

Sewing Seats



By Dennis Wolter

So there are your seats – all fixed up, foamed, painted and sitting on the work bench staring at you right in the face. What to do next? Not to worry, you have options. Here's my plan. I will explain how we sew seats here at Air Mod, and teach the do-it-yourselfers how to sew the seats and side panels. If you can do seats, side panels will be a piece of cake. I plan to deal with Cessna headliners, all three types of them, as a separate article.

Of all the various tasks involved in aircraft interiors, I think the most skill demanding one is definitely the sewing of the seats. Next time you're at Oshkosh, check out the interiors in some of the homebuilts and you will see some beautiful metal work, painting, instrument panels and side panels, only to be disappointed by poorly sewn and ill-fitting seats. For the do-it-yourselfer, don't expect total success on the first try. This whole sewing process can be a difficult skill to master. Be prepared for some rework, but if you stick with it you'll be amazed at how much you can accomplish.

For many of you the sewing part of the interior renovation process may be beyond your technical capability, time allotment, or inclination. In this case, I would suggest checking out some car show and air shows, find out who in your area is doing good car interiors, or ask home builders who helped them with their interiors. Believe me, these hot rodders and home builders will know. Employ these artisans to sew and mount your seats and side panels.

If you are going to do this yourself, here's how it's done. First, you will need a proper sewing machine. It is unrealistic to plan on using your home machine. Home sewing machines have only one foot to advance all those thick layers of material through the sewing head. Also, the lift-and-stroke of these home machines is too short, making it difficult, if not impossible, to pass those materials through the sewing head. This also

results in too many stitches per inch and, since each stitch is a hole, you will end up with a very weak seam much like a perforated check in a checkbook; it will eventually tear loose. This type of work simply cannot be done on a home sewing machine.

What you need is a walking foot, needle feed commercial upholstery sewing machine. They are quite expensive if purchased new, but can be acquired used for \$500 to \$700. Make sure you buy an upholstery machine where the upper foot and needle and the lower foot move simultaneously to advance the heavy material through the machine. Commercial dress and drapery machines look very much like an upholstery machine, but do not have this feature and will not do the job. The two most common walking-foot, needle-feed machines available for this purpose are a Singer 211 and a Juki LU562.

For those of you handy enough to attempt this part of the interior renovation, the rest of the tools and talent needed are pretty obvious, and will be covered as we progress through this series. If you live in a larger town or city, you probably have an upholstery supply house close to you that can be a good source for equipment and

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The business end of a walking foot needle feed machine. All this stuff moves with the material being sewn.



Eight Layers of finish material, backing foam, and fabric. Note the nice wide stitches - strong and durable.

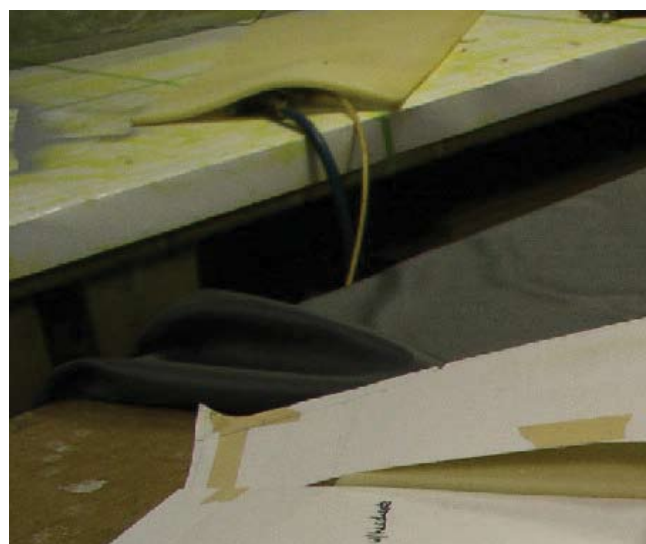
Renovation

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information.

In this month's installment, I'm going to show you the techniques we use to create ergonomically correct, aesthetically appealing and durable seats. Some of the steps we incorporate into our seats could be left out and the seat will still look darn good at delivery, but over time you can end up with premature failure or deterioration. If you are doing this work yourself, be perseverant, stick with it and try to follow all of the steps. I'll give you some tricks as we go to help you attain good results. I'd like to stress again how important it is to use an industrial sewing machine. It is key to success.

Costs being what they are, it's important to first buy enough material for the entire job, including some allowance for a mistake or two. You should have enough left over for future repairs (maybe a yard each of fabric or vinyl and a half-hide of leather). Aviation-approved materials are constantly changing and can become discontinued even before your project is completed. If you're a novice, it's a good idea to buy



Patterns being fabricated on a Cessna seat back.



Efficiently laying out patterns on the raw material.

a yard of non-aircraft scrap vinyl or cloth for practicing difficult stitching or fitting before you use the more expensive treated aircraft materials. A penny spent can be a dollar saved.

We usually buy about five 40-50 square foot hides of leather for a four-place Cessna interior, obviously more for a six-place airplane. This allows for a 10% loss for cutting out leather defects and the half-hide leftover allowance for possible future repairs. If the interior is to be done in a combination of fabric and vinyl we will probably order six yards of cloth and eight yards of vinyl (these quantities can change depending on seat design and the respective usage of fabric vs. vinyl). Barring any major mistakes, you should end up with the suggested extra for future needs. Some patterned materials may require additional yardage to allow for proper pattern alignment. While we are on the subject of materials, we usually buy somewhere between a 12x6 or 12x8 piece of carpet and three or four yards of headliner material.

The first step in seat sewing is to lay out the materials. The gals in the sewing room like to make a set of patterns

to help them organize the layout and cutting of materials. This reduces material loss and mistakes. Heavy paper or thin cardboard patterns are laid out and trimmed to meet the various contours of the seat shapes; use something about the weight of a file folder. Then the patterns are placed on the raw material in such a way as to most efficiently use the material and/or work around leather defects. These patterns are cut to the exact shape of the section of the seat they are to fit plus 1/4" seam allowance. This small overhang past the stitch line is necessary for the material to properly pass through the sewing machine head during the stitching process and also to

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Temporarily staple the seat together to help hold the panels during the sewing process.

give the component strength once it's sewn. If you sew too close to the edge of the material, the cloth will unravel and vinyl or leather will tear loose at the stitch. We also double stitch the seams, and over the past thirty years have experienced no seam failures with this technique. Just flip the material over and re-stitch the other way.

It's a good idea for someone sewing for the first time to allow as much as 3/8" for a seam allowance. More allowance means more control of the stitch. Also for the first timer, there is another advantage to having a slightly more generous seam allowance. You can actually staple the seam to help hold the several layers of material together during the sewing process. It takes a little more time but it sure makes it easier. Don't forget to pull out the staples after the seam is completed. They will surely work their way to the surface if you leave them in – ouch!

Before moving on, I want to discuss the three most common types of seams used to sew seats. How the seams are made not only affects how the seat will look, but also how long it will last. If the folded edge of material and thread are exposed to sunlight and wear, the durability of the seam is affected. So here's the good and bad of the seam game.

Single stitch

This is the easiest and fastest seam used. One simply brings both materials together under the needle. No cording, no double-stitching. It's fast and provides a clean seam, with moderate exposure of the folded material edge and stitching to sunlight and abrasion.

Top or french stitching

This method involves first making a plain stitch as described in the previous paragraph, then fold the selvage or cut edge back on itself and carefully top stitch the material on both sides and parallel to the single stitch seam. We apply a reinforcing tape on the back side spanning both sides of the cut edge to add extra strength to the seam. This gives a very nice looking finished appearance to the seam, but it is the least durable way to sew a seat. All of the french-stitched thread and the folded edge of the material are fully exposed to sunlight and abrasion.

Cording

Last, but certainly not least, is the good old cording seam, the most durable way to sew a seat. This method employs the use of cording, made by folding a 1" wide strip of finish material (usually leather or vinyl) around a 5/32" foam cord that is single stitched to become a flanged cord. This cord is then placed between the two materials. Once sewn together, the cord provides complete protection of the stitching and the folded edge of the upholstery material, eliminating exposure to sunlight and abrasion. If, after a long period of time, the cording begins to show signs of wear, the seam can be carefully cut open and the damaged cording replaced with new.

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Once the edges are worn on a seat with straight stitching or french stitching, the entire panel of material must be replaced. The material will have worn through at the edge, or the thread will have failed. Re-stitching will only make unsightly new holes right over the old ones, a real compromise.

A word about thread. Upholstery thread is available in four types: cotton, nylon, polyester, and Dacron. Without question, the most durable and strongest is Dacron with polyester finishing in a strong second place. If you are considering top stitching, use dacron or polyester. The other two will more quickly fade and degrade in sunlight.

By now you've noticed that every seat section has backing foam and backing fabric bonded to it before being sewn together. These backing materials perform three functions. First,



Top- or french-stitch seam. Looks great but not the most durable.



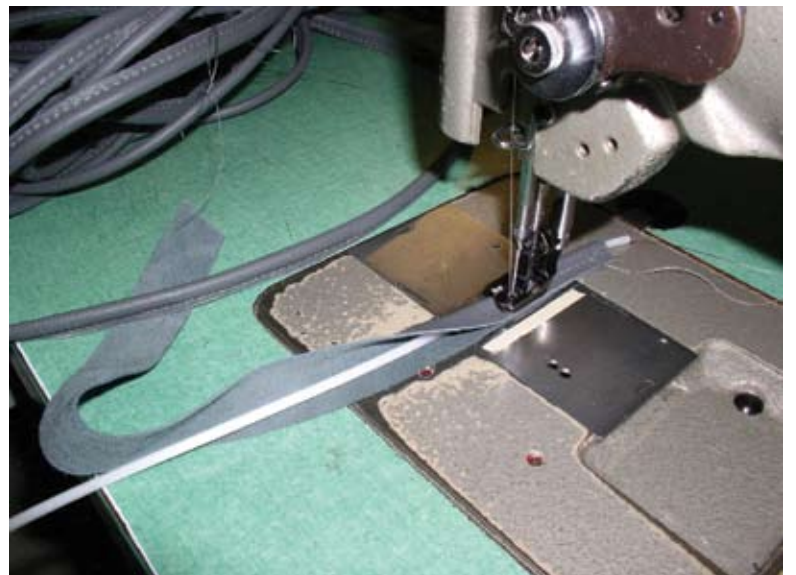
Single stitch seam.

fold the material together on the line of the top stitch, finished sides facing each other. We then run a second parallel line of stitching on the back side of the material about 1/8" from the folded edge. When unfolded and viewed from the finished side of the material, the pleat looks as though two separate pieces were sewn together, giving a more defined design line in the upholstered panel. Not only does the pleat look better, but the thread is hidden between the two joined materials and therefore protected from sunlight and wear, enhancing durability. We typically use this folded pleat method on seats. The material thickness created by the folding process makes for an awkward appearance when the pleated panel is bonded to a hard surface such as a side panel. For that reason, we usually use plain, top stitched pleats for side panels.

The final concept to discuss before the cutting and stitching begins is how to structure and secure the finished cover to the sculpted foamed seat shape. Once an ergonomic seat shape is created, we are challenged with the task of applying an aesthetically appealing assembly of soft finished materials

they help to eliminate wrinkles, and one of the hardest things to achieve in seat upholstery is a sculpted seat shape with no wrinkles. Second, the light density foam imparts a softer, more plush feel to the seat surface. Third, these materials provide a smooth look, adding just enough dimension and an extra measure of fullness when the finished cover is mounted on the seat.

Now that we know how to stitch the seats together, let's talk about pleating. Pleating refers to the process of sewing a non-structural, decorative stitch for the purpose of adding design detail to an otherwise plain panel. There are two basic ways this type of stitching is done. The first and most common is to simply top stitch through the finish material, foam and backing fabric, resulting in the thread showing on the surface of the finished pleated component. The beauty of this method is it allows total freedom of stitch pattern and provides a nice relief and appearance. The second method of pattern stitching is the folded pleat method. First, a single top stitch is sewn as just described. We



Fabricating cording.

to a complex, compound-curve shaped foam form. What this techno-speak means is that the seat isn't flat, and we need to devise a way to securely hold the finished cover to the complex seat form, particularly at low points. The best way to do this is to sew canvas loops into a pleat or panel seam at the location of a low point in the seat. A stiff steel wire is run through the loop of canvas and bent back on itself at the ends to keep it from working its way out



Corded seam. Looks good, wears well and is replaceable.

of the canvas loop. Several lengths of Dacron rigging twine are tied to the wire. These pieces of twine are poked through the foam and seat sling before we pull the sewn cover over the seat. After the cover is pulled over the formed seat, the strings are carefully pulled and tied off to the frame, adjusting the pulled-in contours of the finished seat cover as we go, much like pulling puppet strings, until we create just the right contour and a wrinkle-free sculpted seat.

Of equal importance to the aesthetic beauty of this contoured seat is the structural connection achieved through this rigging system between the upholstered cover and the seat frame. Every time you get out of the seat it is pulled back to its designed shape by all of this structural interfacing. We have tracked countless seats constructed this way that have been in service since the '70s, and thanks to good materials, proper fitting, double stitching and all of this rigging, they still look as good as the day they were first done. Many shops use glue to hold the seat cover in place. It might look good at delivery, but it won't last!

With all of this theory covered, and all your seat materials cut out and backed with foam and backing fabric, it's time to start sewing it all together. To make things simple, let's assume we are using the corded seam method. To

properly sew cording, you will need to use a cording foot. It allows the sewing machine to hold the cording and mating materials close to the needle for more precise control of the stitch. Sounds difficult, but practice makes perfect. You will get the hang of it.



Plain top-stitched pleats, used mostly on side panels.

For those attempting to do the sewing yourself, I suggest that you practice with the surplus material you bought, fabricate some cording and sew together a sample that replicates the actual assembly you will have in your final pieces. This will allow you to develop the skill needed to properly sew the various components together without risking the expensive aircraft materials.

With your practice panels finished to your liking, I would next sew the cover for a small, easy-to-sew component in the airplane like a baggage door cover.

(See: Renovation, pg. 40)

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Folded pleats look good and protect the thread from sunlight and wear. Should definitely be used on seating surfaces.

If you make a mistake, you won't be damaging much of your expensive material. Also, flat surfaced panels are easier to deal with, and the more confidence you feel when you take on the challenge of sewing the seats, the better. After sewing a couple of smaller side panel pieces, it's time to get the hang of sewing a cover for a compound shaped seat. Again, small steps first. I would start with an armrest or a headrest. If you screw up you won't be ruining that much material.

With a headrest patterned, cut, and backed with foam and fabric, lay out the facing and side panels. Index and mark with chalk exactly how they are oriented to the shape of the foam. If cording is being used, sew the cord to the side panel of the headrest first. Next, use the indexing marks to properly align the side of the headrest to its face panel and staple the two together. Now it's time to carefully run a stitch close against the cording (remember the cording foot). Use only pencils or chalk to mark your materials. Pens and markers can bleed through.

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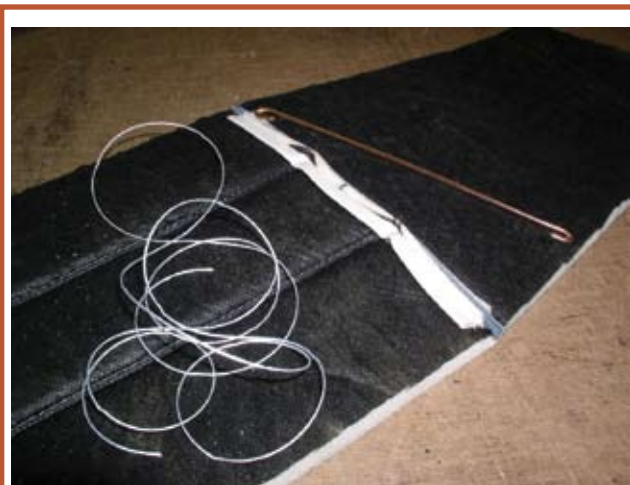
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At this point, don't forget to take advantage of the double-stitching step we described earlier. With the headrest (or armrest) now sewn, remove the staples and turn it right side out and pull it over the foamed shape. If it's too loose, either cut it down and re-sew it or add foam to the headrest. Never stuff loose filler

material between the cover upholstery and the foam. It will shift around over time and the entire piece will look bad.

Sewing upholstery is a skilled endeavor, the full explanation of which goes far beyond the scope of this article. However, if you adhere to the basic concepts presented here and use the old upholstery as a technical guide, you can do it. Your old upholstery can be a great tool. Study how the stitches were made and the components were assembled. It's how I taught myself to sew thirty-some years ago.

I know I've again probably told you how to build a watch when all you wanted to know was the time. Remember, I'm trying to write this stuff for readers doing an interior on all levels. For those who have no intention of ever sewing a stitch, you will be relieved to know that sewing school is almost over



Canvas loop, steel rod and rigging twine. Adds up to a good looking long-lasting seat.

and we will shortly see how to assemble and mount a seat.

Sewing the seat starts with assembling the face panels. Pleated sections are done first, and mating panels are sewn together with a structural pull loop sewn in where needed. Then the adjoining side sections are sewn in place. Next, the



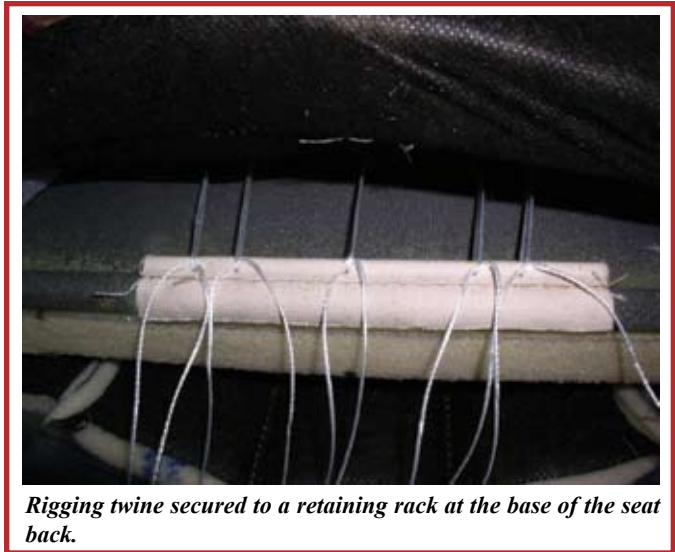
Two-piece cording foot.



Sew the center panels of the seats first.

cording is sewn on to the seat facing panel and the seat side is stapled in place and then sewn to the seat facing panel. Finally, each seam is flipped over and sewn from the opposite side, creating the double stitch mentioned earlier – good insurance.

The staples are removed, and we now install the retaining rods and rigging twine. At this point, the finished cover is ready to be mounted on the foamed seat. With the seat cover



Rigging twine secured to a retaining rack at the base of the seat back.



An unsecured seat map case pulling at top corners.

elastic seam from deforming the edge of the seat back (how many times have you seen that in the field?). Often a seat frame is either too small or the wrong shape to properly accommo-

(See: Renovation, pg. 42)



Sewn seat back with the rigging in place.

inside out, poke the rigging twine through the foam and seat sling. Then lightly tie the lines to the rack that is secured to the seat frame. The cover is then turned right side out and pulled over the foamed seat frame. Now pull the rigging twine through until you get the precise seat contour you desire and all the wrinkles are out of the seat. Secure the rigging, stand back and take pride in a job well done.

Well, almost done. There is one other seat detail to discuss. It is very important to physically secure the upper corners of the seat back map case to the seat frame. This will prevent the



Aluminum tab that properly secures the upper corners of a seat back map case.

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Twelve years in service, and no sign of the map case pulling the seat material.



All of the details add up to durability and beauty. This seat is twelve years old – no sags, no wrinkles.

date this needed fastener. In this case, we rivet a mounting tab of .050” aluminum to establish a good attachment for the map case. Trust me, a map case cannot be properly secured by thread alone.

While all of the above seat activity was going on in our sewing room, the technicians in the hangar were quite busy preparing and modifying the side panels for their run through the sewing process. Sounds like a good topic for next month! See you then – and fly safely!

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