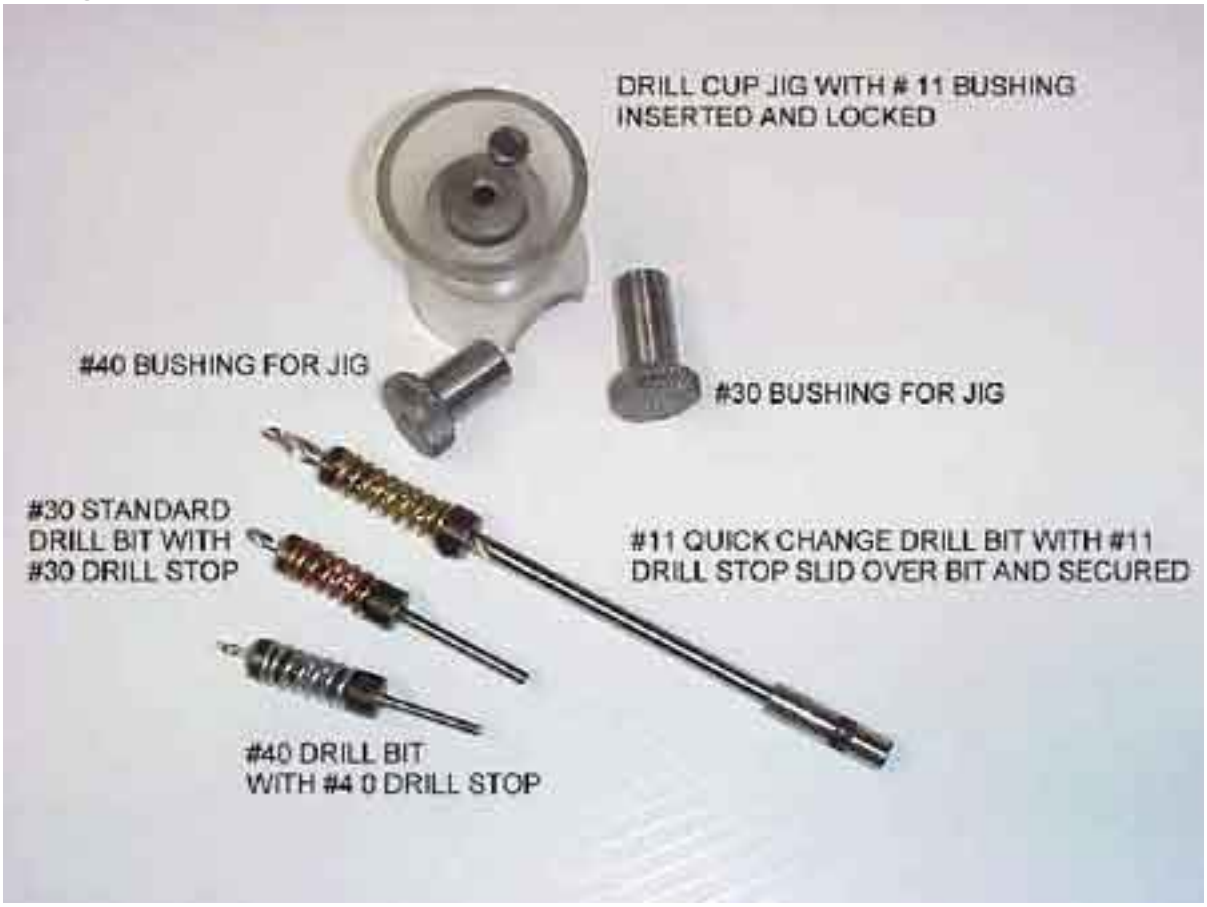
Technical Tips

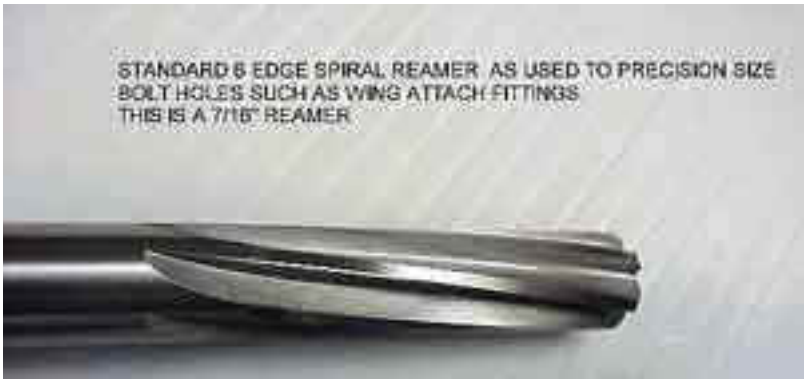
Working With Sheet Metal

Working with sheet metal, especially the thin sheets used in aircraft construction, can be a daunting experience for the first time builder.
One of the problems is that when you ask advice from those in the industry, the response only makes matters worse, as many assume a certain level of knowledge of airframe construction. What takes, for example, an airforce technician several years to learn, must be picked up to some lesser degree in a matter of months by the homebuilder.
Well, lets try and explain in normal English a few basics. I am not some high powered aeronautical engineer, but a guy who has spent many hours working away in a simply equipped shop, building, covering, painting, maintaining, repairing and flying the Murphy line of kitplanes, amongst others. I have also worked in the certified world, and what you will read works for me, even if sometimes it infringes the rulebook.



Drills, drill bits and holes. An aircraft is basically thousands of rivets and bolts flying in close formation. These squeeze various parts together, inserted through holes, many of which the builder has to drill. The industry calls these rivets, bolts, screws etc. “fasteners”.
The drilling of these holes is quite an exact science, and how well you drill them affects the structural integrity of your aircraft (now

are you scared!).
First, select a good air drill. This is hugely important. It should be light, balance well and have a progressive trigger. This allows the drill to start nice and slowly, not fire off like a machine gun.
Chuck the drill bit tightly, hold the drill bit as perpendicular as possible, and use a drill stop.
Two little additions to your tool box here. The drill stop is a little spring thing that fits to the drill bit, and stops the bit shooting through the hole when it breaks through, preventing you drilling your or somebody else's finger, the underlying structure etc., etc. The other is the 90-degree cup jig. This wonderful little tool is a simple cup, with a hole in its center. You fit various collars into this hole depending on the size of drill bit you are using, and once the cup is seated on the work, you drill down through the cup at exactly 90 degrees.
Adjust the air pressure to suit your style and type of drill.



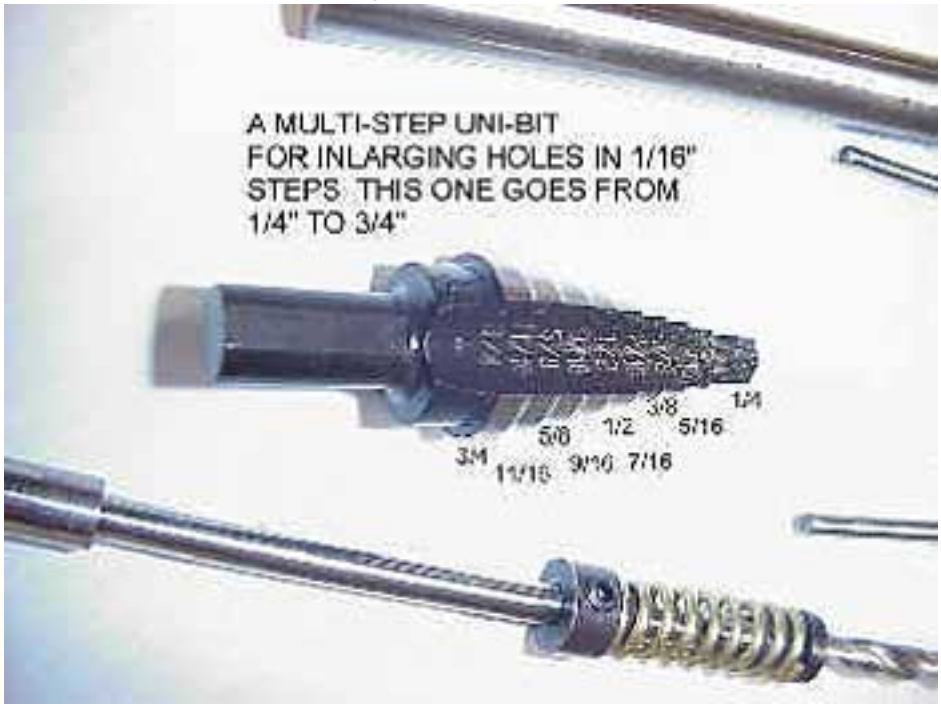
Most drills have 3/8" chucks (the maximum size of drill shank the jaws will accept), but just to annoy you, the mandrels of hole saws and large diameter drill bits only fit into ½" chucks. Now, most drill presses have this size of chuck, but hand drills are also available with ½" chucks, and very useful they are too.
If you are buying a drill press, make sure the ½" chuck accepts a 1/16" bit. Some don't, and its infuriating when you want to drill a hole in a bolt head for locking wire or whatever.

Aluminum is supposed to be drilled fast (high r.p.m.), but actually I find medium speed is fine, with a sharp bit, and you can keep better control. Steel, on the other hand should be drilled slow.

Good quality drill bits are worth it. But a word of caution. A good quality drill bit will grab, and try to pull the drill towards the work. Be ready for this, and always clamp firmly the work in a drill press.
In your toolbox you should have #40, #30, and #11 drill bits. Don't bother to try and sharpen these, its not worth it. I would now never be without a box of titanium and cobalt drill bits (1/16" to 3/8"). Don't even think of drilling steel or stainless with anything other than cobalt.

So lets try and figure out what size (diam.) of drill bit we should use. The diameter of the rivet or bolt is what sets the hole diameter or vice-versa. But in a perfect world you could not get a 1/8" rivet, for example, into a 1/8" hole; the hole would have to be slightly bigger. Also Avex and solid rivets swell slightly as they are installed, so they need a bit of room for this.
Just when you thought you had these wonders of the imperial system figured out, they throw in "clearance drills". As if that's not enough, they give these strange numbers and, to really confuse everybody, letters!
These appear to have no logic, and few people know what they mean.
Clearance drills are the bits that are a teeny bit larger than the actual drill bit size, and provide final drilling to allow for swelling etc.
So how do you work all this out if you are just a mere mortal? Well, there is a little book called the

Standard Aircraft Handbook. In there are a number of tables, mostly incomprehensible, but one which gives drill bit sizes in fractions, numbers/letters and decimals. It's just invaluable.



So you are standing in your workshop, your wife or husband or whoever is wondering why you have spent all this money on a box of bits, and you have to start drilling. What do you do?

All our sheet metal parts are punched at #40. So you drill out first with a #40 bit.
For 1/8" solid or Avex rivets, use a #30.
For 3/16" solid or Avex rivets, use a #11.
For stainless "pop" rivets and bolts, stay with the exact size.
Ah Ha, I hear you cry, you just said in a perfect world the hole must not be exactly the same size as the fastener. Well, it isn't a perfect world, and as you drill, you will certainly create a hole very slightly misshapen or oversize due to chattering, too much wine the night before or whatever. With the bolts, drill out to the exact bolt size first, try it, and if it slides in, fine. If its an "interference fit" (posh word for did you use a hammer to get it in), use a clearance drill, or better still, use a reamer.

Now there is a word that strikes terror into the inexperienced. If you try to seek advice on reamers, you will be given the impression you need to be into the occult to make them work (a bit like all this nonsense about Proseal).
A reamer cuts metal in a different manner to a drill bit (you don't need to remember that) and is more precise, does not snatch the work and produces a cleaner hole (you do need to remember that).
Chuckable (you can put them in a drill chuck!), spiral, med./high speed reamers work fine in your drills (in spite of what machinists and engineers will tell you: ignore them, they know more and are just trying to confuse us).
All you need to remember is that you must take the hole to at least 0.007" (7 thou) from final size. Less than that and its too much for the reamer to cut (they are expensive and brittle). If you don't have the confidence to use your hand drill with a reamer, you can use a hand reamer, and some people feel this provides even more accuracy.
I can see the look of horror on your face: 7 thou! How do I work that out to get the correct drill bit? Just go to that table I told you about.
Its worth scouring Sun and Fun and Oshkosh for bargains on reamers and drill bits.
To end, I just want to mention step drills. To get a nice round hole you always drill the hole in stages. Step drills do this in one go. For example you can get a 1/8 to #11, the first ¼" or so of the bit being 1/8", ending in #11. You can also get reamers that do this.

Next month: counter sinking and cutting sheet metal.

Home | Aircraft | Airshows | Our Story | Contact Us | Shipping | Technical Support
Education | Builder Directory | Builder Projects | Builder Completions | Links