

Finishing Up: Shoulder Harnesses and Carpeting



By Dennis Wolter

Well, we're finally on the home stretch. The final hands-on interior renovation topics to be covered are passenger restraints and carpeting. Our wrap up article next month will be on everyone's favorite subject – paperwork. Yes, even your interior improvements require paperwork.

Those of you who have dealt with “Dennis Wolter the salesman” know that I’m not a high-pressure, get-a-commitment kind of guy. That said, most of our Cessna customers will probably remember my trying to convince them to install the front seat BAS three point inertia reel shoulder harnesses (ph 360-832-6566). If anything will enhance safety in your airplane, it's this restraint system. In my opinion the four most important components in the safe operation of your aircraft are good training, good maintenance, responsible “go” or “no-go” decision making, and shoulder harnesses.

In my younger days, I worked for an aircraft metal repair shop. We would often head off to some field or woods to recover a wrecked airplane. In a very short time it became graphically obvious to me that two airframe-related issues have a tremendous effect on the outcome of an off-airport landing.

The first issue is the structural integrity of the cabin. Cessnas really shine in this area. With a high wing airplane, a lot of structure is needed between the wings and the landing gear. That means that those massive forward and rear door posts have to be hefty enough to absorb landing loads, not just flight loads. This substantial structure is around the cabin, so Cessnas effectively have a built-in “roll cage” that protects the occupants even if the airplane is inverted. Let me tell you, these things are tough. We recovered several upside-down Cessnas during my time at that shop, and the only known injury was a scratch received when a pilot got his pants caught on a barbed wire fence while walking



Forward doorpost – the heart of Cessna structural integrity.

to the farmhouse to call for a ride home.

The second big player in off airport landings is a good shoulder harness. These Cessna airplanes are as tough as they come. Unfortunately, the occupants are, shall we say, not as likely to damage the airplane as the airplane is likely to damage them. The idea here is to keep your torso and head from impacting something hard. An added challenge is the potential for a control column tube to be shoved aft toward a front seat occupant as the firewall collapses. A good shoulder harness will go a long way to keep you out of that confrontation. Keeping your head and face out of the panel may add to the unemployment statistics of the maxillofacial surgeons in town, but we'd rather have you walk away from that incident.

Many of you are already flying with original Cessna fixed diagonal harnesses. Any harness is better than none. However, a “Y” shaped harness that supports both shoulders symmetrically is a vast improvement over the diagonal type. Most rapid stops are such that the decelerating vector of energy attenuation is forward and down. This vector of energy pushes you forward as your spine is compressed by a proportionate downward force. If only one shoulder is being restrained, your torso can twist at precisely the same time as an increased “G” load is put on your lower spine. There's a central nerve column and center located in your lower back and pelvis area. Compressing and twisting this delicate stuff can cause serious neural damage, resulting in the loss of leg function. (Can anyone say Ercole pilot?) Having both shoulders restrained will go a long way to prevent this twisting situation. With the added benefit of an inertia reel, it's easy to see why I like this system so much.

One additional consideration



Comfortable fit and optimal protection with a BAS three-point inertia reel shoulder harness.



Not a good fit (this obviously isn't my senior picture from high school).

with diagonal harnesses is the upper body, vertical center of gravity issue. I can certainly say that my upper body vertical center of gravity has definitely shifted since I first started flying decades ago. What this means is that the diagonal shoulder harness tends to sit higher on my torso than it did years ago. Who remembers when their chest measurement was greater than that of their waist? By

sitting high on the upper torso, the strap can be close to resting on your neck, possibly leading to neck cuts. Also, with the harness strap situated so high above the abdomen, you'll have a greater tendency to tunnel out and under the harness.

The final issue to discuss is comfort. An inertia reel will ensure that the harness is always in exactly the right place for proper restraint and still allow for freedom of movement. With



A BAS shoulder harness, all finished out and ready to go in a 172M.

a fixed harness you must often remove or loosen the harness to switch a fuel tank or pick up something from the floor. This presents the possibility of forgetting to re-secure your harness, and it won't help you in time of need.

The installation and trim-out of BAS inertia reel shoulder harnesses usually takes approximately six hours. Most systems cost around \$1000 for the pilot and co-pilot set, with your choice of 40 colors of webbing. So for about \$1400 you can access a tremendous amount of safety; sounds like a good investment to me. The most important thing to know about safety enhancements to your airplane is that you can't write

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Inertia reel mounted to the aft spar carry-through structure in a 182.



Factory installed diagonal shoulder harness mounting point in a Cessna 180.

the check on the way down. If I pressure you to buy anything, it's definitely going to be good shoulder harnesses.

The inertia reel is attached to the rear spar carry-through with two structural screws located through the upper flange of the carry-through. A third 10-32 structural screw secures the aft side of the mounting bracket to an existing nut plate. Cardinals and strutless 210s are slightly different but similar in installation.

One final note regarding Cessna singles. Your old pilot and co-pilot fixed shoulder harnesses can be re-webbed, re-sized and installed for your two aft seats for under \$200. After 1970, Cessna installed the necessary mounting points in almost all of their high wing airplanes. Such a deal!

Wing mounted twin-engine Cessnas present a very different shoulder harness situation. Due to the fact that they are low wing airplanes, there is no strong spar carry-through in the upper cabin areas. The current harness systems available for these airplanes are the diagonal type that mount to either existing or Cessna kit-installed hard points. These hard points are riveted to a strong point where a cabin top bulkhead meets a window or door frame. This situation dictates that only a diagonal shoulder harness can be installed. For increased convenience, comfort, and safety, inertia reels can replace the fixed ones.

Before leaving the subject of passenger restraints, I would like to make a couple of additional points. We (and I hope other interior shops) thoroughly check these installations for our interior customers. We often find missing or incomplete spacers or non-aircraft hardware holding this critical stuff in place. You should very carefully inspect

the mountings and hardware of your existing seat belts and shoulder harnesses. Consult the parts book for the proper bolts and spacers. Aircraft hardware is manufactured to a very high standard and is substantially stronger than what can be purchased at your local hardware store. The wrong stuff here can be fatal – literally.

The other thing I would advise to do is inspect the belts and harnesses themselves for severely faded, frayed, or cut webbing. Look closely at the stitching; it should be neatly done, with heavy gauge thread and stitched at about ten stitches per

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Check this bushing. Very important!

inch, with no looseness, fraying or breaks in the thread. And be sure there is a proper certification tag on the belt. No tag, no fly! The FAA, for good reason, considers passenger restraints and their mounting as primary structure. No modifications are allowed without an STC or field approval, and that means a proper FAA 337 form covering such an installation.

The final point of concern is the standard attachment common to the factory diagonal shoulder harnesses. Often the durlon bushing that holds the shoulder harness end into the lap belt fitting is worn. If you don't feel a positive click when locking the shoulder harness into the lap belt fitting, have an A&P mechanic check it out. About half the Cessnas we get in our shop for new interiors have severely worn shoulder harness latch post bushings. If any re-webbing or hardware repair is needed, we'll use C & M Marine for this work (ph 214-654-9270).

Well we are finally down (literally) to our last hands-on interior project, that being carpet. Carpeting is available in many different types of pile, weave and backing. The two most common types of aircraft flame-retardant (FAR 25.853a) carpet pile are nylon and wool.

Nylon is less expensive, slightly lighter in weight, and somewhat more moisture tolerant. The down side of nylon is that it is more difficult to flame proof and is prone to sun fading. Nylon pile carpet can be either synthetic backed or jute backed (hemp). Synthetic backed nylon carpets are definitely less prone to shrinkage and mildew if exposed to moisture.

Wool carpet is more plush looking and feeling, more fade resistant, easier to flame proof and available with either a synthetic or jute backing. Due to its dense pile, wool carpet is heavier than most nylons, so a 4 to 8 pound weight increase in your aircraft should be anticipated. Most wool carpets cost twice as much per yard as nylons, but you get what you pay for – they last longer. We see 20-30 year old wool carpet installations that are still going strong (can you tell I prefer wool?).

Installing new carpet presents a great opportunity to enhance the function and maintainability of your airplane. We plan the cutting and installation of the new carpet with the goal of making it look better, have it be more securely attached to the floors but easier to install and remove, and designed to allow for quick access to floor inspection panels.

The key to attaining these benefits is the use of hook & loop (velcro). Properly used velcro allows the carpet to be installed in multiple smaller pieces. Designing these pieces so they can be removed without taking out the seats is a great idea. Making baggage floor carpets as separate pieces means that a wet baggage section can be removed and dried outside the airplane. Easily removable main cabin floor carpets allow you to conveniently throw those sections into the baggage compartment on a day when you have mud or ramp tar on your feet. It's definitely easier to wipe that mess off a metal floorboard than it is to clean your expensive carpet. And it's a very good idea to take the airplane in for maintenance with the floor carpets safely stored in your hangar.

Hook & loop, however, isn't all a bed of roses. Improperly installed, this stuff can be a nightmare. The key to success is proper bonding to the floors, and both bonding and stitching it to the carpets. Over the years we've tried various brands and

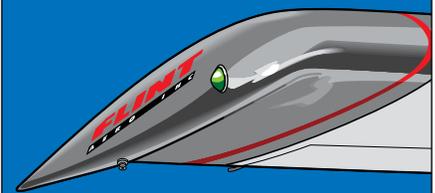
have concluded that the best brand is 3M Pressure Sensitive Adhesive (PSA) self-stick.

We always bond the soft loop to the airplane and the hard hook to the carpet. This eliminates having the grabby hook exposed to catch your clothes and hold dirt when the carpets are removed. Successfully bonding velcro to the floors is all about cleanliness and surface preparation. Since we've already antiseptically cleaned and allodined the floors before chromating, we mask the areas where the velcro will be attached before

chromating. Once the zinc chromate is dry, we remove the masking tape, leaving a clean allodined surface. A better bond will occur to allodined aluminum rather than chromate. We apply a thin coat of fresh contact cement (3M 8410) and allow it to dry for an hour. This is a super primer for the PSA adhesive, and will ensure a permanent bond.

Another trick is to round the corners of the floor mounted soft-loop velcro. This greatly reduces the possibility of the corners peeling up. Always cut around screw mounting holes. Some

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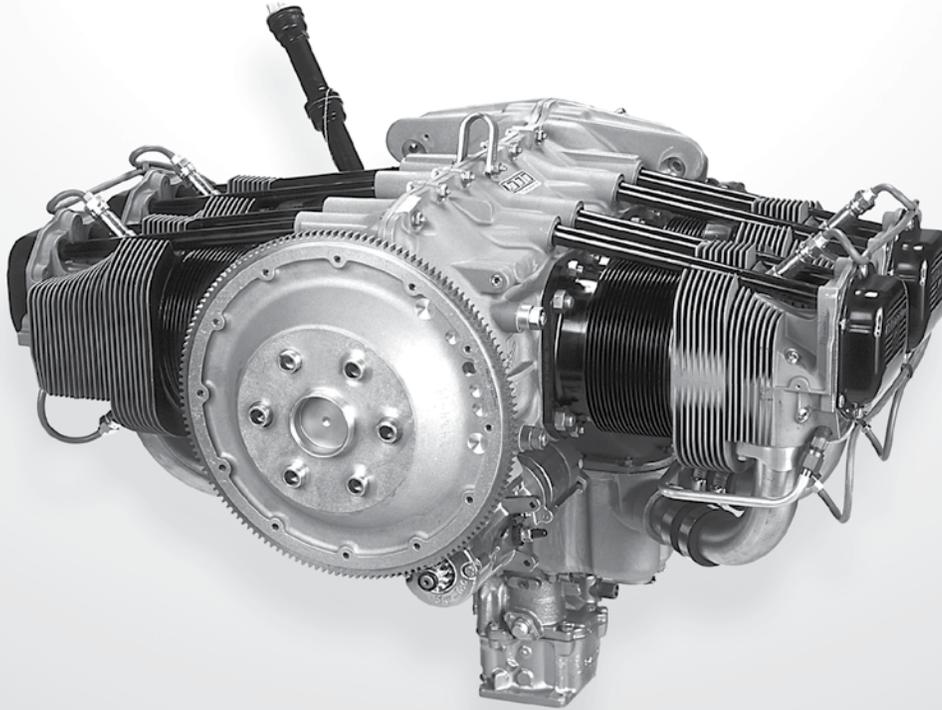
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Having separate carpet sections means the main floor carpet can be removed without having to remove the aft seat.



Easily removable baggage carpet in a 172.

of the floor panels in Cessnas are structural, and screwing through soft velcro will compromise structural strength. To ensure a thorough bond of the velcro to the floor we use a hammer to push the velcro onto the contact cement primed floor. Works great!

Moving on, we next attach the hook velcro to the rough backing surface of the carpet pieces that have been serge-bound with a loop serger (more on serging later). This gives us a durable, repairable and versatile edging for those often complex shaped carpets. To secure velcro to the serged carpet, we first apply a thick coat of contact cement to the back side of the carpet. Again we allow the glue to thoroughly dry for an hour or

so. We then stick the PSA velcro to the backing, locating it so that the outer edge of the velcro is approximately 1/8" over the inner edge of the serging. With our hammer we smash the velcro and glue together from the top side of the carpet, establishing a strong bond between the two surfaces.

As an extra measure of adhesion insurance, we then sew the velcro to the carpet by running a stitch right along the existing stitch line that was created by the carpet serger. This stitch is invisible from the top side of the carpet and ensures that the velcro will never come off the back side of the carpet.

The last step in carpet fabrication is to apply a 1/2" layer of sound attenuat-



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Properly secured velcro near an inspection panel on the floor of a 210.



Firmly pressing down the floor velcro – a hammer works great!



Masking the back of the carpet to neatly apply the spray glue for the velcro.

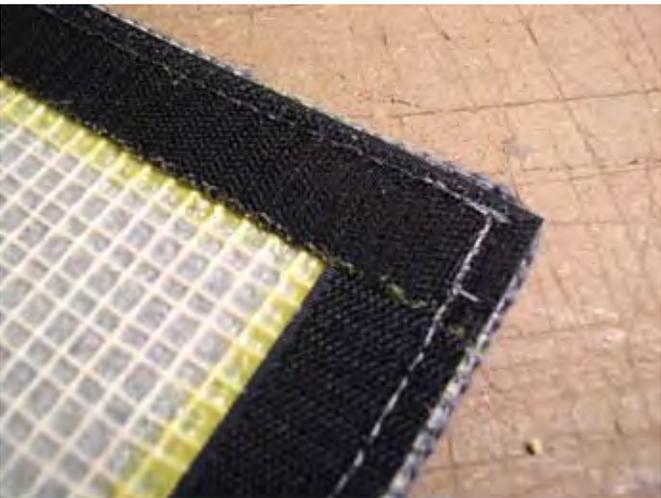


Pounding the glued velcro at the edge of a carpet piece.

ing foam. It reduces both cabin noise and heat loss – I love it!

Regarding the carpet's edges, there are three common ways to finish your aircraft carpet. One is to sew vinyl or leather to the carpet's edge in an attempt to get a finished look that can be sewn with a standard upholstery sewing

method has some drawbacks. The first is that the tape material is often delicate, and fades and wears prematurely. A second problem is that you still have to deal with corners and their awkward appearance. The third problem manifests itself if the securing thread breaks; when that happens the entire tape will pull away



Stitching the bonded velcro to secure it to the back side of the carpet.

machine. Two problems can occur with this method. First, it is difficult to get a nice wrap of this uncooperative material at inside as well as outside corners, resulting in a less than ideal appearance as well as a tendency for the corners to roll up. A second problem faced is that, if leather is used, it shrinks as it ages, increasing the roll-up condition.

A second edge finishing process is to use professional carpet edge-tape held in place by a cross stitch machine. This

from the carpet.

The third and, in my opinion, preferred method to finish the edges of your aircraft carpet employs the use of a loop serger. This three-needle industrial machine applies a beautiful, durable color-matched loop stitch edging using yarn obtained from the carpet mill. Corners look beautiful and stay flat, and if the yarn should break somewhere, you need only to pull the piece through and tie it off on the back. This serging is going

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to look good for the life of your carpet. What could be better?

Well, we made it. I think we've pretty much covered everything involving aircraft interior renovation. Next month, we'll go over the paperwork related to this interior work. I'll cover FAA documentation verifying the flame specs for the materials, certification documents for passenger restraints, STCs and field approval paperwork for modifications, weight & balance and equipment list changes, and finally the appropriate log-book entries that should be done whether a professional shop is doing the work or you are doing the job yourself under the FAA rules of owner-performed maintenance. I so love doing the paperwork. Till then, fly safe!

Dennis and Cynthia Wolter are the owners of Air Mod at the Clermont County Airport in Batavia, OH, www.airmod.com. Dennis also flies and owns a 1973 172M Skyhawk that graces the cover of CPA's 172 Skyhawk Buyers Guide.

