DIY Arca-Swiss Compatible L-Brackets

TJ Avery, 14-August-2008

L-Brackets are handy things to have on your camera body. They allow you to quickly switch from shooting horizontally to vertically in a matter of seconds.

L-Brackets (for the Arca-Swiss style quick-release clamping system) are made and sold by various manufacturers. They are usually machined aluminum and are very high quality. They are also very expensive.

In the hot summer of 2006, I spent many hours in my garage grinding, drilling, beating, and sweating out my first DIY (do it yourself, i.e. home-made) L-bracket for my camera. I've made two others since then.

horizontal (landscape)

vertical (portrait)

The concept is simple – take a piece of steel (or aluminum) flatbar and:

1. bevel the edges
2. bend to match camera body
3. drill holes for screw attachment and also to minimize weight
4. cut notches for shutter remote plug, strap attachment lug, etc.

My goal was to make a working L-bracket that:

- was cheap (costing a few dollars vs. ~$180 for a L-bracket from RRS or Kirk, for example)*
- low profile (the ones typically produced by RRS, Kirk, etc. are thick and sometimes really large)

* This is true provided all the necessary tools are owned.

My First DIY L-Bracket

The first L-bracket I made was in August of 2006 and was for my main camera body at the time, a Canon 1d Mark II.

I decided to use regular carbon steel. I first thought aluminum would be a good choice since it is about three times lighter than steel (and typical grades of aluminum are just as strong as regular carbon steel), but aluminum is also three times more flexible than steel. I realized that my L-bracket would not be very thick, and would therefore be susceptible to flexing (think camera shake) especially when the camera was mounted in the vertical (portrait) position.

(just as a quick engineering note: the stiffness/flexibility of a material is generally not related to its strength. Typical grades of aluminum and steel are roughly equal in strength (i.e. the amount of stress they can endure at near-failure) but they are a factor of three different in stiffness.)

STEP 1: Chop It

I picked up a three foot long piece of steel flatbar with a cross-section of 1.5 x 3/16 inches from my local home-improvement mega-store. I chopped off an eight inch length of the bar to create my work piece.

Note that I used a special carbon-tipped blade designed for cutting metals on my circular saw – do NOT try this with a normal blade designed for cutting wood. These blades are expensive and can cost upwards of $80. A cheap, abrasive cut-off wheel would have worked as well.

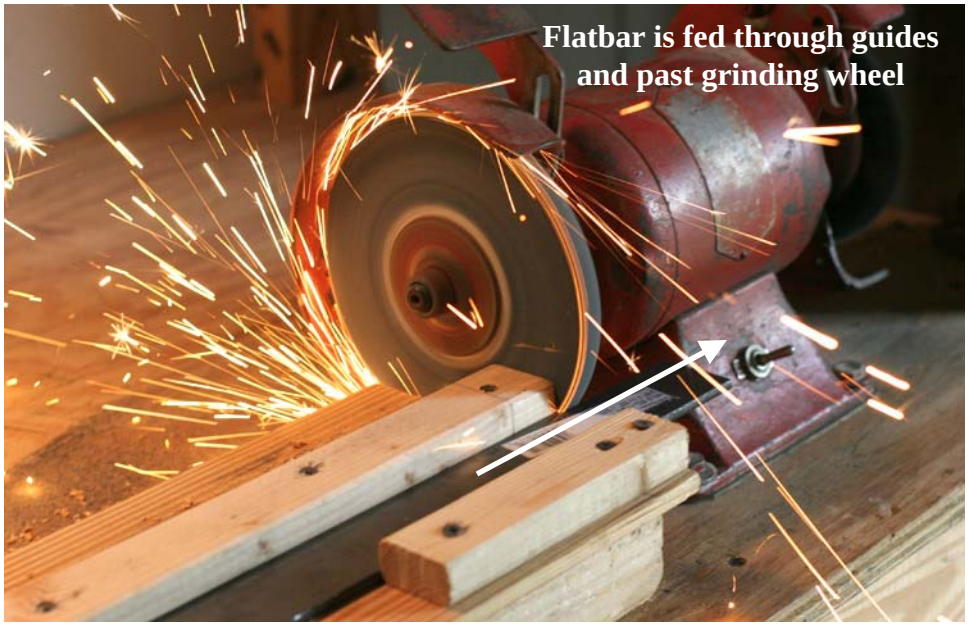
Cutting the work piece
(note that the bar pictured here is actually aluminum, but the process was exactly the same for the steel bar – I'll get to the aluminum L-bracket a little later in this article)

The next step was to bevel the edges of the work piece. The beveled edges (approx. 45°) give the bar its basic shape and allow it to fit into the Arca-Swiss style quick-release clamping system.

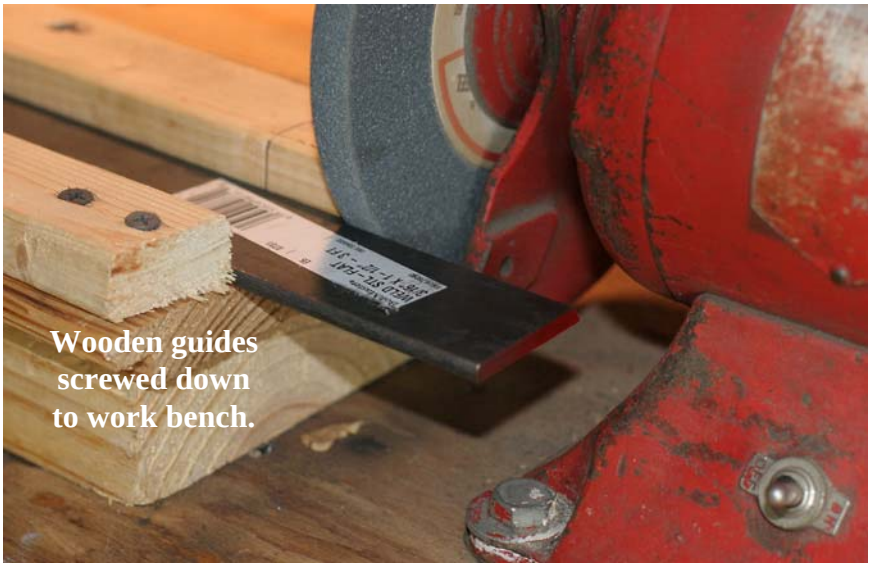
The beveling was done by running the work piece past the wheel of a bench grinder. I set up a wooden guide, and then slowly (VERY slowly) fed the work piece past the grinding wheel. This took a lot of

time and patience and also frequent breaks. The steel tends to get extremely hot when doing this! And yes, it does make sparks like you see below for the entire run.

Step 2: Bevel The Edges



Pretty sparks!

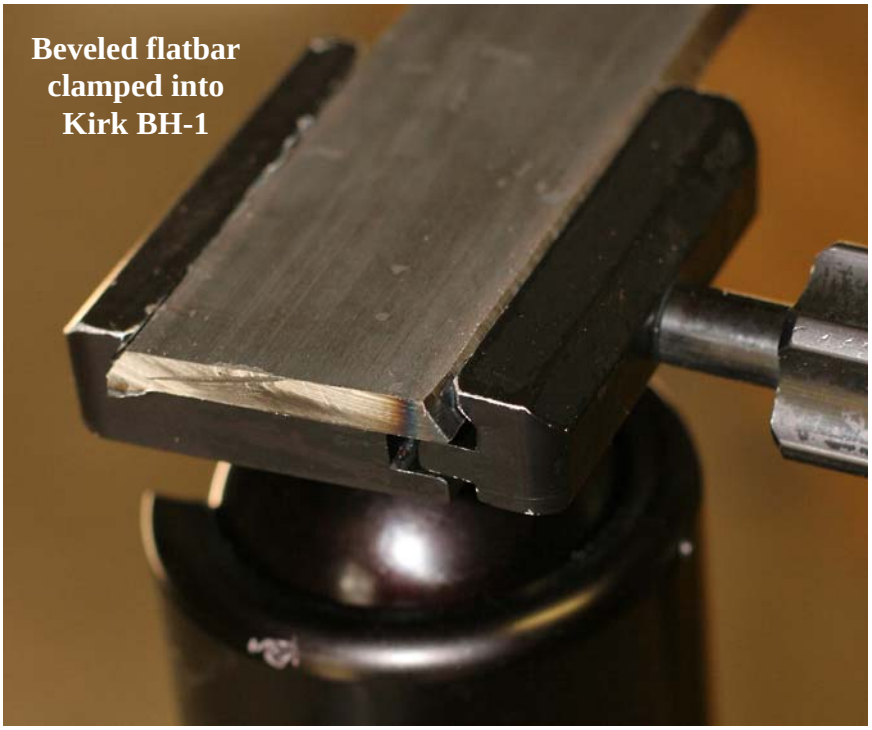


Feeding the work piece past the grinding wheel

As I was finishing up the second edge of the work piece, I realized my first problem with this method. As I fed the bar past the grinding wheel, it was slowly eroding the wheel (reducing its diameter) and therefore reducing the amount of bevel being put onto the bar.

I adjusted the wood guides and did a few extra runs in attempts to even-out the amount (or "depth") of the bevel. In the end, the resulting bevels were not equal along the length of the work piece. I.e. when clamping this, the clamps would not "see" a bar of even width; its width varied slightly along its length.

I began to test-fit the work piece into my tripod clamp as I made fine adjustments to the bevels on the grinding wheel. I finally found a happy spot where the entire length of the bar could be successfully clamped into my quick-release system. Note that the clamps pictured below are the set of stock clamps that came with my Kirk BH-1 ballhead.



The Kirk clamp responded well to my slightly uneven work piece. The moveable side of the Kirk clamp can slightly rotate in all directions to conform to an uneven plate edge, and when it bites down, it stays put.

Step 3: Bend to Fit

I bent the work piece about mid-length. Bending was done by clamping about half the length of the work piece firmly against the edge of my workbench. I then heated up the middle of the work piece with a torch in attempt to get it soft and malleable. Finally, out came the 3-pound sledge hammer to beat the work piece into a 90° L-shape. This was the fun part of the job.

Once the work piece cooled, I test-fit it against my camera body. It didn't fit well, so I resorted to many trial and error cycles of beating and fitting until the L-shape fit snugly against the camera.

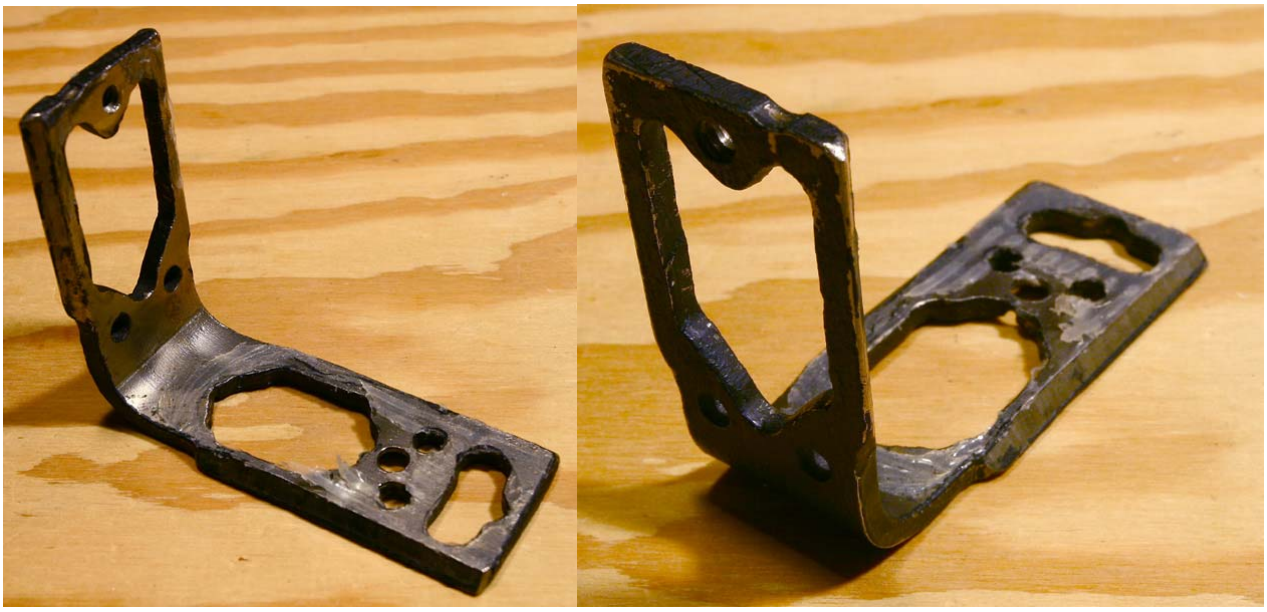
Step 4: Drill & Chop

The final major step involved a drill press and also a Dremmel tool. I created a hole for the screw that mounts the L-bracket to the camera's tripod socket, and I also cut out unnecessary areas in the L-bracket to reduce weight.

One important feature was counter-sinking the screw hole. The overall profile of the L-bracket, once mounted on the camera body, needed to be a flat, flush surface. If the screw head stood proud of the surface of the L-bracket, then it wouldn't mount into the clamps.

I couldn't counter-sink the screw hole deeply, as the bar was only 3/16" thick. So, I made a shallow counter-sink with a ½" drill bit and also ground-down the head of the screw a little. The final result was a screw head that was just flush with the exterior of the L-bracket.

Step 5: Finishing Touches



It wasn't pretty, but it worked!

I ground off the beveled edge in the region around the 90° bend (see photos above). This allowed for the L-bracket to slide either direction on or off the clamps when they are just slightly opened.

I had to reduce the length of the stainless steel attachment screw because the tripod socket of the camera is pretty shallow.

I added silicon to the inside surfaces of the L-bracket to create a thin cushion between the bare steel and the camera body.

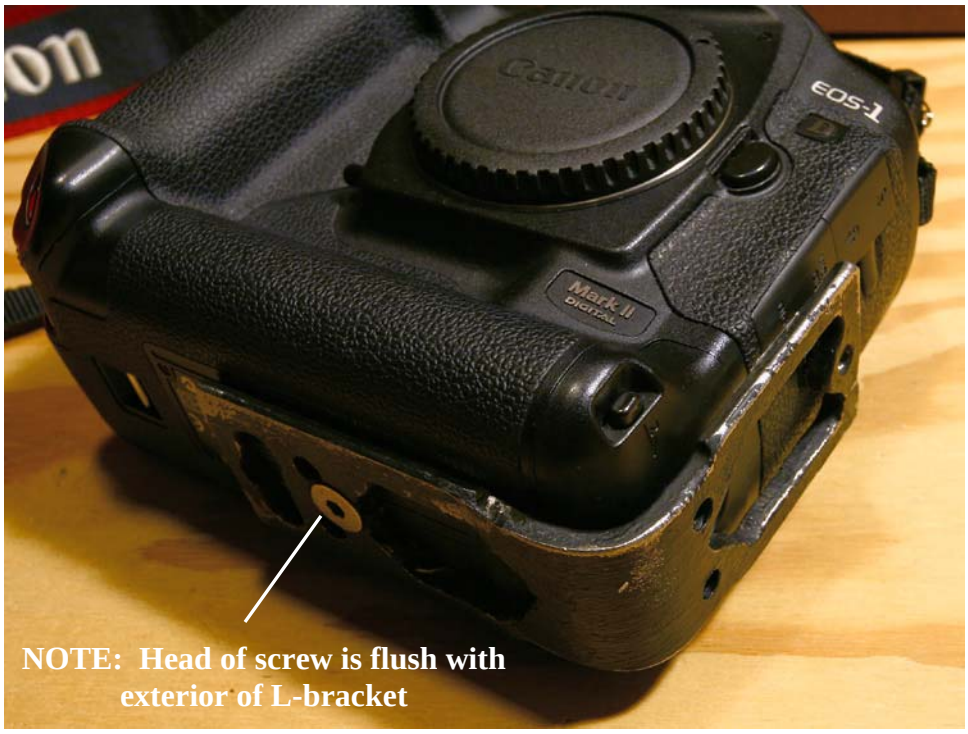
I slapped on some black paint to the exterior surfaces just to get a rough match with the camera. This was done in a hurry with regular flat black enamel paint – I was about to leave for a trip to Zion National Park, and I needed to finish up fast! Most of the paint ended up flaking off during that trip ☺

The final product (see above) looked pretty bad in overall finish, and was truly a *beat-to-fit & paint-to-match* job. **BUT, the design worked fairly well in the field.**

Assessment of First L-bracket Design

Pros	**Cons**
Cheap (about $1-2 in steel)	Blocked battery, had to be removed to change battery (this is specific to the Canon 1d body design)
Relatively Light	Not terribly pretty ☺
Low Profile	Tended to rotate a little if camera was handled or bumped after mounting vertically (portrait)
Allows access to shutter remote	Blocked PC and video ports (but I don't use them often)

Below are photos of the L-bracket attached to the 1d Mark II.



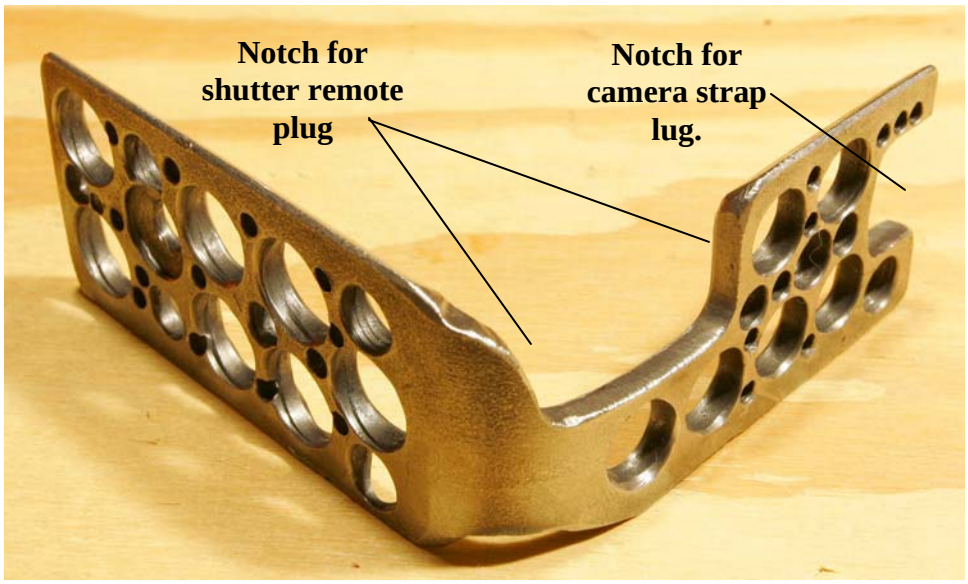
L-bracket mounted to Canon 1d Mark II

L-bracket mounted to Canon 1d Mark II

Version 2 – The Next L-bracket

During the summer of 2007, I bought a Canon 5D. Naturally, the first thing to do was make a custom DIY L-bracket for it ☺

This L-bracket was done the same way as the previous one (for the Canon 1d2). However, the camera body was slightly different.



L-bracket for 5D

The shutter remote port was lower on the body – close to the bottom edge. I had to carve out a large slot to provide access.

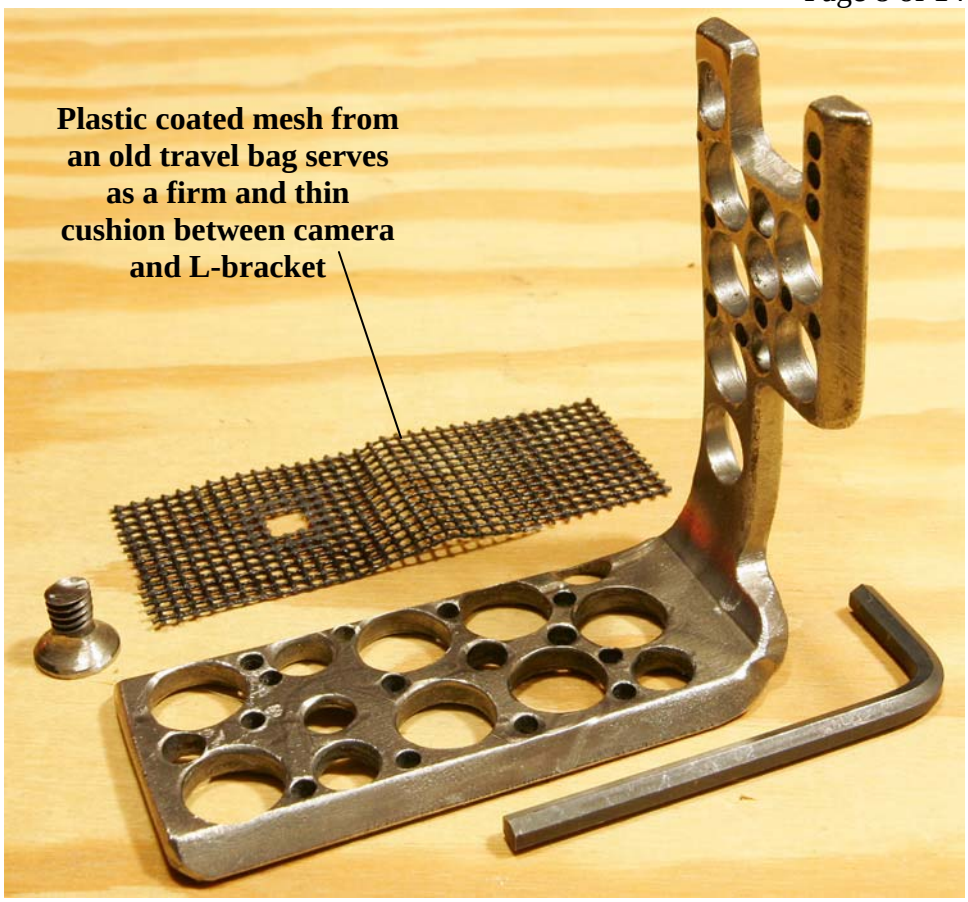
Also, the camera body is much shorter than the 1d2, so the L-bracket actually reached up high enough to interfere with the lug for the camera strap. This turned out to be a positive feature – I had to notch out the top edge of the L-bracket to fit around the lug, and in doing so, created a positive lock. I.e. the L-bracket was therefore NOT susceptible to rotating against the camera body as the previous design was.

I tried to make this L-bracket a little more aesthetically pleasing. Instead of cutting (chewing) out large holes to reduce weight, I decided to carefully drill out holes of various diameters all over the L-bracket. Having a drill press really helps!

The overall appearance would look cool – something like a perforated cooling shroud for a gun barrel ☺ I ground and polished the surface until it was bright and shiny.

I left the metal bare and hoped that the oil from my skin would help protect it from rusting. (Note: this worked up until about summer of 2008; I've noticed tiny spots of rust creeping up now.)

This L-bracket worked great, AND I did not have to remove it to get to the battery compartment. This design still does not allow access to the PC or video ports, but those are things I use extremely rarely (and definitely do NOT use while out in the field).



L-bracket with stainless steel screw, hex wrench, and interior pad (no silicon on this one)

L-bracket attached to 5D

Using L-bracket: Camera in horizontal and vertical orientations

Trouble

In November 2007, I bought a RRS (Really Right Stuff) RH-40 ballhead with quick-release lever. I was disappointed to discover that the clamp cannot be adjusted easily to accommodate plates of varying width (it can be adjusted, but only by sending it back to the factory to have some of the internal shims removed or new ones added).

My custom L-bracket for the 5D would NOT fit the RRS lever-operated clamp. It was actually not wide enough and was loose once the lever was pushed down to engage the clamp.

The quick fix was to line the interior surface of the L-bracket with something. This would effectively shim the L-bracket and allow it to fit. I used black electrical tape and made trial-and-error fits with multiple layers of tape. Some spots along my L-bracket took one layer, others took three layers (remember, the slightly uneven bevels resulted in slightly varying widths of the L-bracket along its length).

The end result was actually quite nice. My L-bracket fit snugly, and the metal-on-metal (between my L-bracket and the RRS clamps) was cushioned by the tape.

I didn't expect the tape to last but one outing into the field, but as I write this, that same tape is still there!

Version 3 – The Aluminum Age

I initially used steel because it's three times stiffer than aluminum. The DIY L-bracket design ends up with a relatively thin cross-section between the spot where the L-bracket is clamped in vertical (portrait) orientation and the spot where it's screwed into the tripod socket of the camera.

I figured that when the camera was in vertical (portrait) orientation, it would be quite susceptible to shake because of the flexibility of the L-bracket material.

I decided that if I used a thicker bar, then I could possibly go with aluminum. I ordered some aluminum flatbar (with strength equivalent to regular carbon steel) with a 1.5 x 1/4 inch cross section from McMaster-Carr. The extra 1/16 inch thickness (as compared to the previous L-brackets made from 3/16" thick steel) would significantly add to the overall stiffness of the L-bracket.

The other benefit is that the 1/4 inch provides more "meat" in which to counter-sink the attachment screw.

In December of 2007, I sold the 1d2 and picked up a new 40D. Naturally, making the DIY L-bracket came next. The steps are pretty much the same as they were for the steel L-brackets.

Cutting approx. 8-inch long work piece from flatbar stock

Close-up of the first step

Beveling the edges with the grinder

It was at this point where I ran into trouble. Working with aluminum is quite different than steel. Although aluminum seems to cut and drill easier, it's much more difficult to grind.

The beveling was painfully slow, and the aluminum was melting off and caking onto the surface of the grinding wheel. This made the surface of the wheel slick, and it would stop grinding effectively. I would frequently have to stop and pick off the caked-on aluminum from the wheel, and this wasn't easy either.

After doing about half of one side, I gave up and decided to freestyle it with a hand-held angle grinder.

Using angle grinder instead of the bench grinder

The angle grinder suffered from the same problems as the bench grinder – the aluminum was still melting off and caking up on the surface of the grinding wheel. But the grinding went much faster.

I'm guessing that there are specialized grinding wheels for aluminum. I just haven't looked into it yet.

The major problem with free-styling with the angle grinder is that the accuracy of the bevel is up to human hands and eyeballs. I ended up with a fairly uneven bevel.

Grinding the aluminum

I beveled each side of the work piece and then began test fitting it into my RRS lever clamp. This process went slowly. It was endless cycles of grind-fit-grind-fit-grind-fit until the thing actually was small enough to be clamped.

I had to be careful because once the material was taken off it could not be put back on, and a plate that wasn't wide enough would not fit well into the RRS lever clamp.

After the plate shaped up to be "clamp-able", I realized the edges were fairly uneven. Now, the unevenness was slight (probably something like 1/16" variance, if that), but enough to make the clamping too tight in one place and just right in other spots.

I found an old steel file in my toolbox, some old ancient thing my dad had. It's basically a small piece of hardened steel flatbar with heavy knurling (cross-hatch pattern to make the surfaces rough).

I clamped the aluminum work piece to my bench and then started to run the file (which is about 12 inches long) back and forth over the beveled edges. It took some time, but I eventually got the beveled edges of the aluminum work piece very straight and smooth!

Beveled and filed – it fits!!!

The remaining steps (bending, drilling, etc.) were exactly the same as done in the two previous steel L-brackets. The finished aluminum L-bracket looked very much like the steel L-bracket I made for my Canon 5D, except that it was a little thicker.

Final Thoughts

- Beveling is the primary problem. Using a milling machine to make the bevels would be ideal, but I don't have one (or access to one). I've investigated buying special attachments, cutting heads, and a machinist's vice to turn my drill press into a mill, but my drill press does not have bearings that will support significant side-loading.

- Grinding aluminum is tedious and tough. I'm going to have to look into the different types of grinding wheels available to see if there's a suitable type for aluminum. It may also be a function of speed. Perhaps slower RPM's would help too, but my grinders do not have variable speeds.

- Drilling relatively thick metal (and 3/16 to 1/4 inch is relatively thick for household type stuff) with large drill bits up to 1/2 inch diameter is best done with slow speeds and cutting fluid (and using a drill press). When I made my first L-bracket, I hit the steel with max. RPMs and pressed down the bit with a lot of force. I chewed up many good drill bits by overheating and overstressing them. I figured out later that slow RPM's (e.g. 150 – 200), light force, and cutting fluid makes for easy drilling. Cuttings should peal off in long helixes (like pealing an orange) instead of spewing out in tiny bits.

- My second and third L-brackets have worked out great. They function well in the field and have been proven with heavy use. Both my clamps (the Kirk and the RRS lever) tolerate them well. I really enjoy their low-profile against the camera and they fit into my camera bags almost as easily as when the brackets are not attached. They aren't perfect, but they provide a nice, economic compromise.

If you have any suggestions or comments, I'd love to hear from you. If you know of a good, cheap alternative to making bevels, please email me!

thomasjavery@gmail.com