The Trailing Edge

November 2023

EAA SportAir Sheet Metal Workshop

Friends that know me best, know that I'm a member of the AA. My name is Glenn Nicholson and I'm an addict. Fortunately, two of my best friends persuaded me to join Aircraft Anonymous, or as you may know it E-AA (the Experimental Aircraft Association). And now, like Dr Martin Luther King, I have a dream. Unlike Dr King, my dream is much smaller and completely self-serving. I dream of slipping the surly bonds of Earth in my very own Van's RV-8A built with my own two hands. I want to dance the skies on laughter-silvered, 2024-T3 alloy aluminum wings. Unfortunately, I was not blessed with an abundance of mechanical ability. In fact, I am not very mechanically inclined; indeed, I'm "mechanically-challenged." While my dream is much, much smaller than Dr King's, due to my heretofore mentioned mechanical inability, it is a very daunting dream for me. What's such a guy with such a dream to do? Of course, I should use that newly minted EAA membership to attend EAA SportAir Workshops and learn the skills necessary to bring my dream to fruition!

In keeping with that ambitious plan (can a guy like me really learn those skills?), on 2 November 2023 I arrived at Flabob airport in Riverside, California at 0730 to attend a two-day Sheet Metal SportAir Workshop. As I drove up and parked, I noticed an EAA emblem painted on the side of the hangar with "EAA Chapter #1" proudly displayed. Yes, Flabob airport is the home of EAA Chapter #1 -- the very *first* chartered EAA chapter. EAA Chapter #1 was hosting the SportAir workshop I was attending and several others that week. EAA Chapter #1 was formed by aviation legend Mr Ray Stits, of Stits aircraft fame. He was a U.S. Air Force mechanic and an aircraft designer. He designed, built and flew the Junior SA-1, the Sky Baby-2 (smallest bi-plane in the world with a 7 ft, 2 in wingspan), the Playboy SA-3 (the most influential homebuilt of its time), and a half dozen others. Ray convinced EAA founder, Mr Paul Poberezny, to expand the Wisconsin-based organization by creating local chapters. Ray founded Chapter #1 in 1954, and the rest is history with the EAA expanding to almost 1,000 chapters world-wide. And all this I learned by walking around the EAA Chapter #1 hangar before the class even started!

I walked into the classroom and introduced myself to Mr Mark Forss, our instructor for the class. Turns out that Mark has been on the EAA staff for over 20 years. He is an expert in homebuilt aircraft. He teaches this sheet metal workshop and the RV composite workshop many times throughout the year in many different locations across the U.S. He is also the director of workshops and lectures for AirVenture in Oshkosh, WI. He coordinated all of the 1,700 workshops & lectures at AirVenture 2023. I attended AirVenture 2023 and benefited from many of those workshops and lectures. I was somewhat nervous about taking this class since I am so "mechanically-challenged," but Mark put me at ease from the very beginning.

Mark opened up with an introductory briefing on sheet metal basics to the 6 lucky workshop participants. All of a sudden, I was surrounded by unfamiliar words, phrases, and numbers like AN470-3-3, Cleco, Noxon, 3-X gun, deburring, rivet fan, squeezer, dimple, witness marks, bucking bar, back riveting, pulled rivets, and my favorite, micro-stop countersink. Whew! My head was spinning. A few of these I'd heard, but most of these things or processes were completely new. Mark explained what each of these words meant and how they are used in sheet metal work. Next up, I, and the rest of the workshop students, would get a chance to use all these tools and techniques in a sheet metal project. Then Mark said something that *REALLY* got my attention. He said, "If you successfully complete the sheet metal workshop project, you will be able to build an RV. Some of the techniques you will do during the project are harder than anything you'll do in building an RV." Wow, I wondered, could that really be true?

Mark demonstrated how to use the sheet metal tools and processes, and in no time at all, we were busy using air drills, clecos, rivet squeezers, rivet guns, and bucking bars on our warm-up project. This initial project was designed to help us learn the basic skills of: laying out a project from a drawing & instructions, match drilling, assembly, deburring, dimpling, countersinking, and, you guessed it, riveting. We would gain experience in using both round-head rivets and flat-head rivets in the project. The task of the initial project was to rivet three pieces of aluminum skin measuring 1.5 inches x 6 inches to a piece of 6 inch, 90-degree aluminum angle. I don't mind admitting that at first, I was very timid and slow. I was unsure of my ability and struggling to understand the new concepts and the drawings and instructions. But I soldiered on. We used sharpies to lay out the rivet hole patterns. I had an early misstep. I tried to use a ruler to lay out the pattern, but soon had a permanent, black line mess on my piece of aluminum, and then I remembered the rivet fan. For those of you unfamiliar with a rivet fan, it is a hinged, accordion-like measuring tool that allows a person to easily lay out equally spaced, even rivet holes. Once I started using the rivet fan, layout was easier and much faster. Within a few hours I had laid out rivet holes, deburred the holes, dimpled a row of holes for flush-mounted flat head rivets, counter-sunk a row of holes for flush-mounted flat head rivets in thicker aluminum, used the cleco pliers to "cleco" (or assemble) the project together, used the manual rivet squeezer to rivet one row, and used the rivet gun and bucking bar to "drive" another row of rivets. To dimple the aluminum, we used a manual dimpling tool. This tool is used to deform a hole inward a small amount to make a flat head rivet fit flush with the thin skin. For thicker pieces, we used the micro-stop countersink to drill a similar looking hole into the aluminum. This also produced a tapered hole to ensure the flat head rivet would fit flush against the metal. After driving that last row of rivets, I was, with some amazement, looking at a completed project. As I took a picture of my project with my cell phone, I realized that I had learned the basics of sheet metal riveting.

Rivet Fan

Warm-up Project

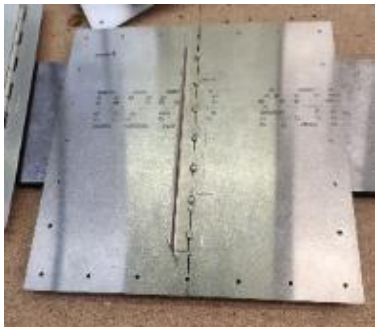
After becoming familiar with the basic tools & processes, we would start work on the main, more complex project – a small wing structure. The first step, and arguably the most important step, is to study the drawings and instructions. Once I got a mental picture of the project in my head, I started work. The first step was to form the ribs. For this task, we used forming blocks. We placed the pre-cut aluminum into the forming block using screws and wing nuts, secured the forming block into a vise, and used a rubber mallet to bend, or "form," them into ribs. Next, I laid out the holes in the front and rear spars per the drawings, drilled the spar holes, matched drilled the spars to the ribs, assembled them together by using clecos, and finally riveted them together using round head, solid rivets. During the riveting process I used a combination of the manual squeezer, pneumatic squeezer (easy!), and the traditional rivet gun hammer set & bucking bar. I wanted to get experience using all three techniques. The next step was to strengthen a piece of aircraft skin by using a stiffener. The stiffener was 6-inch piece of thicker aluminum angle.

Forming a rib

Spring-loaded back-rivet tool tool

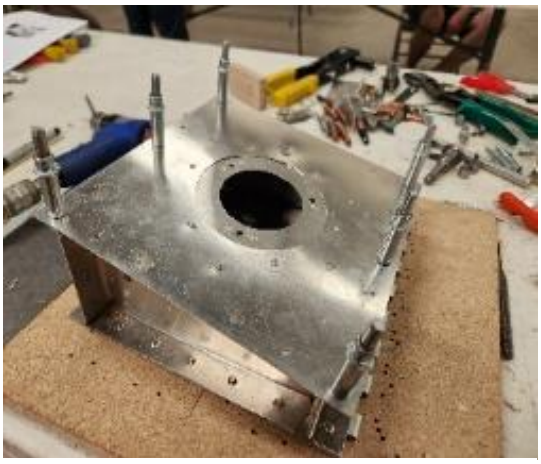
From time-to-time, Mark would ask us to pause our work to give us instruction on some new concept or procedure. This was one of those times. For this task, we'd need to "back-rivet" the stiffener onto the skin using flush mounted rivets. He demonstrated the technique using riveting tape and a spring-loaded back-rivet tool. After the demo, we returned to work. I laid out the holes per the diagram using a ruler and the rivet fan, drilled the holes, match drilled, dimpled the skin, dimpled the stiffener, and riveted them together using the back-

rivet technique. You may be sensing a pattern. That's good, because this is the basic set of tasks you will be performing over and over to build an aircraft. Again, I was one of the slowest students, but as I worked, I became more confident and naturally picked up speed.



Installed Stiffener

Next, we installed an access panel into the bottom skin by riveting nut plates onto a doubler and riveting the doubler on the bottom skin. Then we riveted the bottom skin onto the structure and screwed the access cover into the nut plates on the doubler. During this process, Mark stopped us to show us the technique to drill out rivets that were not installed correctly. This was one of the things I was worried about. I figured I would be making mistakes early in my real-life aircraft project due to lack of riveting experience, and I was nervous about enlarging or creating other defects in the holes. Mark told us to pick some of the rivets we weren't happy with and practice drilling them out. I drilled out three of my rivets and found the technique was much easier than I expected and could be done without botching a hole. As I continued with the project, I matched drilled, dimpled, and riveted the top skin onto the spars and ribs. On the rear of the wing, we constructed and connected a small flap-like structure, or "tab." In this part of the project, we learned how to install piano hinges in both the rear of the wing and the front of the tab. Toward the end of the second day, I again was looking at a completed project. I don't mind telling you it was a very satisfying feeling to have learned so much in two days and used the skills to build a small piece of aircraft wing.



Installing access panel

I can't say enough about EAA Instructor Extraordinaire Mark Forss. He was very patient, and never once laughed at my stupid questions or the mistakes I made as I was learning all the concepts and techniques. He thoroughly explained all the necessary concepts and techniques, demonstrated each one, and answered all of our questions. As I finished my final project, I thought back to Mark's statement early in the class. It echoed in my mind, "If you successfully complete the sheet metal workshop project, you will be able to build an RV." I took several pictures of my completed project and smiled. Even though this was a small project, I have learned the sheet metal skills necessary to build my dream experimental aircraft. I now have the basic skills and confidence to start the project. I also have enough knowledge to know when to ask questions and where to get help, if needed. If you are thinking about building an experimental aircraft, but like me don't have the confidence or skill you need to get started, I highly recommend the EAA SportAir Workshops. The combination of lecture and hands-on training is just what I needed, and I'm sure it would help you, too. I enjoyed every minute of my Sheet Metal Shindig! I am looking forward to starting to build my RV-8A in 2024!

Completed Sheet Metal Workshop Project

To find more information on the EAA SportAir Workshops, go to the EAA website: [EAA SportAir Workshop Schedule | EAA]

- Glenn Nicholson