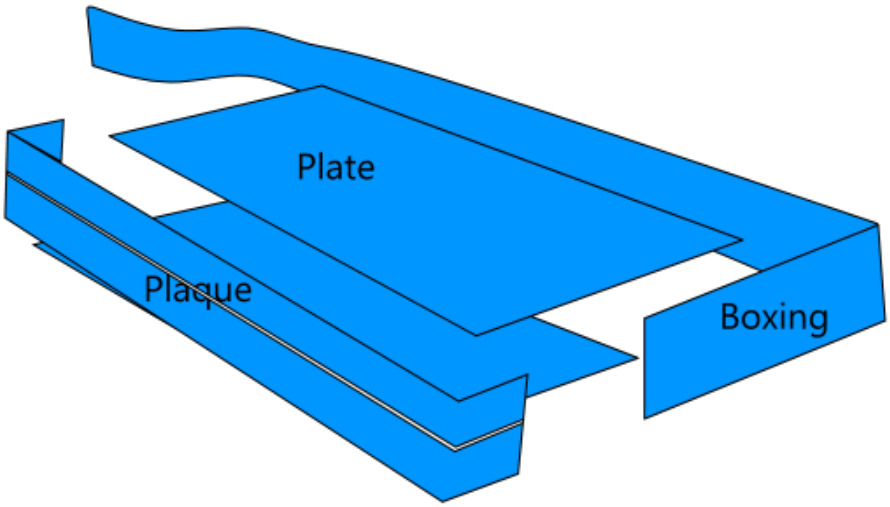
Obviously Sailrite is very much a family business. As it has grown over more than 50 years this characteristic may have become somewhat less than obvious to many of our customers, but it is our intent to maintain the passion for fabrics and their use (that binds this family) a central part of the business.

Jim Grant
Culver, Indiana
November 4, 2014

Introduction

Building cushions is fun and rewarding! At Sailrite we have always, in the past, added “And its easy”! Perhaps we should drop the easy part having published this and the new box cushion calculator. The fact is there are many ways to botch a cushion. Especially if one intends to match or center pattern repeats. And we have always displayed a lax attitude regarding fit and finish — our sizing rules were “a little more when. . .” or “a little less when. . .”. The calculator requires that those rules be made much more concrete (although there is still some room for judgment). Now it can perhaps be said: “Cushions are easy if there are no missteps”. What follows here and in the use of the calculator is our attempt to prevent missteps.

Let’s begin with some definitions. Plates are the top and bottom panels of a cushion. These plates sandwich a filler that can be foam or fiber or a combination of the two. “Box cushions” by definition also have boxing, a narrow band of fabric all round the plates. And there is often one side of the cushion boxing with a slit (often closed with a zipper) that enables the insertion and removal of any filler. At Sailrite we call this section of boxing a plaque. (Note that this use of the word “plaque” is not to be found in any dictionary — it is a term created by Sailrite to serve where no other was currently available. The word “placket” is commonly used to refer to a flap of fabric that covers a closure device over a slit opening — so there is some justice in our usage.)



These cushion elements are sewn together inside out so all seam allowance and seam edging will be on the inside. The seams can be dressed with piping if desired. Piping can be “home made” by folding a narrow strip of fabric over a cord or it can be purchased as a prefabricated vinyl strip. It is also possible to use “French Mattress Seams” to finish edges.

We will be considering all of this in detail in what follows.

Chapter 1

A Cushion Filler Primer

The heart of every cushion is the filler inside. This first chapter focuses on that very important aspect of all box cushions. When should it be replaced, what to replace it with, and, finally, how to fabricate the replacement?

Replacing Cushion Fillers

It may not be necessary to replace the filler in old cushions. It is true that they all suffer from age and use. Cushions can get soft or lumpy or smelly. And there will be a tendency for them to develop depressions (due to a failure to resume their original shape through cell deterioration or fiber compaction). Also damp environments tend to encourage the growth of mold and mildew which can lead to black spots (not a serious problem) and a foul smell (a serious problem). But, if the cushion in question is relatively uniform in shape and not smelly, go ahead and simply recover rather than replacing it entirely. And keep in mind that layers of new foam or batting can be added to old compressed fillers giving them new life.

If new filler material is called for, there are many choices available: latex foam, memory foam, polyester fiberfill, compressed polyester, polyurethane foam, open cell polyurethane foam, and closed cell foam. There are three measurement parameters used to compare these fillers. The chart below summarizes the foams available from Sailrite (latex foam and memory foam are not available — the former is very expensive and the latter does not breath well which makes it rather hot to use).

Firmness is indicated by a value called Indentation Force Deflection (IFD). The IFD represents how many pounds it takes to compress a 50 square inch circular plate of foam by 25%. IFDs are listed in the foam descriptions, here they are generalized in firmness: soft (6-24), medium (30-36), firm (36-45), and very firm (45+).

Product	Firmness	Density Lvs/Ft	Drainage
Fiberfill	Soft	Variable	Good
Nu-Foam	Soft	Variable	Good
Polyurethane	Medium	1.4 — 1.8	Poor
Reflex Plus	Medium	1.5	Poor
DryFast	Firm	1.8 — 2.2	Excellent
Closed Cell	Very Firm	3 — 5	N/A

Density is expressed as weight in pounds per cubic foot. It is a measurement of how much air is in the foam. Generally speaking, the higher the density, the firmer the foam. For boat cushions, the industry minimum is roughly 1.2 lb./cu.ft. for seat backs. Seats are generally 1.5-1.8 lb./cu.ft.

These densities are considered fine for occasional use such as on seasonal boats and patios. Indoor applications that see daily, year-round use do better with a higher density foam which will increase longevity.

Drainage indicates how quickly water will drain from a soaked cushion. An "excellent" rating means that a stream of water entering on one side will exit the other with very little change in its flow. Closed cell foam, at the other end of the continuum absorbs almost no water at all, and can be used for flotation. For a foam that does not drain well, it is a good idea to keep it as dry as possible. This can be promoted by wrapping it in silk film (available from Sailrite) as a protective layer.

TYPES OF FILLERS

There are many ways to fill cushions. The most common these days is with fiber or with foam or with a combination of the two. These materials are what we will consider here.

Fiberfill

Fiberfill is not foam, but rather blown polyester fibers. It is an affordable option when a soft irregular shape is desired. It comes in a bag. It is used to stuff pillows, pet beds and deep back cushions. It is often stuffed inside a pre-sewn cover of Spun Bonded Pillow Protector Fabric, which is then inserted into the cushion or pillow fabric to give support and shape.

Fiberfill is non-allergenic, and resistant to mildew. This 15 Denier material has a slick finish to help prevent bunching. Denier, by the way, is fiber mass in grams per 9000 yards — 15 is a very fine fiber. Common #50 sewing thread, in comparison, has a 180 Denier. Polyester Fiberfill is machine washable. The fiber may bunch up in laundering, but it can be nicely smoothed out within the cover when necessary. Indeed, providing a slip cover of Spun Bonded Pillow Protector Fabric which has a very smooth, slippery surface itself helps with this.

Fiberfill Stuffing and Polyester Batting

This 100% polyester material is also available in 55 inch (1397 mm) wide rolls loosely bonded to a 3/4 inch (19.1 mm) thickness. In this form, it can be used in addition to foam to fill up gaps or to create a soft rounded appearance. Batting wrap also helps protect the foam inside from UV rays. Polyester batting can be used with any foam type. It allows moisture to escape, and it will not support the growth of mold or mildew. Secure multiple layers in place with a spray contact adhesive like 3M Super 77. Each layer can be expected to add about 1/10 inch (2.54 mm) to the boxing thickness of a cushion (about twice that in the center where compression is not so great).

The Adhesive Used Here is 3M Super 77

The Rounded Look of a Batting Layer

Fairfield Poly-Fil Nu-Foam

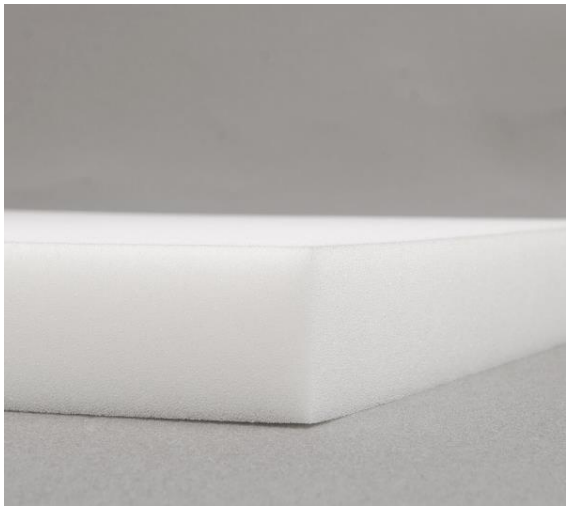
Fairfield Poly-Fil Nu-Foam is made from compressed, densified polyester batting. A safe and inexpensive alternative to traditional foam, Nu-Foam offers many performance benefits. It is flame retardant, mildew resistant, non-allergenic and washable. Nu-Foam will not yellow or disintegrate like traditional foam. This foam alternative is ideal for chair cushions; deck furniture; camping, boating and RV accessories; futons; upholstery; crib bumpers and playpens. It is available in 2, 3, and 4 inch thick panels (50.8, 76.2, and 101.6 mm).

Poly-Fil Nu-Foam: Inexpensive Yet Effective for Small Cushions

Nu-Foam works best with occasional seating, as it will compress over time. Indeed, to ensure that cushions with Nu-Foam maintain their shape, we recommend assuming an initial compression of 25% or so (enter a thickness in the fabric calculator 25% less than the actual thickness of the Nu-Foam used). It will compress to fit snugly in the thinner cover and give very good service.

Polyurethane Foam

Polyurethane Foam is the standard foam for outdoor cushions and boat seats. A common choice for OEM boat builders, this polyurethane foam is formulated with a biocide, antibacterial agent to prevent mold and mildew growth. It has a medium firmness and a density of 1.4 lb./cu. ft. Polyurethane foam does absorb water just like a sponge. Therefore, when using this foam for exterior cushions, we recommend wrapping it in silk film to protect it from moisture.



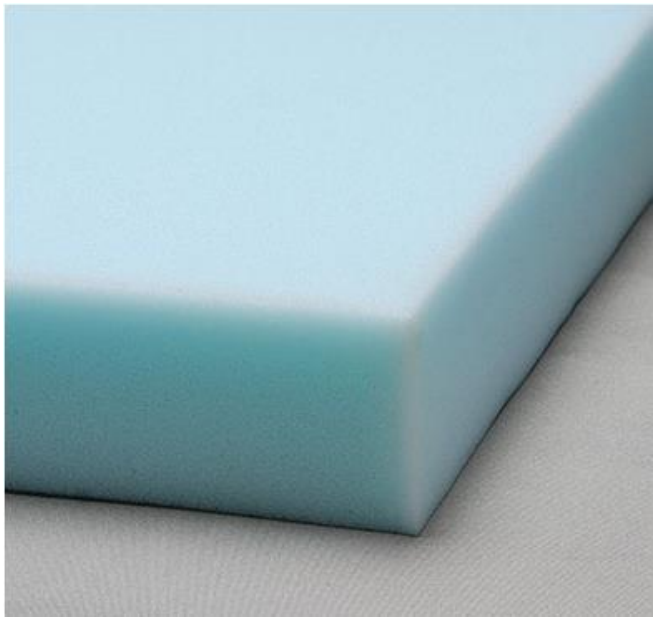
Polyurethane Foam is Most Commonly

Polyurethane foam with the anti-microbial treatment is excellent for use as boat seats and outdoor cushions. This foam is recommended for only occasional indoor use. It is not appropriate for applications that receive continuous daily use, like living room sofas, which require a higher density (2+ lb./cu. ft) foam. Additionally, indoor applications do not require the antibacterial agent although it will do no harm.

This foam is available in the normal 2, 3, and 4 inch thicknesses as well as 1/4, 1/2, and 3/4 inch (6.34, 12.7, and 19.05 mm) sheets 60" wide sold by the yard. This foam (often called scrim foam or sew foam) features a spun-bonded polyester backing. It is perfect for many upholstery applications—the backing holds stitches so pleats or channeling can easily be formed. The backing also holds adhesives well, making the foam easy to glue in place.

Reflex Plus Polyurethane Foam

Reflex Biocide Foam is actually a specially treated brand name version of the polyurethane foam just above. It is especially designed and treated for indoor and outdoor use. The treatment gives it a light blue color. This foam is a medium density polyurethane with a special antibacterial agent. It is designed to meet the special needs of those in a damp, hot environment. It is available in 2, 3 and 4 inch thick (50.8, 76.2, and 101.6 mm) panels ideal for bunks and settees.



Reflex Plus Has a Blue Tint

Dry Fast Open Cell Foam

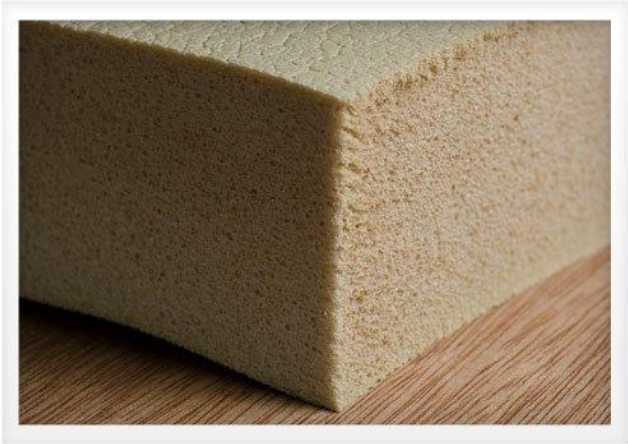
Dry Fast Open Cell is an open cell foam (reticulated foam) with open pores that allow water and air to pass through easily. As a result, Dry Fast foams are softer and cooler to sit and sleep on than closed cell foams. Open cell foam is perfect for mattresses, settee cushions, seat backs, or seating.

"Dry Fast" Open Cell Foam — Water Runs Right

Dry Fast Foam has proven to be a superior cushioning material alternative with better quality, consistency, airflow, and heat dissipation than most other polyurethane foams. It is manufactured using a patented Variable Pressure Foaming (VPF) technology which produces the open pores that enhance airflow, drain-ability, and durability for more consistent comfort and a better night's sleep. Dry Fast's open pores give it the unique ability to drain water quickly and easily, straight through the foam. This foam is also formulated with an antibacterial agent so mold and mildew will not grow.

Closed Cell Flotation Foam

A closed cell PVN foam that is designed for flotation gear and marine cushions. It is 3 times as firm as polyurethane foam and resists moisture absorption, weather-aging, and mechanical abrasion. It does not support combustion. This foam is excellent to use for cockpit cushions, life jackets, bosun's chairs, or anywhere a firm, thin cushion is needed. It is available in 1/2 and 1-1/2 inch (12.7 and 38.1 mm) thicknesses.



Closed Cell — It Floats But It Is Firm

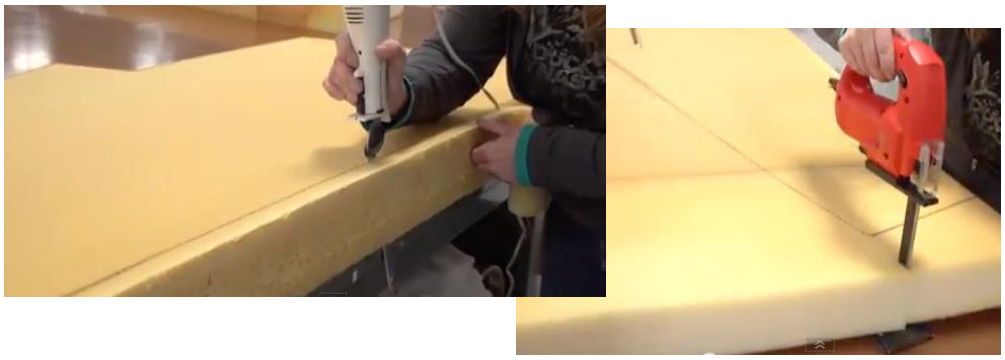
Closed cell foam may shrink, especially in colder weather and over extended periods of time. And, if creased or folded when left in storage, permanent indentations will result.

A Final Note on Foam

All foam (not batting or Fiberfill or Poly-Fil) will harden over time. This process is speeded up when there is exposure to ultraviolet. So protect it from sunlight if possible.

FOAM CUTTING TECHNIQUES

It is not difficult to cut foam. A sharp knife will do just fine except that it is difficult to create a clean sharp edge with repeated cuts. The best cuts will be made with reciprocating blades. Indeed, the electric carving knives used to slice meat work very well. The tool can be run along the side of a table to encourage a straight (vertical and horizontal) cut. The photo on the left below demonstrates using the table top to guide the blade along the wedge edge (here on the bottom and note that the foam may have to be repositioned one or more times) — the top line can be followed to yield an accurate wedge of variable dimensions. There are also more professional cutters that will make the work go faster, especially for vertical cuts. Such a device is illustrated on the right.



Cutting a Foam Wedge with an Electric Knife and Using a

The Finished Wedge Cut in Dry Fast Foam

Fiber fillers can be cut with a shears or with a utility knife. If foam is to be wrapped in fiber, use a contact cement like 3M's Super 77 to hold everything in place and help prevent bunching.

GLUING AND SHAPING FILLERS

Foam is expensive so it should not be wasted. Fortunately, small scrap pieces can be edge glued easily with any good contact cement. Solvent based cements that can be smoothed on with a brush will give the most secure joint, but spray on adhesives like 3m's Super Trim Adhesive work just fine. The glued seam will be slightly stiffer than the foam along side, but this "seam line" will be almost undetectable in a finished cushion. Because the finished shape is generally encased in a cover, there is little likelihood that glued seams will break down.

Fiber fillers are also frequently glued to themselves and to the foam under them. This helps keep the finished cushion from becoming lumpy and misshapen.

Note that one or more "V" shaped wedges can be cut three-quarters or so deep in foam panels to facilitate smooth bends. And two or more layers of foam are not unusual if complex shapes are desired or, perhaps, combinations of different foam densities. It is not unusual, for example, to stack open cell foam on top of a closed cell foam base layer.

Creating a Rounded Edge in Four Inch Open Cell

Don't underestimate the utility of contact cement. Coat the surface heavily and let it dry to a tacky state before matching the surfaces. If a rounded edge is desired, coat the edge of the foam and pinch it together while pushing in on the center. The result will be a nicely rounded surface. This works just fine on polyurethane foam as thin as 2 inches while the firmer Dry Fast benefits from being somewhat thicker. In the picture above a pony clamp secures the starting corner. If a gap appears such as the one two inches or so from the open "V", apply more adhesive, let it get tacky, and close it.

Closed cell foam is so firm that it cannot be "pinched" this way on its edge, but the contact adhesive can be used to form very handy shapes such as cylinders or rounded bolsters.

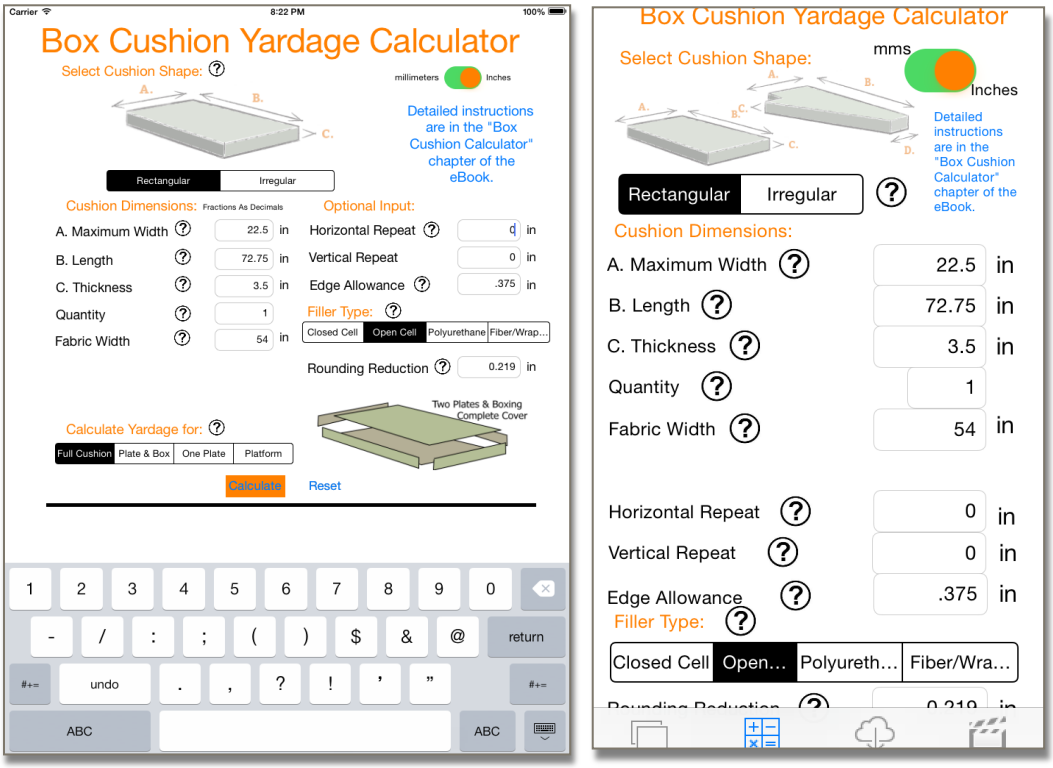
Such rounded shapes (sometimes called "bull nosed") can be covered with a wrap of fabric so boxing will not be necessary on that edge.

A "Bull Nosed" Cushion Cover

Chapter 2

The Box Cushion Calculator

The calculator is the best way to determine exactly how much yardage will be required for any cushion cover job. The box cushion calculator started as a simple program to give yardage ordering information. But it has evolved into a rather sophisticated tool which will not only calculate yardage but also show a rendering of the of the panels needed to complete a project. The renditions are very accurate, including pattern matching requirements — both vertically and horizontally. This increased functionality introduces some complexity which justifies the instructions that follow. In addition, some necessary assumptions for seams and hems and boxing and plaques should be made explicit — more about all of this in the following paragraphs.



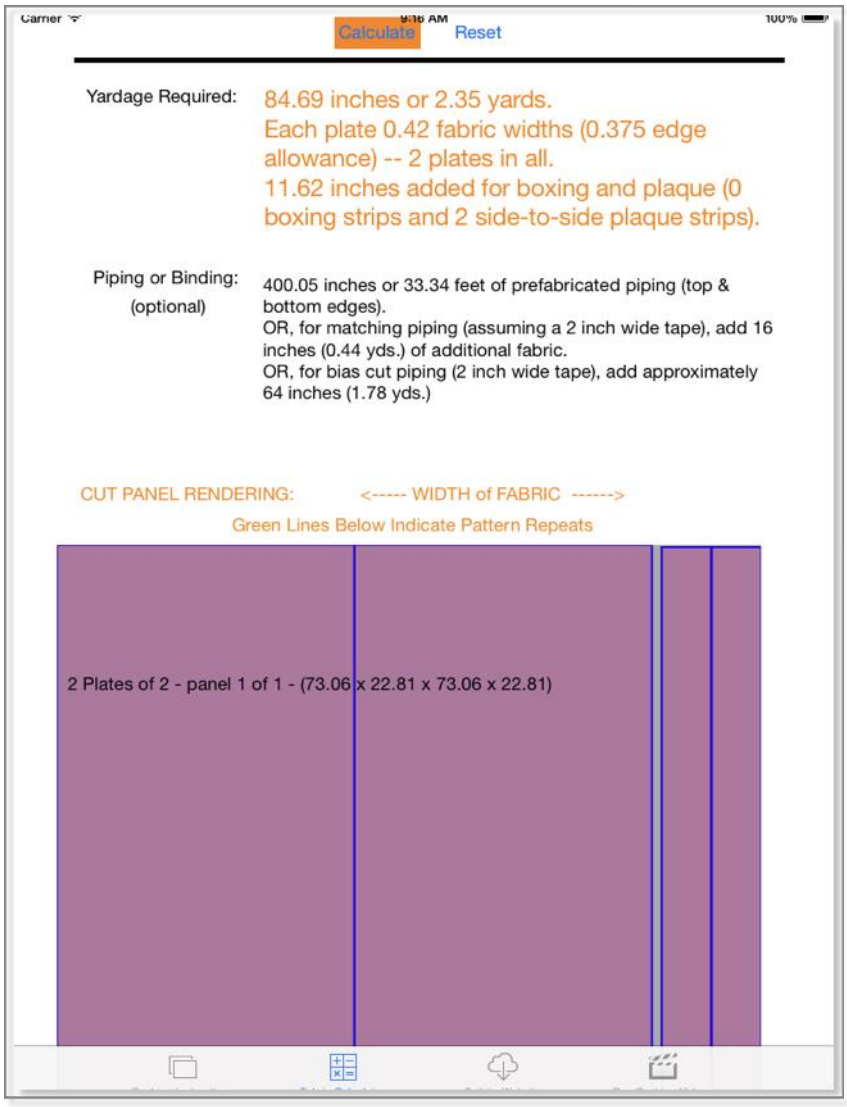
The Input Screen (IPad and IPhone) with Dimensions for a Sample Cushion Entered.

The Data Entry Screen

At first glance the calculator input screens (above) may look somewhat forbidding. Keep in mind that the calculator must account for (1) cushion size, (2) shape, (3) fabric pattern measurements, (4) pattern orientation, (5) edge finishing allowance, (6) functional requirements, and (7) fabrication alternatives. There is input functionality for each of these attributes.

Note the question marks in circles on the screen. A short description of the role of each input control can be displayed by touching the accompanying question mark. The resulting text box can be retired by hitting the “exit” button.

Enter the measurements shown in the input screens above (22.5, 72.75, 3.5, 1, 54 — leave the rest at default) and hit “Calculate”. We will make use of IPad screen renditions in what follows because they include more real estate with each screen shot than the IPhone screen. But the same content can be found on both even though a little scrolling may be required to find it.



The Yardage and Optional Piping Required

The input screen still exists so input values can be checked. It has just been scrolled up out of the way. The yardage required for this single cushion is 2.35. Note in the scale rendition that the plates, which require just .42 of the fabric width, can be placed side by side running the length of the material and that there is sufficient scrap to enable two long boxing strips. Scrolling the screen up, two strips of plaque will be revealed requiring an additional 11.62 inches of fabric.

If piping or binding will be needed to finish the edges of the cushion, the quantity to order is displayed right below the yardage required. This figure will be halved when just one plate or one plate with boxing is requested on the assumption that just one plate edging will require it.

It is assumed that tape for piping that is not cut on the bias will be cut across the width of the fabric. Thus, in 2 yards (1829 mm) of 54 inch wide fabric there would be 36 2 inch strips or a total of 2016 inches (56 yards or 51206 mm). Bias tape will be cut on a 45 degree angle across the cloth. It is assumed that only full length tapes (76 inches in the case of 54 inch wide fabric) will be used. Thus, there will be 18 2 inch strips or a total of 1368 inches (38 yards or 34747 mm).

"Matching piping" (as opposed to "prefabricated" piping) is created from the same material as the rest of the cushion and, thus, requires a bit more yardage. The calculator assumes two inch wide strips for this piping construct. This is enough width for cord up to 0.5 inches (12.7 mm). A cord 0.25 inches (6.3 mm), which is used in most cushion projects, requires only 1.5 inch wide strips of fabric tape. So the calculator will call for more than enough yardage for normal cushion work.

Bias cut piping strips require more fabric since there is quite a bit of waste. Again, the calculator figures rather more than will normally be required. These optional needs are not included in the rendition, but there may be sufficient waste to make any additional fabric unnecessary. There is a sliver of scrap illustrated in the example rendition.

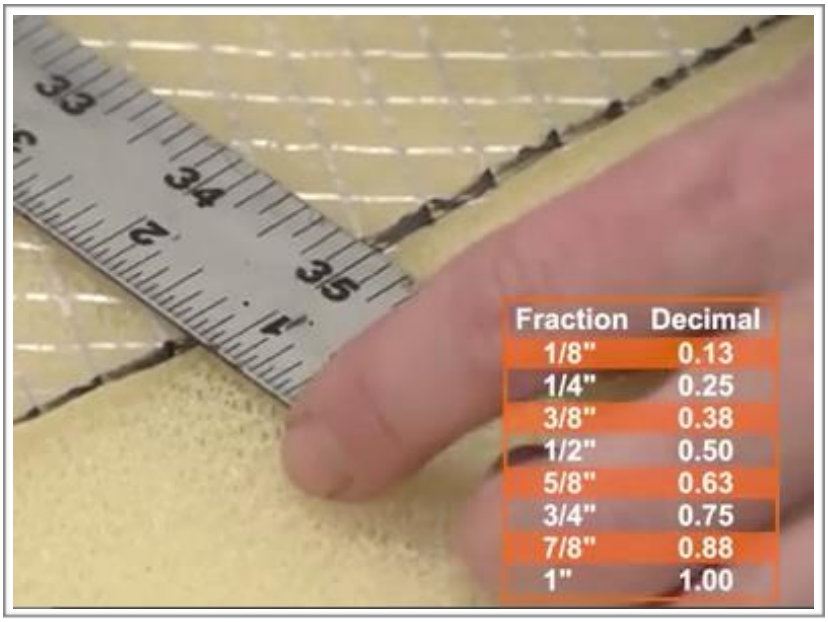
This example may seem almost trivial since it would not be difficult to estimate yardage for such a cushion manually. But it can help prepare for more complicated cushions. The dimensions (in inches or mm) of each plate are printed right over the upper portion of their rendition. The first measurement applies to the left side, the second to the top, the third to the right and the fourth to the bottom. In more complicated shapes there may be more or fewer sides. But measurements will apply to the left and then clockwise round the plate or plate segment. All odd numbered "irregular" panels will be rotated to better "nest" together. The measurements for these rotated panels will start with the right side (instead of the left side) and proceed round the shape clockwise. We will see examples of this as we move along.

Boxing and plaque widths will be displayed just once at the lower left corner of the rendition.

CUSHION DIMENSIONS

The basic dimensions of the cushion are labeled in the opening illustrations under “Select Cushion Shape” with the letters: A, B, C, and, in the case of irregular cushions, D. In addition there is one other input in the first cluster of fields; it is used to indicate cushion quantity. “1” is the default quantity, but it can be increased. Do keep in mind that the devices we use have only a limited amount of memory so large cushions in quantity that require more than 37 yards (33.834 meters) of fabric for an iPad and 32.5 yards (29.718 meters) of fabric for an iPhone will result in an error message with a reset button. Your machine will not crash when dimensions are too large and the yardage required figure may be displayed in the background. If so, it will be displayed after the reset (scroll down on the iPhone) This figure will be accurate, but the rendition will not be displayed.

Decimal numbers must be used to dimension cushions with fractional measurements when entering length and width and thickness into the calculator. Fractions are not a problem when the metric system is used, but not so with inches and that does make initial data entry a little tedious. To convert 3/8 inch, for example, to a decimal divide the numerator by the denominator (which, in the case of 3/8, yields 0.375).



A Handy Fraction to Decimal Chart

Published fabric width figures are often “nominal”. That is, the actual fabric will sometimes be wider than the published figure. Usually the edges of these fabrics will be rather ragged. It is intended that this extra material will be trimmed away or utilized as seam allowance. So the published width (not the “actual”) is always what should be entered in the fabric width input field. And trim your fabric roll to this published width before locating panels using offsets from the edge (margins) provided by the calculator.

Trimming Excess Width Beyond the Nominal

The calculator automatically builds in a 0.5 inch (12.7 mm) seam allowance when it is necessary to join two panel segments together. Thus 0.5 inch (12.7 mm) is added to each of the two segments for each seam. If two segments were used to create a given length, they would total 1 inch more than the finished intended length . The plates in the example that we have considered thus far are of a single piece of fabric so there is no seam allowance. Seam allowance is always assumed to be 0.5 inch for each segment. It cannot be changed.

"Edge allowance" used to finish the top and bottom of a cushion cover is variable and has its own input field defaulted at 0.375 inch (9.19 mm). Note now that this is entirely distinct from seam allowance — it is added all round plates and boxing no matter how many segments are involved. More about edge allowance below.

Cushions sometimes have angled sides which will result in plates that are larger on one side of the cushion. In this case a separate calculation can be run for the top plate as distinct from the bottom one using the "CalculateYardage For" selector on the input screen to work with just one plate per cushion at a time. Or the dimensions entered in the calculator can be for the largest plate. As will be clear later, a pattern will be made for the bottom side of the cushion and the dimensions of the top surface will be indicated with offset measurements. Extra material can be removed when the bottom panels are cut.

The Edge Finishing Allowance and the Rounding Reduction

Edge finishing allowance is an entirely different thing from seam allowance. It is the extra fabric required to fashion the top and bottom edges of the cushion. This will vary depending upon the finishing technique employed and upon the materials used. French Mattress Seams, for example, require more than twice the allowance of an edge finished with piping (7/8 or 0.875 inch or 22.2 mm). Prefabricated vinyl piping has a "tail" of just 3/8 or 0.375 inch (9.53 mm) and that is the calculator default. Those who fabricate their own piping may prefer a 1/2 or 0.5 inch (12.7 mm) edge allowance. The calculator permits overriding the default for edge allowance. Whatever is entered will be added to all sides of each plate and to the width of each strip of boxing and plaque. The boxing for platform cushions will have edge allowance added to one side only — 2 inches (50.8 mm) will be added to the second side to provide an excess for staples into the platform.

Our example made use of the default 0.375 inch (9.53mm) edge allowance. That increased plate width was increased from 22.5 to 23.25 inches and the length from 72.75 to 73.5. And note that the boxing width was increased from our 3.5 cushion width to 4.25 because of the edge allowance at top and bottom. But these are not the finished measurements on the rendition!

The reason is that "rounding reduction" is subtracted from plate length and width and from boxing width top and bottom. Rounding reduction is necessary because cushion edges are not 90 degree angles. They are more or less rounded depending upon the firmness and upon the thickness of the filling. The calculator automatically adjusts this measurement depending upon the thickness of the cushion in question and upon the selection made in the "Filler Type" selector. In the example, the rounding reduction is 0.219 inch. Change the filler type to "polyurethane" and the reduction becomes .328. Hit calculate again and notice that all panels and boxing have been slightly reduced in size to accommodate the less dense foam. Thus, for the most part this input can be ignored. But, if a very soft filler is used, or if a loose fiber is used as filler, the calculated value for rounding reduction can be overridden with larger values. We recommend that lesser values never be used.

The rules used to determine the rounding reduction follow:

- For every inch of closed cell foam, .0417 inch reduction. (1.059 per 25.4 mm)
- For every inch of open cell foam, .0625 inch reduction. (1.588 per 25.4 mm)
- For every inch of urethane foam, .09375 inch reduction. (2.381 per 25.4 mm)

BOXING AND PLAQUE STRIPS

The calculator will include enough fabric for 105% or more of the actual boxing length required. The resulting strips can be run vertically or horizontally (or both) if there is no fabric pattern. Note that the software found room for two strips of boxing in the scrap along the length of the two cushion plates above. Boxing is always increased by two edge allowances (.75 inch or 19 mm in our example) over the indicated cushion width to provide for edge allowance top and bottom (the increase would be 2.375 inches (60.33 mm) in the case of platform cushions — an edge allowance on top and 2 inches below to provide extra fabric to wrap over the platform). These boxing widths are further modified by subtracting the rounding reduction. Here the rounding reduction for 3.5 inch thick open cell (Dry Fast) foam is .219 inch (5.56 mm). So the actual boxing width is rendered at 3.81 inches (96.77 mm). All this decreases slightly if polyurethane foam or a fiber wrapped foam is selected due to the increase in the rounding reduction.

When a vertical pattern dimension is entered (without a horizontal pattern — stripes for example), the boxing (and plaque) is always drawn so that the pattern will run from side to side (that is, the boxing will run from side to side across the roll). The pattern will thus run up and down along the edge of the cushion. It is easy to manually truncate the ends of these boxing lengths to achieve pattern matching. On the other hand, if only a horizontal pattern dimension (a "railroaded" fabric pattern) is entered, the boxing will be drawn along the length of the fabric roll (with a minimum length of 20 inches — 508 mm). Once again, the pattern will run up and down on the cushion sides. Pattern matching is possible here with the same sort of manual truncation as described above.

If there is pattern in both directions, the calculator will run the boxing in just one direction — from side-to-side. Note that there will be no attempt to match pattern in the vertical direction. If that is desired, it will be necessary to calculate manually the extra fabric required (or scrap may be useful in making "lengthwise" boxing or plaque0).

In many cases (where the boxing will not be seen, for example) pattern matching in the boxing and plaque can be ignored. In these cases, it may be possible to utilize scrap in the rendition for some of the boxing and the indicated length of fabric required can be reduced manually.

In addition to boxing, except in the case of platform cushions, there will be a strip or strips of fabric drawn in the rendition that is the width of the boxing plus 2 inches (50.8 mm). This "plaque" will be used to fashion a closure for the cushion. It will be sufficient in length to make up a zipper closure on one "length" side for each cushion drawn. The final width of the plaque will be dependent upon the closure system used. If a zipper will close the cushion, the plaque should be the width of the cushion filler plus the width of the closed zipper tape. Since these tapes are generally less than the 2 inches added by the calculator, minor trimming will be required. Some closure methods that we describe later on require wider plaque strips. If these are desired, there may be enough scrap to make them possible. If not, add fabric to the total displayed by the calculator.

The French Mattress Seam does not require any plaque at all. Platform cushions, too, do not require plaque. Designating the cushions as "Platform" in the "Calculate Yardage for:" segmented selector will automatically remove plaque from the rendition. And the software is smart enough also to eliminate plaque when edge allowance large enough for the French Mattress Seam is entered — any edge allowance greater than 0.8 inches or 20mm.

CUSHION SHAPES

The calculator can be used for all common cushion shapes. Rectangular cushions are normal and the calculator will handle them nicely. Irregular shapes are often used in the forepeak and quarter berth areas of boats — they normally have two right angles at each end of one side. This condition is not absolutely necessary to use the irregular functionality of the calculator, but there will be more waste and perhaps even fabric shortages as the deviation increases. The "Minimum Width" (D) input field will appear only if an irregular cushion shape is indicated. There may be corners or edges that require customization (the cut away corner at the wide end of the irregular cushion illustration demonstrates this) but that should not be of concern since the unneeded material can be easily trimmed away as waste prior to sewing.

PATTERN MATCHING

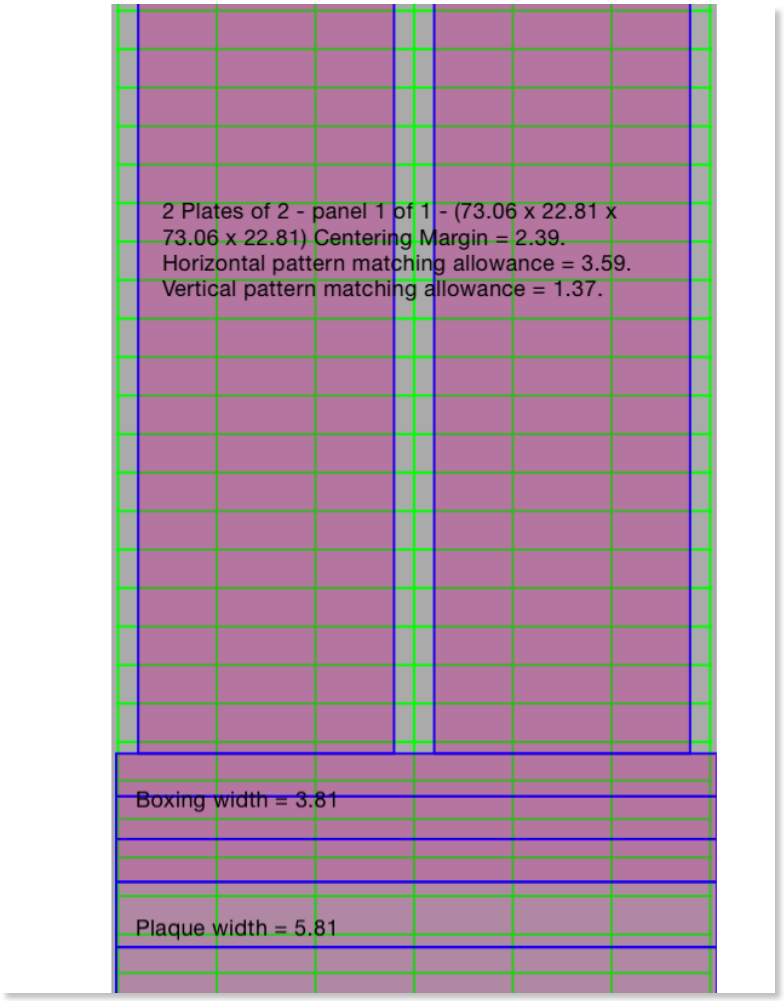
The pattern matching algorithms in the calculator are perhaps its most unusual and useful feature. Pattern matching means that the pattern will run continuously from one end of the cushion to the other and that all plates will resemble one another. This will often require space between panels in the direction that the pattern runs — that space is required to move the new panel over to the proper beginning point on the pattern repeat. But the calculator goes beyond merely keeping the horizontal patterns matched on opposite plates. When rectangular plates require less than one fabric width, the calculator will center them over the horizontal pattern repeats. This centering can be accomplished with vertical patterns as well if an appropriate starting point on the roll of fabric is chosen manually.

Pattern repeats cannot be accommodated unless their values are known. The horizontal and vertical repeat fields are necessary to provide for pattern matching. With a little study, it is possible to determine the beginning and ending points in a patterned fabric but, fortunately, these measurements are readily available from whatever fabric outlet is used. Sailrite displays them under the "description" listing for each fabric. If one or both repeats are missing, that means that there is no pattern (at least no discernible pattern) in that direction.

Vertical repeats run along the length of the cloth roll and horizontal ones across its width. The pattern repeat input fields both default to "0". If the defaults are not changed, the cushion images will display with a uniform pink color and there will be no pattern indicated. When values are entered in one or the other of the repeat input fields, the "pattern orientation" selector will be displayed to give the "width" and "length" choices and the cushion images will display light green lines depicting the direction and location of the repeated pattern. Changing the width/length selector will alternate the direction in which the cushion plates and boxing run but not the pattern lines. If both repeat fields are used, a cross-hatched pattern will display. The width/length selector will change the orientation of the plate and boxing panels on these lines just as above.

Note that these light green lines are only displayed when the pattern repeat (in either direction) is greater than one inch (25.4 mm). Smaller repeats are considered inconsequential and, were they not ignored, there would be a noticeable delay in program execution resulting from so many calculation iterations.This feature can be used to overcome the default orientation of cushions along a solid colored fabric roll since a small repeat will call up the "Pattern Orientation" selector so width or length can be designated.

Continue with the example above: 22.5, 72.75, 3.5, 1, 54. But enter 8.8 as the horizontal repeat and 3.43 as the vertical repeat. Now when the calculate button is hit the following will appear.



An 8.8 inch Horizontal Repeat with a

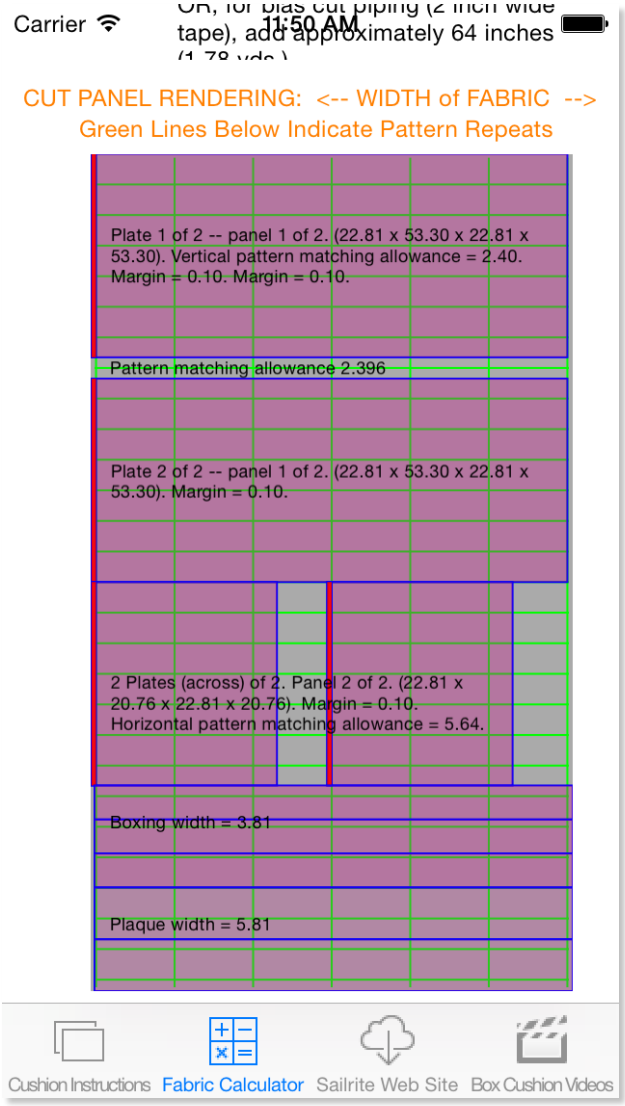
3.43 Vertical Repeat on Our Sample Cushion

The plates are centered on the horizontal pattern lines. A “centering margin” (2.39 inches) indicates how far from the edge of the fabric roll each long edge must be to achieve this. And a “vertical pattern matching allowance” (1.37 inches in this case) indicates separation one plate from another which can be useful if more than two plates are in sequence.

Change the pattern orientation to “width” and hit calculate. The plates run across the width of the fabric as shown below. Each plate segment (there are two here for each plate) either starts on a vertical pattern line or ends on one. A “pattern matching allowance” (here 2.40 inches) makes this possible. We can not be sure how the fabric will be cut, so these panels may not be centered on the vertical repeat, but this can easily be accomplished by moving the first cut line down until all following segments are centered. Order one extra length of vertical pattern to make this possible.

There is still a small margin (.10 inch on the left and .60 inch on the right). The left hand margin is reduced by 0.5 inch to provide for a seam allowance. The same reduction is made in the “remainder segments” that follow the 2 full width ones. The seam allowances are all

indicated in bright red. The remainder segments can be rotated 180 degrees or flipped as necessary to match up with the full width segment patterns above.



Width Oriented Plates with Vertical and Horizontal Pattern

FUNCTION AND FABRICATION ALTERNATIVES

The function and fabrication rolls are filled by the selector under the heading “calculate yardage for:”. The first three choices yield, first, two plates and all necessary boxing and optional piping or binding for the quantity of cushions indicated. The second choice yields just one plate with all boxing and optional piping or binding for just the top circumference per cushion desired. And the third choice yields just a single plate in the specified cushion quantity. The fourth choice yields a single plate (for the quantity indicated) with piping or binding for the top circumference(s) and with a boxing two inches wider on the bottom edge to permit wrapping it round the platform(s).

Change the pattern orientation in our test cushion back to “length” and hit the “plate & boxing” selector as well. After hitting “calculate”, the single panel rendition below will be generated. By rule the calculator will only draw boxing and plaque from side to side for fabrics with horizontal and vertical pattern repeats. The lesson here is that it will make use of any scrap greater than half the width of the fabric. The result may be a number of relatively short strips that have to be sewn together. It is perfectly acceptable to break with the calculator and orient boxing and plaque “lengthwise” if it looks good. That may result in longer boxing and plaque segments and fewer seams.

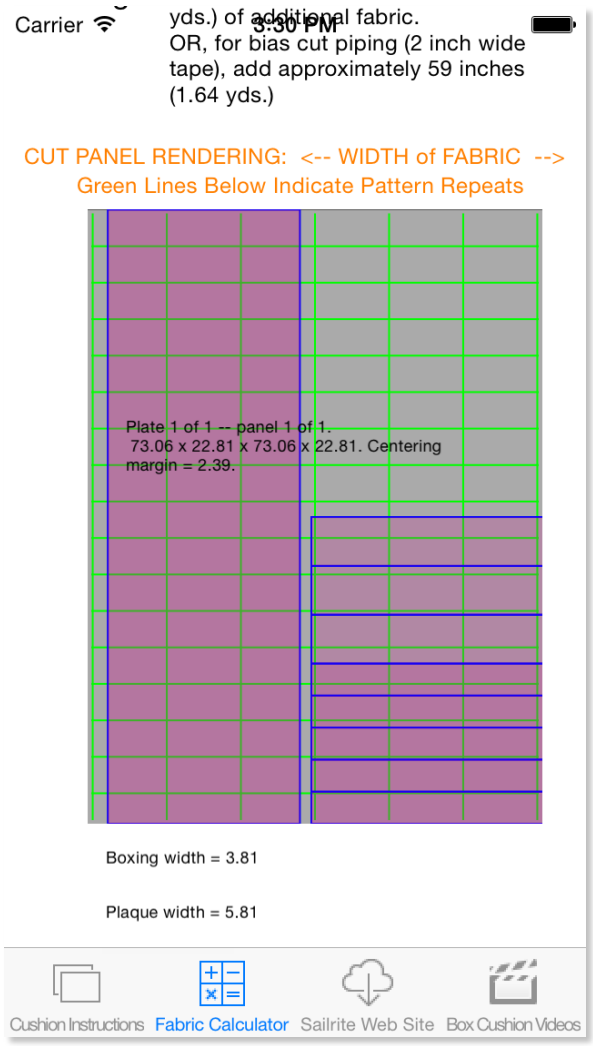
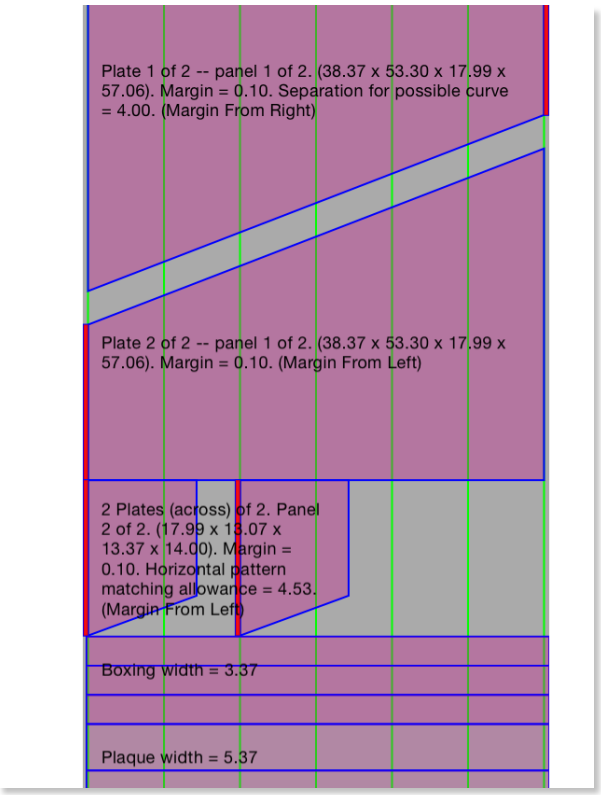


Plate & Boxing with
Vertical and Horizontal Repeats

AN IRREGULAR EXAMPLE

Let's consider another example — this time irregular. Hit "reset" to clear everything and enter the following: "irregular", 38, 65, 3, 1, 54, 13, 8.8. Leave the default edge allowance and rounding reduction and width and full cushion selections. After calculation the rendition page (below on the left) illustrates panel separation along non axial abutting edges. These sides of forepeak cushions in boats are often curved and the separation is intended to provided extra cloth for that. The width of separation is a vertical displacement .08 times the average of the wide and narrow ends raised to the next whole number or a minimum of 2 inches (51 mm) unless there is separation forced by the vertical pattern repeat in which case the separation may range from nothing to nearly one entire repeat width. In this case, the separation is 4 inches (101.6 mm).

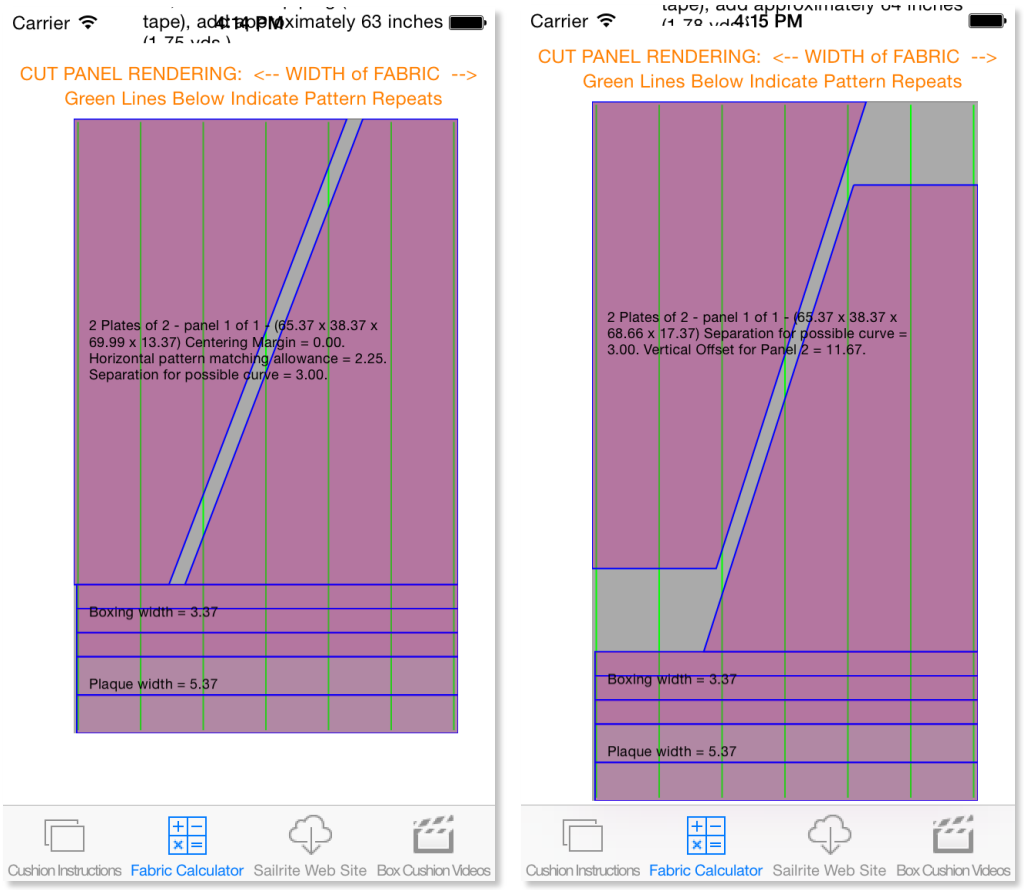


An Irregular Cushion

The seam allowance of 0.5 inch (13 mm) required to join the two panel segments is indicated in red on the appropriate panel edges. The seam allowances are all just beyond the pattern repeats. When two segments are placed face to face and a straight stitch is run down 0.5 inch inside their matched edges, the repeat pattern will be perfectly matched. Note that the seam allowance with this particular horizontal pattern actually takes up most of the pattern border leaving only a 0.1 inch (2.5 mm) piece of scrap as "margin". Also note that alternate panels are rotated so the margin will be measured from one side then the other as indicated in the text.

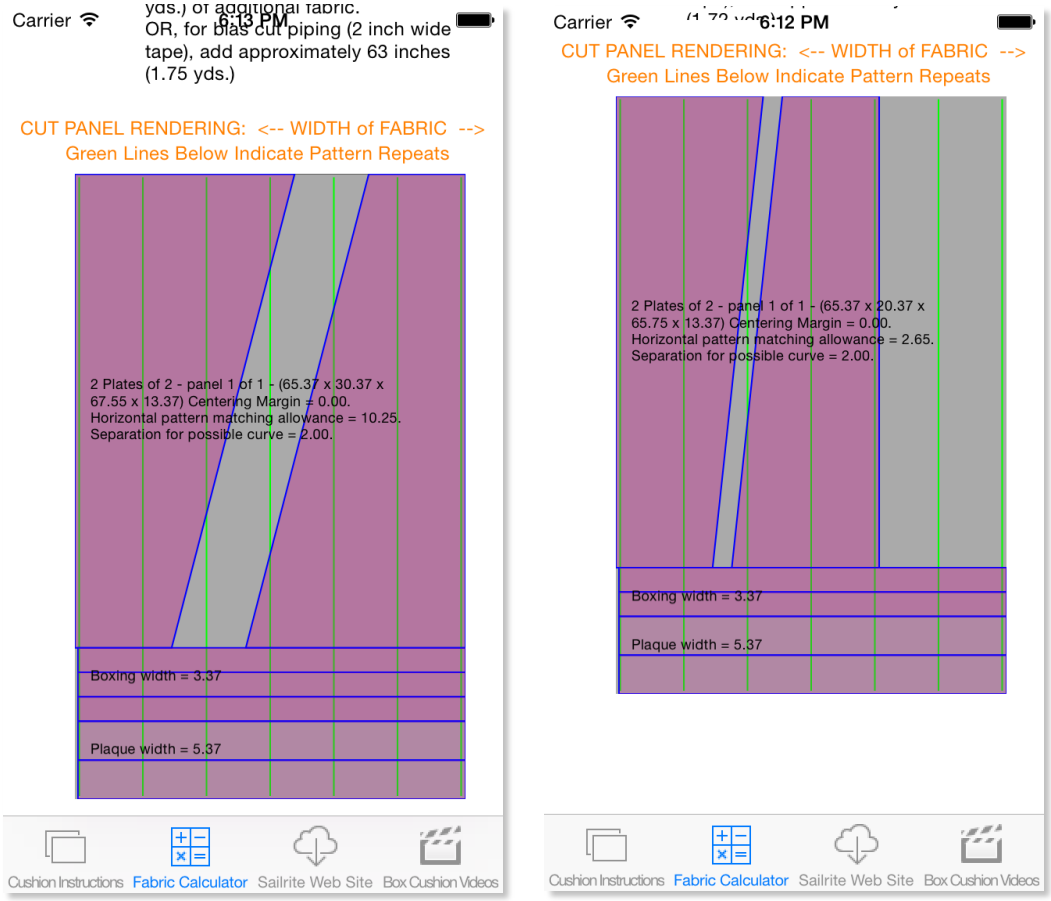
The small "remainder panel segments" below the full width are small enough to permit more than one to a row. Each row (if there be more than one) will be rotated to nest neatly together. The rows will be labeled as to whether the margin is from the right or left. The "pattern matching allowance" of 5.15 inches is the separation horizontally one remainder panel to the next required to keep the pattern in the same place all along the finished plate's length (or width).

If the pattern orientation selector in this example is switched to “length”, another instance of column rotation will be displayed. The panels on the left below nest together nicely with a 3 inch (76.2 mm) separation for curvature along the diagonal. If minimum width is increased to 17 inches, the rendering on the right results. It shows a “vertical offset” of 11.67 inches (296.42 mm) to nest the rotated panels efficiently with 3 inches of vertical separation to offset the center diagonals.



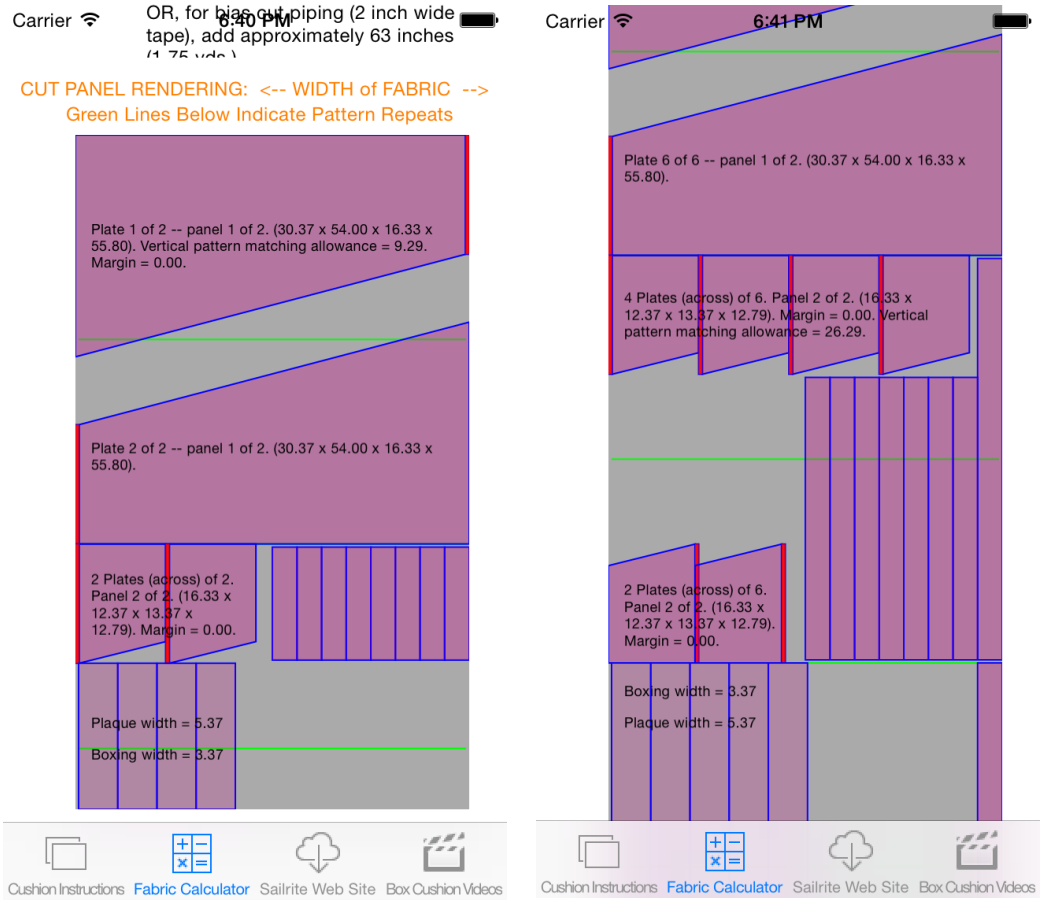
Nesting Irregular Plates

Reduce the maximum width in this example to 30 inches (762 mm) and the minimum to the original 13 inches (330 mm). Hit calculate. Scrap fabric is kept centered between the pair to provide for unusual fullness in the diagonal side of the cushion as illustrated on the right below. If, however, the panels can be nested within pattern matching distance shy of the full panel width and with normal separation, that will be the result. Examine the rendition on the right where the maximum width has been reduced to 20 inches (508 mm).



Experimenting with Width and Horizontal Pattern

If a vertical pattern is to be matched, the vertical offset will be increased by an appropriate amount. To test this, enter 28 in the vertical repeat field with any of the above values in appropriate fields and hit calculate. The resulting rendition is below on the left. A “vertical pattern matching allowance of 9.29 inches (235.97 mm) has been used to separate the first two panels so their base lines will both be on pattern repeat lines. If the quantity is increased to 3 it will be noted that the same thing is done with the remainder panels. Examine the rendition on the right.



Irregular Plates with Vertical Pattern Repeats

Extreme Examples

Imagine that we need to cover an exercise mat that is 120 inches by 144 inches (3048 mm by 3657 mm) with a 1 inch thickness. When these dimensions are entered in the calculator it will be noted that all of the panels that take up a full width are rendered first. There are three, in this case, for the first plate and three for the second. Each one is identified as “Plate x of y” and “panel c of d”. And there follows dimensions for each side of the panel. The partial panels or “remainders” for both plates are paired at the end. Each row of remainders (consisting of just two panels in this case) will be identified “x plates (across) of y” and “panel d of d” followed by complete dimensions for each side. This is the way all large cushion plates are handled.

Many more examples could be offered, but personal experimentation is likely to be the best learning technique. There are instances where unusual shapes will create spaces or overlaps in the rendition. And there will be opportunities to make use of scrap material that the software ignores (indeed, the renditions just above could be improved and required fabric reduced slightly by extending the length of the each boxing strip down into the fabric added for the plaque). Fortunately, the renditions make it easy to adjust for these shortcomings manually. We are aware that there are other similar shortcomings and we will work hard to fix them in the future, minor though they may be. There may be some more serious “glitches” of which we are not aware. Those using this software should exercise “due diligence” prior to cutting or ordering fabric. And

do let us know if you discover a bug. Email Eric Grant at Sailrite (eric@sailrite.com) or Jim Grant directly (islanderinfinity@hotmail.com).

Chapter 3

Materials and Tools

There follows a representative list of materials and tools for a box cushion project. Not everything here will be required for every project. But nothing of consequence will be overlooked if each item below is considered prior to beginning work.

Materials List	Sailrite Pt#
Fabric (Brisa Outdoor, Geobella, Naugahyde, P/K Lifestyles, P/Kaufmann, Phifertex,, Sunbrella, Tommy Bahama, Waverly, Seabrook, Stamoid, Weblon, Ultraleather, and Many More!)	Varied
Cushion Underlining Beige (for Bottom Plates)	#103934
Spun Bonded Pillow Protector Fabric (for Fiberfill Stuffed Cushions)	#104466
Dura Skrim Patterning Material	#103134
Foam (polyurethane, Reflex, DryFast, or Closed Cell), Batting, Fiberfill, Nu-Foam	Varied
Seamstick 1/4 inch Basting Tape	#104167
3M Super 77 Spray Adhesive	#636
V-69 Polyester Thread	Varied
5/32 inch Foam Piping Core OR Prefabricated Piping	#1055/#103291
YKK #5 Coil Continuous Zipper OR #5 Vislon	#104378/#28218
YKK #5 Coil Slider (Metal, Non-Locking) OR #5 Vislon Slider	#104333/#103161
Cushion Wrap Silk Film	#103933

Tools	Sailrite Pt #
Sewing Machine (The LS-1 Ultrafeed is a Good Choice)	#300501
Acu-Cutter 350 (or an electric kitchen knife)	#100157
Edge Hotknife Package	#103800
Deluxe 5-1/2 inch Magnetic Sewing Guide	#103597
Deluxe Seam Ripper	#18104
Pencil, Scissors, Tape Measure, Yard Stick	Varied

All of the fabrics listed above are perfectly acceptable. Some will be more durable in sunlight. Some will be more resistant to abrasion. Some will "breath" more freely. Some will have a softer "hand". Some will be available in more desirable patterns or colors. Picking fabric from the vast array available is great fun! Have at it!

The cushion underlining is used only where cushions will always be "bottom side down".

The pillow protector fabric is used to make a lining that encases Fiberfill when that is used as the cushion filler. Because it is very smooth and slippery, it helps keep the Fiberfill evenly distributed.

Dura Skrim is necessary only if the shape of the cushion is such that a pattern is necessary.

A whole chapter above is devoted to filling materials. It is important to note that the various foams and fibers can be combined. The Super 77 adhesive can be used to keep the combined fillers in place.

Seamstick is the beginner's best friend! It will keep everything just right until it can be sewn. There are several varieties available. They all "work", but some are more appropriate in particular cases. The Sailrite web site does a good job of differentiating them. Of course, pins are often used for this and a desk stapler can prove very handy as well.

Polyester thread is wonderful stuff — very strong and durable. Nylon thread would also work fine for cushion work since stitches are usually buried under the fabric and thus not likely to be damaged by ultraviolet exposure. Indeed, only if topstitching is employed when joining plates or boxing comprised of two or more panels or if the French mattress seam edging is used will any thread be visible. Thus, except in these two cases, thread color is of no importance.

There are many prefabricated piping choices in addition to the one listed here. Many of these can be reviewed on the Sailrite web site.

The two most common types of zipper (coil and toothed or Vislon) both give excellent service, even in a damp marine environment. Zipper sliders are available in plastic and metal. Each has advantages and disadvantages. At Sailrite we usually choose plastic only for the larger zippers (#10). By the way, we list only #5 zippers above but there are many who prefer the larger size, especially for larger cushions.

Silk film is used to help get fillers into their covers. When used with a vacuum, it can reduce the size of fillers by as much as half. It can be left in place or removed to use in future cushion projects.

The list of tools should be clear all by itself. Do let me stress how much easier this work is when a walking foot sewing machine is used and there is none better than an Ultrafeed from Sailrite!

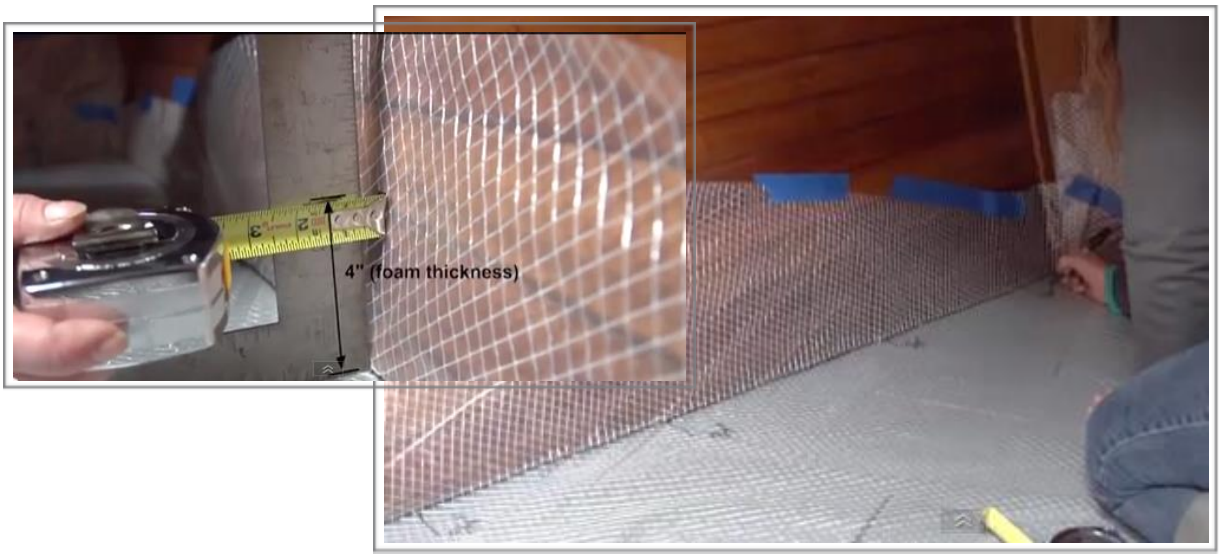
Chapter 4

Fitting and Cutting

The calculator is all that one needs to determine rather accurate yardage requirements, but the dimensions it provides are not always enough. In the real world adjustments are often required. Some cushion edges may be curved or angled. This chapter is all about creating cushion covers that fit. The goal is to make our cushions fit a designated space. They must not be too small or too large.

PATTERNS

Patterns are often not necessary. For example a simple rectangular cushion would require just three measurements: length, width, and thickness. Here the results from the calculator can be transferred directly to the fabric just prior to cutting. Cutting the filling will require some minor modification of the basic measurements but nothing serious (more about this below). More complicated shapes can be reproduced on Dura Scrim pattern material or some other inexpensive but stable medium (even butcher paper taped together as necessary would do nicely). Spread the pattern material out carefully over the cushion's platform and carefully mark it.



Using a Marker on Dura Scrim to Create Forepeak Patterns — Slope

If offsets to this pattern are required for a sloping surface, a block of wood the thickness of the cushion (or a right angle — see above) can be placed on the pattern edge and the gap to the sloping surface can be measured. Mark the offset right on the pattern with an arrow to show where it was taken. Such marks are visible in the photo above. The resulting pattern should represent the exact finished size and shape of the bottom side of the finished cushion. However,

even though the pattern, whether a set of numbers or a sheet of plastic or cardboard, is an accurate representation of the finished cushion, we don't actually cut anything to match it. We rather use it along with a set of rules to create the filling and the fabric cover panels.

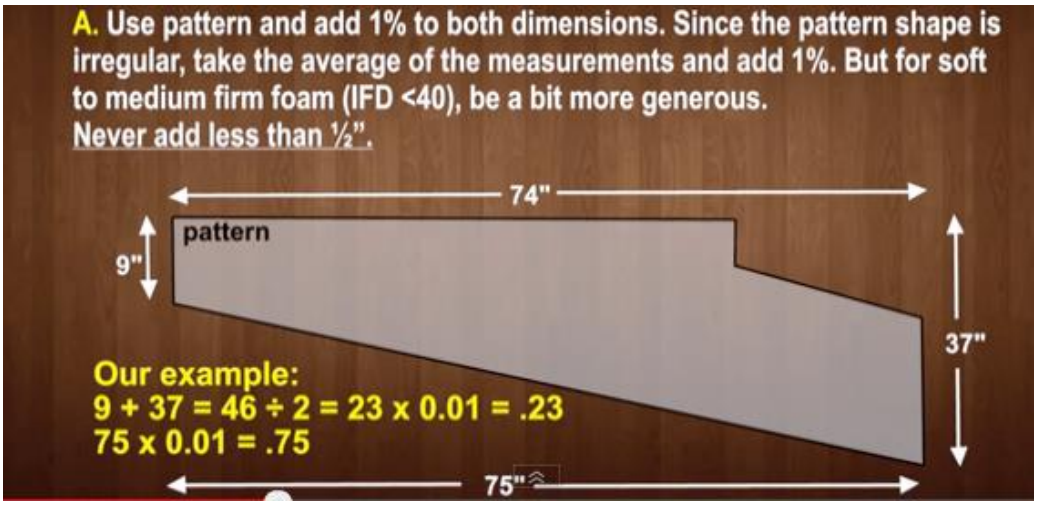
Finished Patterns for Forepeak Cushions

USING THE PATTERN TO SIZE A CUSHION FILLING

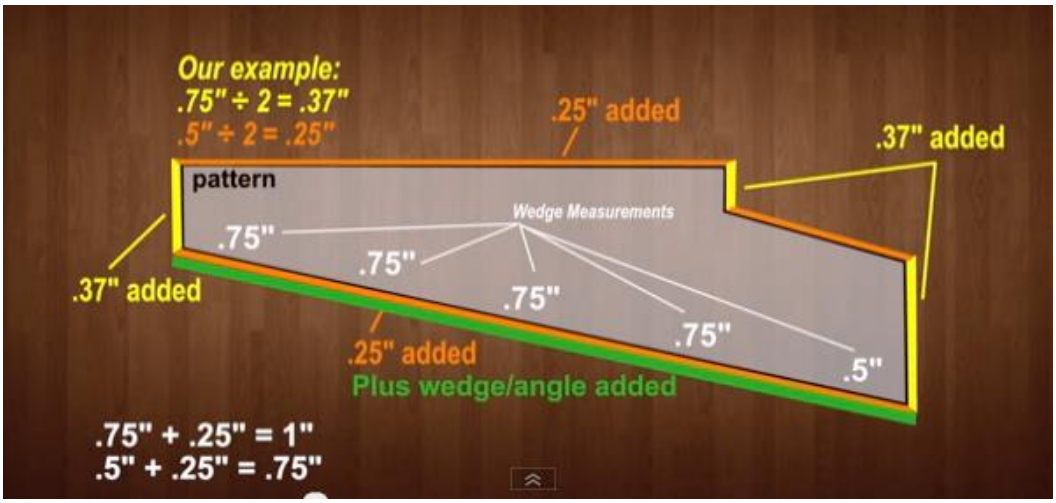
Even though the pattern, whether a set of numbers or a sheet of plastic or cardboard, is an accurate representation of the cushion, we don't actually cut anything to exactly match it. The filler should be slightly oversize so that it will be under compression when the cover is in place. This will keep the surface of the cover smooth and wrinkle free.

If the filler is a simple fiber stuffed into the cover it is just a matter of enough stuffing. Cutting foam, on the other hand, requires the application of some simple rules: Because initial compression is significant, the rule of thumb is to make all foam shapes oversize by 1% of side in question or 1/2 inch (13 mm), whichever is greater. If the cushion is irregular in shape, add 1% of the average width or length. In order to assure neat, tight cushions, cut softer foams erring on the large side of this rule of thumb. Of course it is always possible to add layers of fiber mat or "batting" as necessary. And, indeed, that is the best way to make up for any shrinkage that may have occurred in old foam that is being recovered. Compress the fiber mat that is being used between thumb and forefinger and measure this compressed thickness to estimate how much it will add to the finished filler. Wrapping fiber mat round old foam tends to create rounded edges. If a relatively square edge is desired, cut the fiber mat in strips the thickness of the boxing and the size of the plate and glue it in place with contact cement (like 3M Super 77).

The illustration below is an attempt to make these rules somewhat more concrete. Since the 0.23 inch width addition is less than 0.5 inch, 0.25 inch (half of the total) would be added to both long sides of the foam. One percent of the length is 0.75 — which means that half of that, or 0.375 inch can be added at each end.



Those additions are illustrated graphically in orange and yellow below. The green addition is applied only to the top surface the cushion foam to create a wedge along that side. All of this may seem somewhat arbitrary — and it is. But it works!



Cutting Plates, Boxing and Plaque

Upon measuring the width of your fabric, you may find it to be somewhat wider than the "nominal" figure used to describe it. This is quite common in fabric that does not have a "finished" edge. In order to use the margin and offset dimensions provided by the calculator, it is a good idea to remove an equal amount from both sides of the material until it matches the designated finished width. If pattern matching is not necessary, the extra width can be utilized. But be careful that it is straight and "whole".

All fabric cutting can be done with scissors or with a "hotknife". The latter is appropriate for synthetic fabric. It can be a soldering iron or gun with a narrow blade or it can be a specially designed professional tool. The advantage in cutting a synthetic fabric with a such a tool is that the edge will be cut and sealed at the same time. Cotton, and other “natural” fabrics require cutting with a scissors. The resulting edge will not be sealed. But this is not a serious problem with cushions where all the raw fabric edges finish inside the cover. Any raveling should go unnoticed. And, if necessary, an overlocking stitch can be used to finish all raw edges if desired.

Be careful to cut all lines as straight as possible. We will actually be using the cut edges to guide us in our placement of stitches. And straight stitching is very important to maintaining a professional look in the finished cushion.

One more caution. Synthetic fabrics do not shrink or stretch enough to warrant special treatment, but the same often cannot be said of natural fabrics. If in doubt, it is a good idea to wash and dry cloth made of natural fibers before fabrication (be sure to follow manufacturer’s cleaning instructions).

We will start cutting using the pattern (whether a set of numbers or a sheet of plastic or cardboard) discussed above that mocks the finished shape of the cushion. But it needs modification in order to accommodate an allowance for seams and for foam compression. This modification is for the sake of insuring that the finished cushion cover will match the size of our pattern. Note that we build the cushion cover to fit the desired space. Even if an old foam that has compressed somewhat is to be reused, the new cover should not be reduced in size. Rather additional foam or “batting” (the fiber mesh described above) can be added to the old foam to bring it back to proper dimensions. This has the added advantage of giving some new life to the old foam.

Thus, no matter the size of the filler, the rules that govern the cutting of the plates, boxing, and plaque follow. These rules are incorporated into the fabric calculator. Except for curved or angled shapes, the results of the calculator can be directly applied.

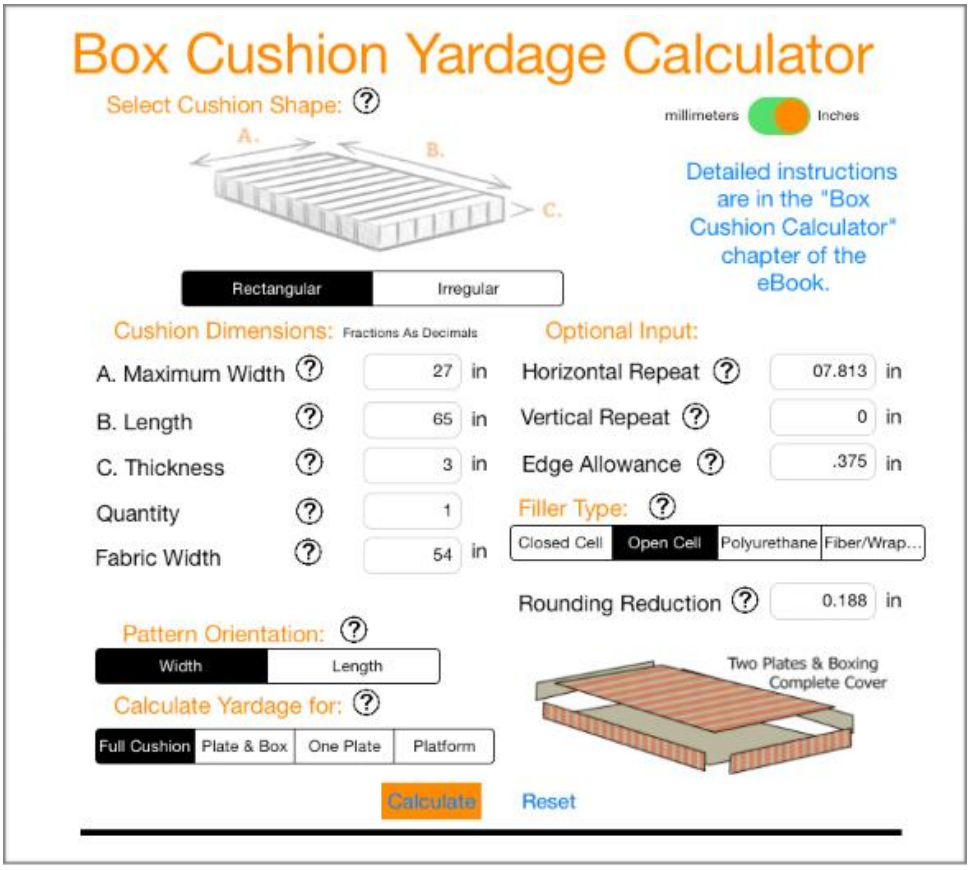
- **Rule 1 — Top and bottom plates should be cut equal to the pattern plus edge allowance LESS “rounding reduction” on all sides.** Edge allowance is whatever width of fabric will be required to attach the boxing to the plates — it will run between 3/8 and 7/8 inch (9.525 to 22.2 mm). The rounding reduction is dependent on cushion thickness and filler density. Cushion edges are slightly rounded when a snug cover is applied. The distance round a curve from one plane to another is less than when the change in direction is more abrupt. Even very firm and thin foams like closed cell will round somewhat. But thicker and less dense foams and fillers will have significantly more round. The calculator offers four choices in calculating rounding reduction. The first, labeled “closed cell” represents very firm filler that will result in cushions with well defined edges. The fourth, labeled “fiber wrapped” represents a soft filler, often polyurethane wrapped with two or three layers (an inch or so) of batting that will have quite rounded edges. “Open cell” and “polyurethane” represent fillers that are “firm” in the first instance and “medium” in the second. In practice these categories merge into one another. For example, batting can be added to open cell foam to create a slightly less firm composite structure. But the four distinct categories offer enough specificity to guarantee good outcomes.

The rule we have devised at Sailrite follows:

- Closed cell foam .0417 inch (1.059 mm) per inch (25.4 mm) of foam thickness.
- Open cell foam .062 per inch (1.587 per 25.4 mm).
- Polyurethane foam .094 per inch (2.38 per 25.4 mm).
- Fiber filled or batten wrapped foam .1 per inch (2.54 per 25.4 mm).

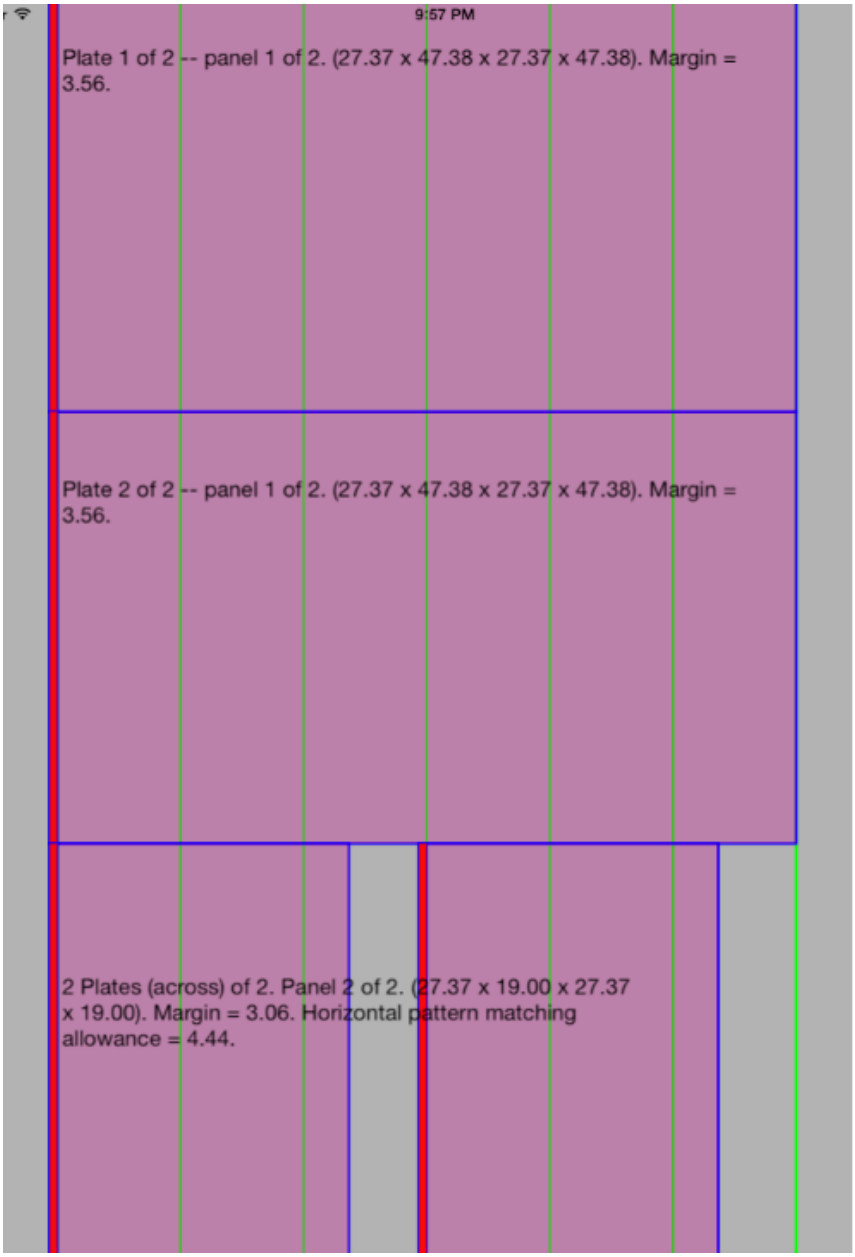
The calculator automatically applies these rules and reduces the extent of all plates, boxing and plaque by the resulting amount on all sides. Note, however, that the resulting "rounding reduction" can be modified in unusual circumstances such as when the filler is extremely soft.

Note that the length and width of the plates do not affect the rounding reduction — just the thickness of the cushion and the density of the filler matter. Consider the following: a rectangular cushion 27 by 65 by 3 inches thick with 54 inch wide fabric with a horizontal repeat of 7.813 (686 x 1651 x 76 with 1372 fabric and a 198 repeat in mm). Let's run the pattern across the width of the cushion. Leave the default edge allowance and open cell filler type.



If this data is entered in the calculator, each plate will be rendered as two panels. The first, or "primary" panel will be 27.37 x 47.38 (695 x 1203 mm) and the second will be 27.37 x 19 (695 x

482 mm). The seam that will join these two panels (colored purple in the rendition) will consume 1 inch (24.5 mm) so the finished assembly will be 27.37 x 65.38 (47.38 + 19 - 1). Why do these panels not measure just 27 x 65 as specified in the width and length input fields?



The reason is that .375 inches (9.525 mm) is added to each edge for a total increase of .75 inches (19.05mm). And the rounding reduction of .188 inches (4.775) is subtracted because our 3 inches of open cell foam will round moderately. This subtraction leaves just the extra .38 inch (or .37 due to rounding) excess of fabric indicated in our finished plate sizes. If the open cell foam were padded on each side with a layer of batting, the thickness would increase to 3.25 (measure with 2 or 3 lb.. of pressure to compress the batten material), but the type of filler in the selector should remain unchanged. Test the result in the calculator. Increase the thickness to 3.25 and note the increase in rounding reduction. If the filler used were 3 inch polyurethane, the selector

would be advanced a notch and the subtracted amount would jump to .281 inches (7.137 mm) to accommodate the increased tendency for rounded edges and the finished plates would measure 27.19 x 65.19 (690.58 x 1655.38 mm). Test this out for yourself by changing the filler thickness back to 3 and the type to “Polyurethane” in the calculator. The “rounding reduction” automatically adjusts for the type of filler selected following the Sailrite rules above, but it can also be adjusted manually if desired.

- **Rule 2 — Boxing should be cut with the same rule: the thickness of foam or other filler (foam and batting, for example) measured under slight compression (just a pound or so) PLUS whatever the edge allowance is LESS the appropriate rounding reduction at top and bottom (except in the case of platform cushions where the bottom reduction is not required).** Once again, just as above, the boxing width itself is increased by the edge allowance and reduced by the rounding reduction. Here too, seams should run inside the edge of the boxing to match the edge allowance.

This rule can have a noticeable impact on boxing width. Consider the table below. The edge allowance in all three examples is 0.375 inch (9.5 mm) on the assumption that a prefabricated piping will be used. It has a “tail” just that long which means that the edges of all three of the surfaces to be sewn together can be kept flush as they are run through the machine. If this were the only consideration in cutting boxing, it would all be cut 0.75 inch wider than the cushion thickness. But rounding reduction reduces the width of the boxing a variable amount. Thicker and softer foams result in rounder edges which, if the cushion cover is to fit well, require narrower boxing. Indeed, plate size will be effected in the same way though it will not be so obvious since the change is relatively minor over the broader expanse of material.

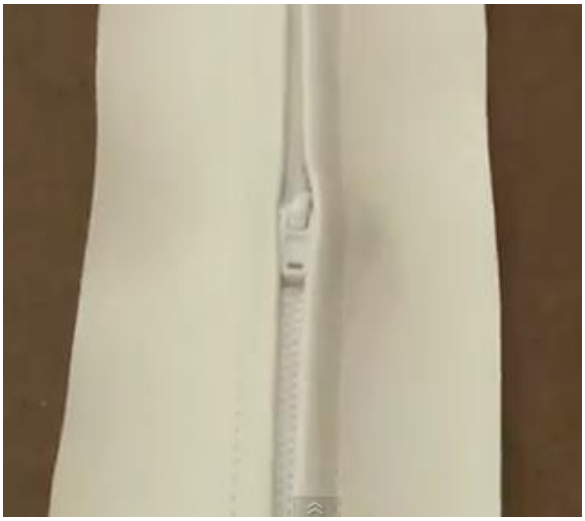
Boxing Width Examples	
4 inch polyurethane foam	4.00
Edge allowance .375 (3/8) inch top and bottom	.75
Rounding reduction .375 (3/8) top and bottom	.75
Cut Boxing Width	**4.00**
4 inch open cell foam	4.00
Edge allowance .375 (3/8) inch top and bottom	.75
Rounding reduction .125 (1/8) top and bottom	.25
Cut Boxing Width	**4.50**
2 inch polyurethane foam	2.00
Edge allowance .375 (3/8) inch top and bottom	.75
Rounding reduction .188 top and bottom	.38
Cut Boxing Width	**2.37**
2 inch open cell foam	2.00
Edge allowance .375 (3/8) inch top and bottom	.75
Rounding reduction .125 (1/8) top and bottom	.25
Cut Boxing Width	**2.50**

The length of the boxing should equal the perimeter of the cushion less the length of the side that includes a closable slit for filler insertion and removal (if any). We call this slit panel a "plaque" to distinguish it from the rest of the boxing — it will be taken up below. Add to this length as necessary for seam allowance and pattern matching. The boxing can be fashioned as one long continuous strip or it can be cut in pieces that match the exact length of each plate side (if there is an inside corner, cut the appropriate boxing with an extra seam allowance added to its length to provide for that corner). If there is a wedge on the cushion, the boxing for edges adjoining that wedge side will be longer on the "top" side. All of this will be taken up in greater detail when we consider assembly detail in what follows.

Cushions with angled sides will have slightly wider panels on those sides. To determine the proper width, prepare the boxing for the adjacent sides following the rule above. Then cut the end of that boxing to match the cushion angle. The length of that cut edge is the width of the panel on the angled side. Note that if the angle increases along the side of the cushion the width of the panel should increase as well. This angled side will often include a closable slit (we call the resulting assembly a "plaque" to distinguish it from the rest of the boxing).

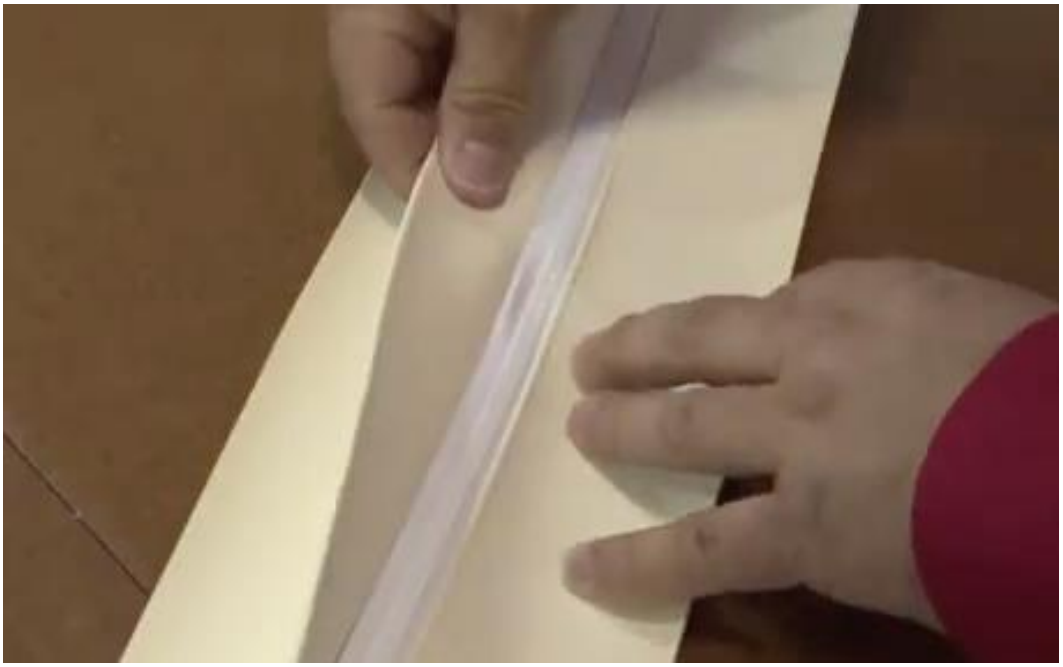
If the pattern includes one or more wedge sides, one plate will be larger by the amount indicated by the offsets on the pattern in addition to the seam allowance (and an appropriate rounding reduction) along the appropriate side or sides. When the pattern is used to mark the fabric, measure out at each offset the appropriate distance (two plus figures and one minus) and put down a point on the fabric. Then use a long batten to connect all the points with a smooth curve. This, in essence, creates a new pattern for the larger plate right on the fabric.

- **Rule 3 — Plaque (the side of the cushion with a slit for filler insertion, if any) should be cut with extra width to provide for the placket so, when finished, its width will equal that of the rest of the boxing**. If a "standard" zipper closure is used, this extra should be the exact width of the zipper. If a "flap" or "hemmed" closure is desired, we like to make the initial plaque 2 times the thickness of the cushion plus 3 inches. There will be more about these alternative closure systems below. Note that the fabric calculator adds 2 inches (50.8 mm) to the boxing width when creating plaque renditions. Thus, the indicated plaque can be reduced in width if small zipper is used. On the other hand, if a hemmed closure is desired, a plaque width equal to the twice the boxing plus 1 inch (25.4 mm) will be required. This will mean ordering a few extra inches of fabric. The length of the plaque, in either case, will normally be roughly the length of a long cushion edge though it can be shorter or longer and still accomplish its purpose.



A Standard Zipper

The discussion thus far might seem to suggest that only zippers are used for closures. It is true that they are frequently used, but other closures are possible. Velcro is perfectly satisfactory and so are snap fasteners. If these alternative closures are used, a hemmed plaque is appropriate (but hemmed plaques can also make use of zipper closures).



A "Hemmed" Plaque

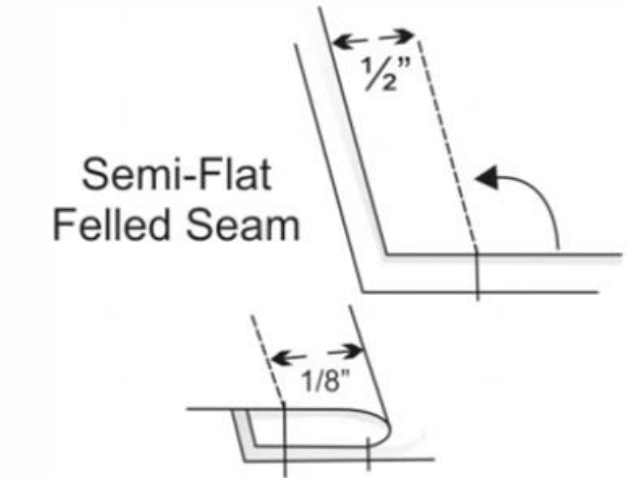
The sizing rules set forth above differ from earlier ones found in Sailrite publications and videos. Be assured that we are aware of the deviation and stand by these new rules as likely to yield better results. It is true that the nature of cushion construction makes seam and compression allowances satisfactory over a wide range. In other words, the acceptable margin for error is rather large. But we have carefully tested the rules above over a broad range of cushion types and sizes and find that they provide a consistently uniform and satisfactory outcome.

Chapter 5

Panel Assembly

This chapter follows naturally on the previous one. There we cut all of the primary fabric parts that will be needed. Here we move to fabricating them into assemblies and, eventually, into the finished cushion cover. There are alternative approaches to plaque construction, boxing assembly, and to edge finishing (all of this has been indicated above but not really fleshed out). Here we will accomplish these tasks in detail as well as final assembly and stuffing.

Before turning to details, if it is necessary to join two lengths of fabric together, whether to make plates or boxing or plaque, do it as follows. Lay one segment on top of the other “face to face” (not all fabrics have a top and a bottom side, but, if yours does, then the top sides should be facing each other).Baste the assembly together with double sided “transfer tape” (Seamstick) to insure accuracy. Put a row of straight stitches 1/4 inch (6.35 mm) inside the matched edges. Put down a pencil line to insure a straight line of stitches or use the Deluxe Magnetic Guide or do both — accuracy here is very important. The calculator will have added just the right amount to the segments to make this seam possible. Then spread the two panels to their full length and iron them flat with the seam allowance up against one or the other side. A topstitch here is unnecessary and it would clearly be unsightly so skip it!



Two Boxing Segments Attached with a Semi-Flat Felled

CHAPTER 6

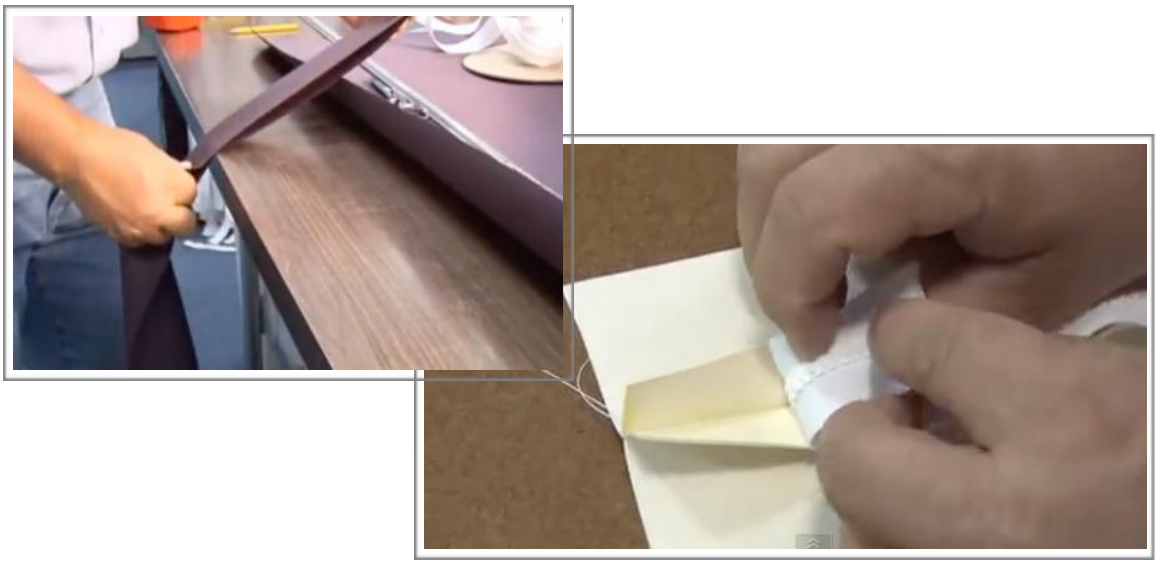
The Plaque

The finished length of the plaque is entirely arbitrary. It is true that if the opening goes round two edges it will be easier to insert and remove the filler foam, but even an opening of three or four feet in an eight foot cushion will make it possible to perform needed foam maintenance with just a bit more effort. We suggest that the opening go all the way along one edge and 2 inches (50.8 mm) round the corners at both ends. Add 1 inch (25.4mm) to this length for seam allowance when we attach the boxing at each end (0.5 inch for each end).

Zipper Closures

If a zipper is used as closure, we prefer a toothed (Vislon) zipper size #5 although a #10 will do just fine and there is nothing wrong with a coil zipper as well. The plaque for a zipper closure should be cut the width of the boxing PLUS the width of the zipper tape. Fold this plaque in half down its length keeping the “good” side of the cloth inside. Run the folded tape over the edge of a table to create a distinct crease. Then place a row of straight stitches just 1/2 the width of the zipper tape away from the fold all along the length of the plaque (this measurement will be 5/8 inch (15.875) mm for a #5 zipper). When the stitches are in place, cut the plaque on its fold. The result will be two pieces of cloth sewn together 1/2 of the width of the full zipper tape from one edge.

Splay the plaque out flat with the “seam allowance” side up (the "good" side will be down). Press the two edges down away from the stitching so that the parts touch only where they are sewn. Place the closed zipper on top of the border with the teeth centered over the stitches. The zipper slider may be removed from the tape completely at this point — we will replace it shortly. Note that Vislon and chain zippers both have no "right" or "wrong" side. Nor is there a "right" or "wrong" direction for opening and closing these zippers.



Creasing a Plaque Tape and Centering Zipper Teeth Centered Over Flaps

Sew both sides of the zipper to the plaque tape with a row of straight stitches. Start sewing with about 1 inch of the zipper tape extending out over the end of the plaque. The zipper is secured to the "inner" surface of the plaque. It may be helpful to use a zipper foot for this task although the stitches should be about 1/4-inch or so from the teeth and this can normally be accomplished without a special foot. When both sides of the zipper are secure, rip the stitch that joins the two halves of the zipper plaque down its center. Remove the broken stitch remnants. The resulting assembly should measure exactly the width of the boxing cut above.

A Finished Standard Zipper Plaque (for 1.5 inch thick foam)

Now put the slider back on the zipper tape (assuming it was removed as directed above). Pull the zipper teeth apart on one end for three or four inches and push the lead end of the slider onto the separated sides at the same time so that the teeth mesh together. Be careful to install the slider so the pull tab is on the "outer" side of the plaque. Run the slider about half way into the zipper's length and leave it there. Note that the slider will close the zipper as it is run along the tape while opening it in front. This is perfectly normal. There will be a small opening in the zipper tape in front of the slider.

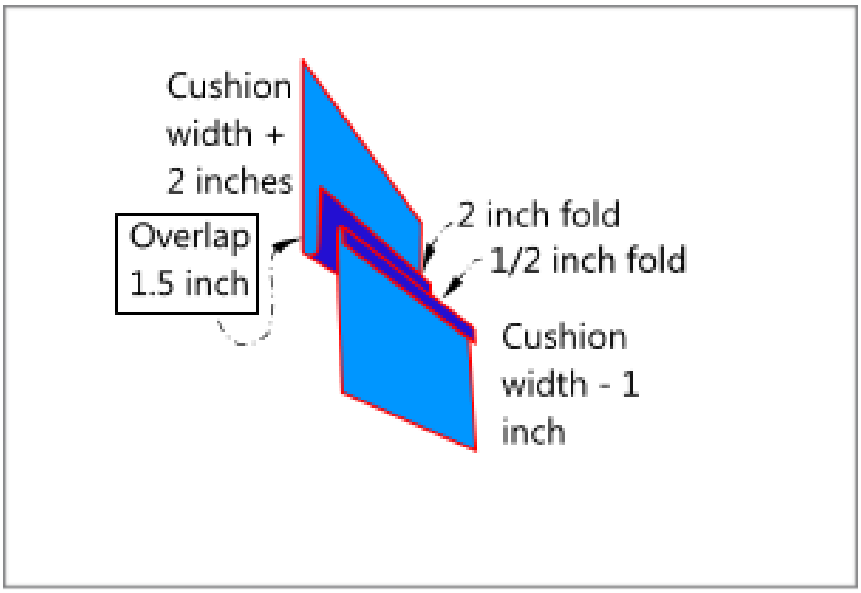
Finish the zipper opening by sewing right across the zipper teeth at each end. A 2 inch (50 mm) fold in the plaque over the ends of the zipper covering this "cross-over" stitch will dress the assembly nicely but this is not necessary — just an option.

Check the width of the finished plaque now. It should measure exactly the width of the cushion foam. If it is too wide, simply cut it down to size. If it is too narrow, take this into account when joining it to the plate. That is, cut the edge allowance of the plaque to allow for the shortage in width.

Creating a Hemmed Plaque Closure

A hemmed plaque provides a somewhat more finished look than the zipper plaque and it has the overlapping flap that Velcro and other mechanical fasteners like snaps require. It features a large folded fabric "hem" that covers the closure from the top by a little more than an inch or so.

This closure can make use of a zipper if desired, but it is usually closed with 1 inch wide Velcro or with snap fasteners spaced on 6 inch (152.4 mm) intervals.



The Anatomy of a Hemmed Plaque

Since the hemmed plaque closure itself will finish out at nearly two inches, the following technique is not useful for cushions less than two inches or so thick.

The fabrication of a hemmed closure will require a plaque width equal to the twice the boxing plus 1 inch (25.4 mm). If the steps below are followed, the hemmed assembly will finish somewhat oversized. It can be trimmed to match the boxing width after assembly.

Begin by cutting two tapes. One should be the width of the cushion thickness less one inch (25.4 mm). The other should be the boxing width plus two inches.

Create a two inch (50.8 mm) fold in the top (wider) tape and a 1/2 inch (12.7 mm) fold in the bottom (narrower) tape. Crease the folds well onto the inside surface of the plaque and sew them in place with a row of straight stitches within 1/8 inch (6.35 mm) or so of the inside edge of each fold.

Next sew 1 inch wide Velcro hook and loop tapes to each tape so they will be opposite one another when the tapes are overlapped 1.5 inch (38.1 mm). Use a straight stitch and sew all round the sides of each tape. Or, if snap fasteners will be used. Install them opposite each other on 6 inch (152.4 mm) centers all along both tapes. A zipper could also be sewn along the top edge of the bottom tape and along the fold edge of the upper tape as shown in the photo below.

Using a Zipper to Close a Hemmed Plaque

Finally, secure the two tapes together if they are not already with whatever fastener system is used. Trim the width of this assembly so that it matches the width of the boxing. Trim each tape to keep the hem flap roughly in the center of the plaque. The finished assembly will be sewn permanently together when it is secured to the boxing at each end.

CHAPTER 7

The Boxing

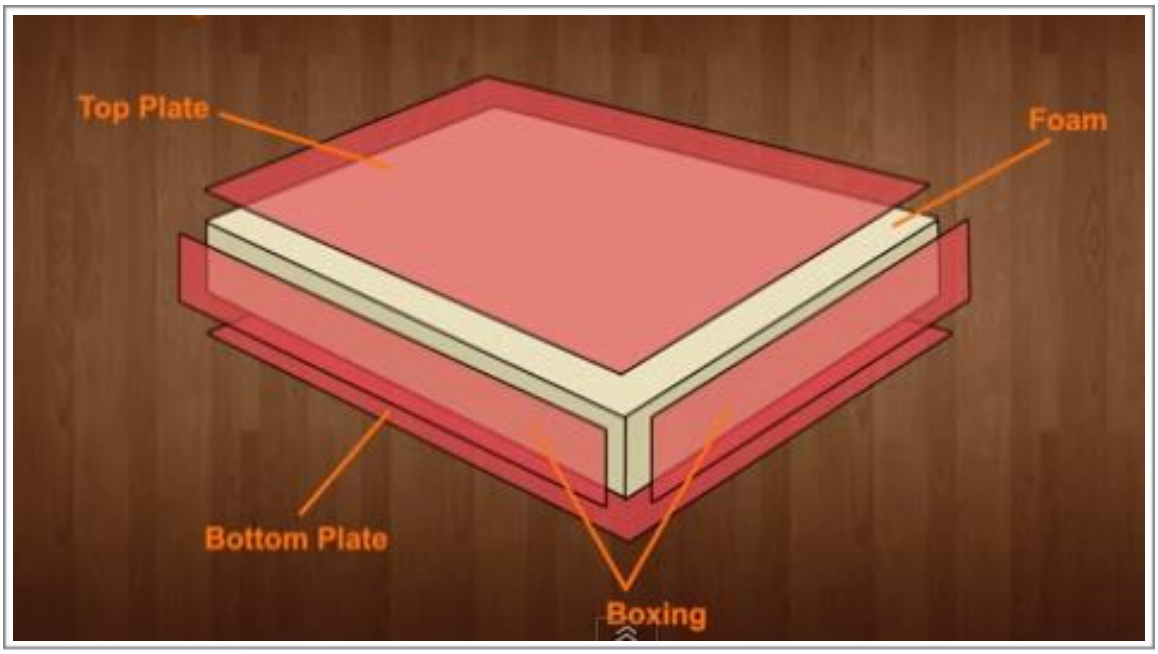
There are two ways to make up cushion boxing. It can be a continuous strip of fabric or it can be a separate, “segmented”, length for each cushion side. The first technique eliminates vertical seams at each corner. The second one facilitates pattern matching and makes wedge shaped cushions possible. Both are equally easy.

Continuous Boxing

The continuous strip requires a single length of boxing long enough to circle the cushion less the plaque. This single length must nevertheless be carefully matched up with the cushion sides. Measure down each side and cut a 1/4 inch (6.35 mm) notch in the boxing at top and bottom exactly at the location of each corner LESS the edge allowance at both ends (continuous boxing does not have need of edge allowance at outside corners — inside corners require the addition of edge allowance at that corner). Once again, the importance of ACCURACY here cannot be overestimated. Note that it is “edge allowance” that is deducted (or added for inside corners). This can range from 3/8 inch to 3/4 inch (9.53 to 19.05 mm) depending on the way the edges will be finished (more on this below).

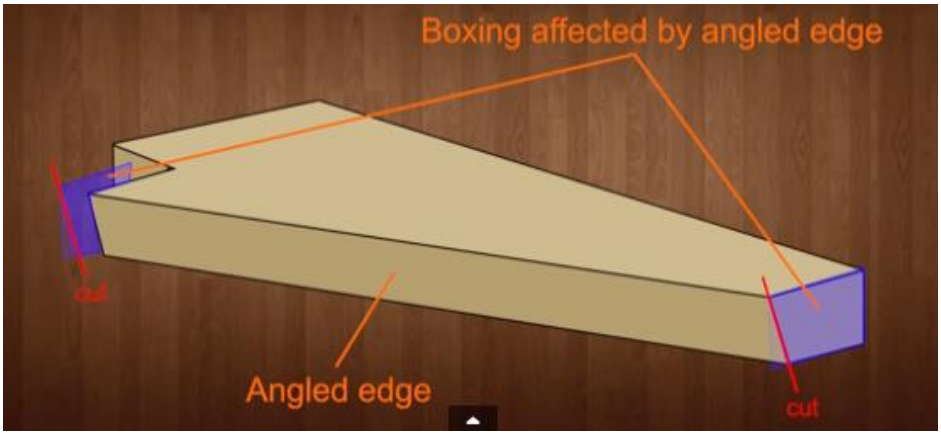
Segmented Boxing

Segmented boxing requires separate lengths of boxing that match the sides for which they are intended. Just as there are edge allowances in the plate, they will also then exist on the boxing strips allowing them to be sewn to their mates at each corner. If there is an “inside corner” the boxing strip there must have an extra edge allowance added to the length of that side. The corners of cushions made this way will all have vertical boxing seams required to attach the separate lengths to one another.



Separate Boxing for Each Cushion Side

This approach to boxing is actually required if the cushion has an angled side (at least along that side) because the appropriate boxing corners will have to be cut to match that angle (refer to the illustration below). Note that the blue boxing on the left runs into an inside corner and, thus, it should be an edge allowance longer than the filler surface that it matches.



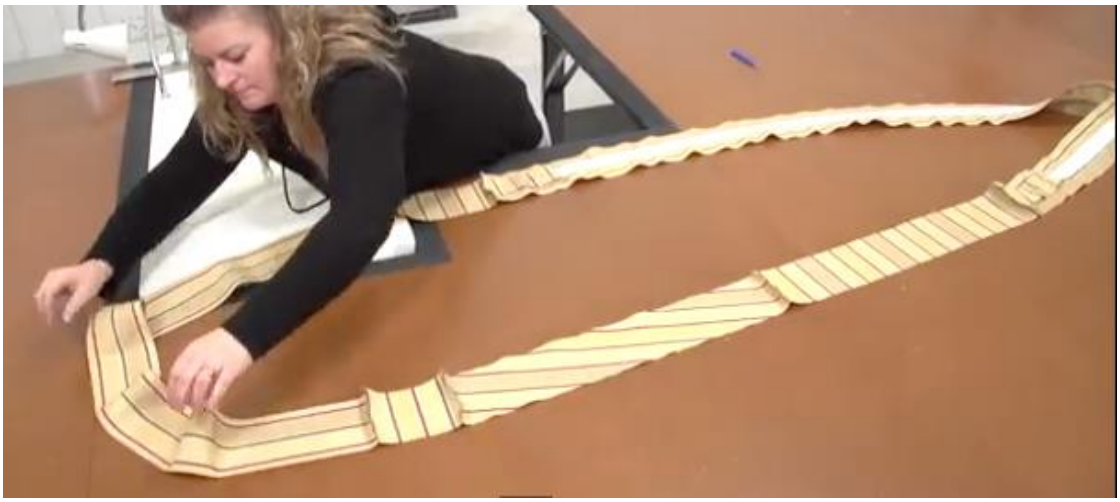
CHAPTER 8

Joining the Boxing and Plaque

Create a continuous circle by joining together all of the boxing and the plaque. To do this accurately, it must be decided just how long the plaque will be. Some prefer to run the plaque 2 inches or so round the ends of the cushion. Others like to end the plaque at the corners or even short of the corners by as much as 1/6 the length of the cushion's plaque side. Having decided just how long the plaque should be, cut it with appropriate edge allowance at each end (between 3/8 and 1/2 inch (9.525 to 12.7 mm depending upon edge finishing used — see below). Join the boxing and the zipper plaque end to end. Make sure that the zipper (or other fastener system) is closed all along its length except for the small opening in front of the slider which should be somewhere near the center of the plaque. Place the two strips of fabric "outer" face to "outer" face on top of one another. Run a row of straight stitches the edge allowance width inside their flush narrow edges (the zipper tape or Velcro will actually extend out beyond these flush edges because we cut it a couple inches long and centered it on the plaque). It is a good idea to turn the machine's balance wheel by hand when going over the zipper teeth so the needle can be guided to relatively open places — hitting a zipper tooth directly can break a needle. Reverse the machine over the zipper so there are at least two stitches holding everything together. Unfold this assembly. An optional topstitch can be run next to the joint with the edge allowance (and zipper or Velcro) folded up against the boxing side. If the topstitch is used, it will be visible in the finished cushion so choose the thread color carefully.

Continue as above to close the entire boxing circle. Seam allowances can be folded either way except for the plaque ends where they will be folded back on the boxing. The final stitches will link the end of the boxing to the opposite end of the plaque. You will notice in the photo below that the pattern changes direction several times. There is nothing wrong here. Indeed, the bias boxing segment actually continues the pattern on the top plate — it was intended to do that. And the lengthwise pattern on the two long sides was also intentional since it saved several seams in those boxing lengths and the pattern "mismatch" would not be visible. Even so, the norm is to make pattern run up and down consistently in all boxing and that is the way the calculator will present it.

Some prefer to hide the zipper slider in a pocket at both ends of the plaque. This can be done by increasing the length of the boxing by 2 inches (50.8 mm) over that determined above. Then, after the boxing ends are sewn to the plaque ends, fold 1 inch (25.4 mm) of boxing up over the plaque slit at both ends and sew the fold in place with stitches along the edges of the plaque (to keep them out of sight in the edge allowance).



The Boxing/Plaque Circle

As a final check, make sure that the boxing circle matches the plates. If there is an angle in a cushion side, it will be important to keep track of which side of the boxing is “top” and which is “bottom”. If the boxing is segmented, the corner seams should be exactly at each corner of the plates. If the boxing is continuous, the notches cut into the top and bottom of the boxing should match the plate corners less the edge allowance.

CHAPTER 9

Edge Finishing

There are four commonly used ways to finish the edges in a cushion. First, a simple seam can be used to join the boxing and the plates. as illustrated here.

A Seam Edged Cushion with Segmented Boxing

Second, a piping can be inserted in the seam (see below).

Using Piping to Finish the Edges

And, third, a French mattress seam can be used (in which case a plaque for filler insertion is not required).

French Mattress Seam Edges

The fourth edge finishing technique is just wrapping the fabric over a platform and stapling it in place.

A Platform Cushion

Each technique results in a quite different appearance. Choose one and proceed to the appropriate section below.

The Seamed Edge

Lay the plate right side up and put the assembled boxing/plaque ring over it right side down so the appropriate segments are facing one another. If a topstitch was not used in the ring, it will be possible to line up the segments by matching their lengths. If there is a topstitch, add the edge allowance when matching up where necessary. Accuracy is very important. It is a good idea to use double sided tape to baste everything in place before sewing. Baste one boxing/plaque segment at a time making sure that the segment begins and ends exactly on the beginning and ending of the plate side in question. Make sure that the basting tape is narrow enough to remain entirely in the edge allowance — it will collect dirt if not.

Using Double Sided Basting Tape

Run a single row of straight stitches exactly the edge allowance inside the two flush edges of fabric (the plate and boxing/plaque). The edge allowance will have been determined when plates were cut. It will range between 3/8 and 1/2 inch (9.525 to 12.7 mm). A magnetic guide can help keep this stitch exactly that width inside all round the cushion.

Using a Magnetic Guide for Accuracy

When the top plate has been secured all round the bottom plate is put down right side up and the boxing/plaque/top plate assembly is placed face down on it. The illustration below shows a bottom plate of special cushion underlining fabric — it breaths nicely and has a non slip finish that helps hold cushions in place. It is also relatively inexpensive so we recommend its use whenever it is unlikely that the cushions will ever be turned over in use.

Positioning the Bottom Plate

Now baste the bottom plate to the boxing/plaque just as above. Make sure that all the corners match up properly and then sew all round with the constant edge allowance stitch.

Finishing Edges with Piping

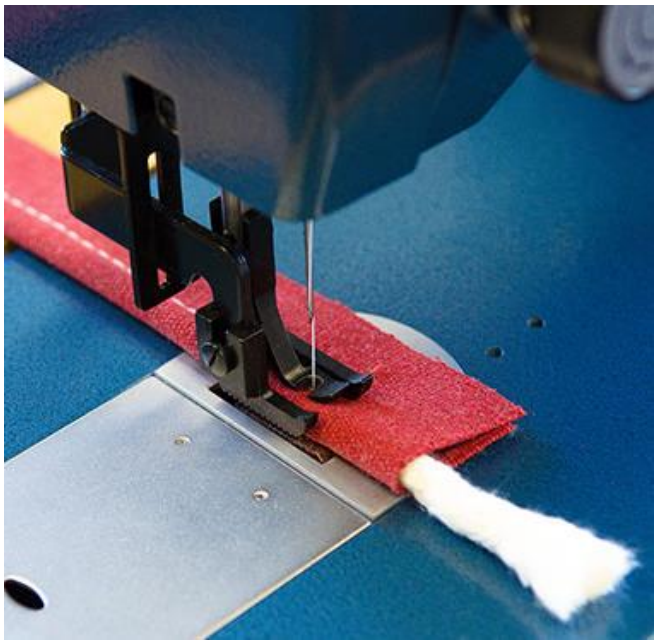
Piping is a prefabricated vinyl or a fabric covered cord (foam or fiber) that can be inserted in a seam to give it a more finished appearance. The prefabricated vinyl is available in a number of solid colors. But many prefer to make up their own piping.

If you decide to make your own, the box cushion calculator will indicate how much additional material should be ordered. Indeed, it will offer two figures: one for bias binding and one for binding on the grain of the cloth. In both cases the calculated number is based on the assumption that 2 inch (50.8 mm) wide strips of fabric will be needed. In fact this is usually more than will be required. More about this below.

Using a 2 Inch Swing Binder to Make Piping

What about using a “bias” binding as opposed to one cut on the cloth grain? Most dressmakers would insist on cutting their piping tape across the diagonal of the fabric. That makes the tape much more flexible because the nature of fabric is that it stretches a good deal more on the bias of the weave than it does on the grain. Since cushions make use of long straight lengths of piping so we seldom cut our tapes on the bias.

As indicated above, the size of the core will determine the width of the binding tape. Ideally, the width of the two “tails” of material that are left after encircling the cord should be the same as the seam allowance chosen for the project. If so, the layers of cloth can be kept flush as they are basted and sewn together. If the foam cord that Sailrite sells is used, a 1-1/4 inch (31.75 mm) wide tape is appropriate. It will yield about a 1/2 inch (12.7 mm) “tail”. Simply fold it in half over the cord and place a row of straight stitches right up against the cord using either a cording foot or a zipper foot in the machine Both Ultrafeed machines have cording tunnels built into the standard foot to enable a very accurate stitch positioned tightly against the cord. The cord can be fed directly under the presser foot as shown below. If a zipper foot is used, the foot will ride over the two thicknesses of the folded tape next to the cord and the needle will penetrate on the cord side.



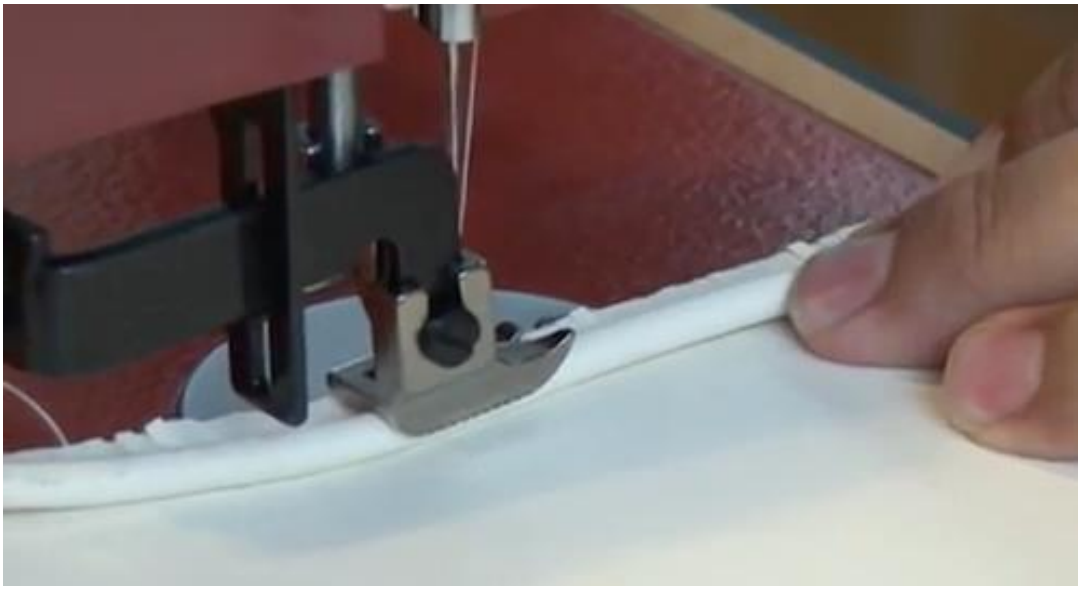
Using a the Ultrafeed Cording Foot

To join two binding tapes together end to end there are two techniques. If the fabric is patterned, place the two strips of fabric face to face so the pattern continues as it should. Then sew right across the width of the tapes at the continuation point. Trim the excess to a 1/2 inch (12.7 mm) seam allowance and fold it up against one side or the other. We described the same technique earlier with boxing. If the strips are solid color, a slightly less bulky joint can be created by placing the strips at right angles and running a straight stitch across the diagonal. When trimmed, the seam allowance can, again, be folded up one way or the other.

Fabricated and Prefabricated Piping

Finishing edges with piping is just like the seamed edge described above except that the piping is inserted in the seam. This can be accomplished in one step by matching the piping between the plate and boxing edges. The basting tape my not hold this bulky assembly securely enough. If so, staples can be used at intervals of a foot or so. just remember to remove them when done!

There will be less possibility for error if the task is broken down into two steps. First, attach the piping to the top side of a plate. Line up the "tail" of the prefabricated welt (end on it looks like a tadpole — hence the "tail" reference) with the edge of the plate (the seam allowance should have been tailored to match the length of the tail). Begin sewing the piping near the center of the side that will eventually have the zipper plaque. Leave about 2 inches of piping at the beginning unsewn.



Step 1 — Using the Tunnel in an Ultrafeed to Place a Straight Stitch Right Next to the Piping Bulge

It is always a good idea to sew clockwise round a cushion. This keeps the bulk of the material outside of the machine. Everything that follows assumes this routine.

Sew to the first corner and stop with the needle down about 1/2" short of the corner. Cut "eases" into the tadpole tail of the welt if necessary so it can be bent round the corner (the prefabricated welt already has eases which may be enough to permit a smooth turn. It is a good idea to operate the machine manually at this point making the turn slowly. Bury the needle and lift the presser foot of the machine to turn the work 30 degrees or so. Once turned, drop the foot and manually produce another stitch. Stop with the needle down and continue on in this manner to complete the corner. Make 90 degree turns as cleanly as possible but do not be discouraged if your turn has a small radius — it will look fine in the finished product as long as it is consistent.

Lift the Presser Foot with the Needle Down to Turn

Continue all round the plate in a clockwise direction. When just 5 inches or so short of the unsewn welt at the beginning, stop sewing and trim the end of the welt so the two ends are overlapped about 1 inch. Open the end of the piping tape a couple of inches to expose the cord inside. Match up the opposing cords and cut them so they meet end to end. Cut the tapes so they overlap an inch or so and wrap them over the cord. Sew the entire assembly together.

Cutting the Cords End-To-End

It should be noted that there are many ways to finish the final joint in the piping. But this one looks good!

If a piping is desired along the edge of the second plate, it should be attached just as we did this first one.

The second step in this process is, of course, to baste the outer side of the boxing edges in place carefully so each segment or V-cut is matched to a corner. The assembly is finished with another row of straight stitches directly over the first with a zipper foot or a cording foot. Accuracy here is very important. The stitches must be exactly the edge allowance inside the edges of the fabric assembly. If they are too deep, the boxing will be shortened relative to the plate. If they are too shallow the boxing will become too long.

The French mattress seam

Finishing edges with the French mattress seam creates a cushion with more definition. The edge allowance, instead of being buried inside the cover, is exposed all the way round the cushion.

An edge allowance of 0.875 inches (7/8 inch or 22.2 mm) is required to fashion this seam.

Start just as though a seamed cushion edge were in play. That is make up the cushion cover inside out, just as we did with the seamed edge above, with a seam all round just 3/8 inch (9.5 mm) inside the plate and boxing edges:

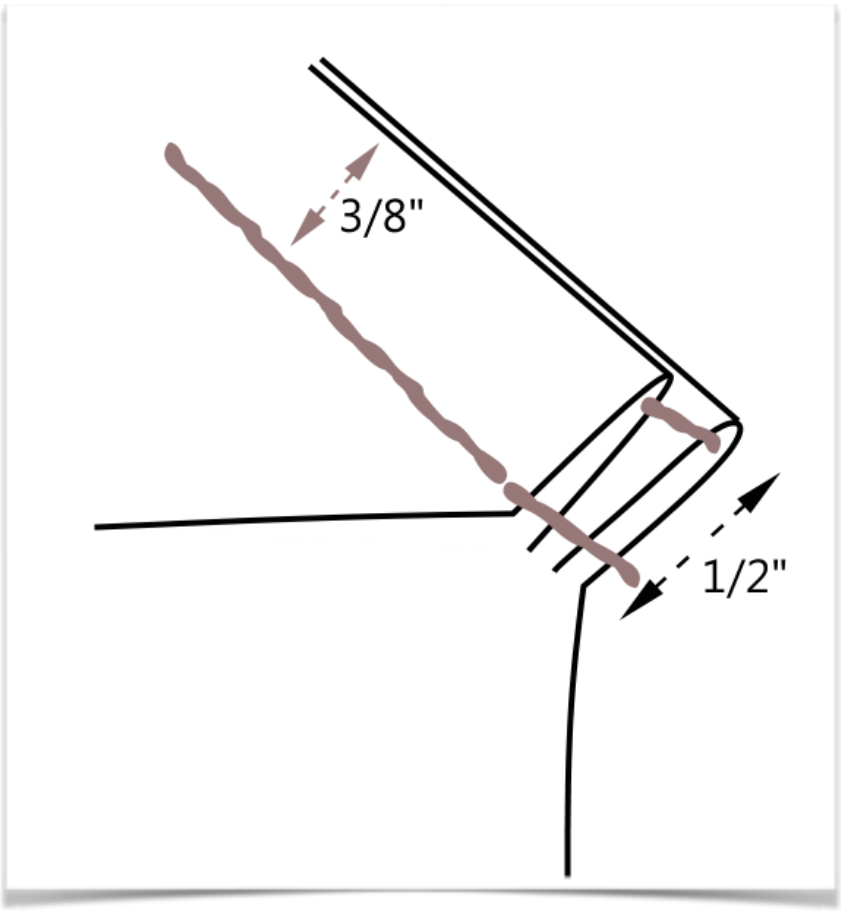
1. If the boxing is segmented, join the strip for each side end to end with its neighbor using a 1/2 inch (12.7 mm) edge allowance. If the boxing is continuous, make sure that there are

notches cut in it at each corner point of the boxing top and bottom. Use these notches to keep the continuous boxing properly matched all along its length in step 2 below.

2. Then, using the same 1/2 inch (12.7 mm) edge allowance, sew the boxing to the plates.
3. Leave about half of one long side unsewn so the filler can be inserted.
4. Then turn the cover right side out and force each seam line out to its crease. Run a line of stitches 3/8 inch (9.5 mm) inside the crease along each edge (except for the opening in one edge). If the boxing is segmented, do not sew all the way to the corners — that would require sewing over edges that should stand proud. Stop roughly 3/4 inch (19 mm) from each plate corner. Use a short backstitch at beginning and end to lock everything in place. If the boxing is continuous, this stitch can be run all the way round both plates.

The Final Stitches End Just Short of the Corner

5. If the cushion has segmented boxing, run similar stitches along each boxing corner edge 3/8 inch (9.5 mm) inside the crease found there. Stop short of the actual point at each corner top and bottom by a distance of roughly 3/4 inch (19 mm). Use a backstitch to prevent the stitch from raveling.



A Cross Section of the French Mattress

The stitches in step 4 and 5 will be visible so choose a thread color that looks good.

Insert the filler through the half length opening that was left unsewn along one side (see the chapter below for more on inserting the filler). Once the filler is in place, close the opening with a single line of stitches. There will be four layers of fabric in the fold. Just extend the fold that was initiated above. Use pins or a stapler to hold everything in place prior to sewing it. This stitch can be difficult with the firmer foam fillings. It will be hard to get the fabric under the presser foot. If necessary, it is perfectly OK to close the opening by hand with a needle and thread.

The Platform Cushion

Here a board replaces the bottom cushion plate. Two inches of extra material are added to the boxing so the fabric can be stretched over the board and stapled in place. The board will usually be slightly smaller (a quarter inch or so — 6.4 mm) on each edge than the foam filler. This will prevent a hard edge when the material is stretched in place. The Duo-Fast EIC-3118 electric stapler from Sailrite illustrated below is a wonderful tool but about 10 times more expensive than an Arrow or Stanley spring powered stapler from the local hardware store and these tools will work just fine.

Stretching Vinyl Over a Platform

Staple insertion and placement is not critical. We like to start with staples at the center of each side followed by staples splitting the remainder on all sides. Then work on the corners. Finally fill in open areas so staples are roughly an inch (24.5 mm) apart.

The Initial Staples — More Will Follow

CHAPTER 10

Filler Insertion

Fold the filler in half and insert it into the open cover. Once it is partly in place flatten the foam and reach inside to tug on the far corners and the far side to nudge the foam deeper into the cover. Be patient. It may seem that the foam just will not fit, but, once the job is done, the cushion covering will be properly filled.

To simplify the process, a piece of the light weight plastic used by dry cleaners to protect clothing can be used to aid the insertion process — it can be removed after the foam is in place. Or "silk film wrap" can be ordered from Sailrite and left in place to provide moisture protection or removed and saved for future use. If DryFast foam is used, it is best to remove the silk film to encourage drainage.

The Hose Has Been Removed — The Foam Is Much Smaller than the Pocket

In either case simply wrap the filler loosely with the film. Insert a vacuum cleaner hose into the wrap and turn it on. Depending on the density of the foam, the volume will be reduced by from a quarter to a half. It should be noted that closed cell foam is an exception. It compresses very little.

A Batten Wrapped Polyurethane Foam