

Building the STEN Mk 2.5 Semi-Auto Carbine

Part 1

By Steven Matthews

This isn't a one-weekend project, but Matthews says if you have the eye, the skills and the ambition, you can make a realistic semi-auto Sten for a price that will leave you some ammo money.

Building your own gun is a big project, but Matthews says you can do it with planning, patience and the right tools and materials. A commitment to the job is needed.

The Sten series of British submachine guns needs no introduction to fans of World War II arms. It was made by the millions and issued to almost all of the armies of the former British Empire. The British military had bought thousands of Thompsons, but needed millions more submachine guns that were cheap and easy to produce.

With these design parameters paramount, Reginald Shepard and Harold Turpin submitted a design that became known as the Sten Mk 1. This design featured basic blowback operation, a steel tube receiver, a horizontal magazine, fixed sights, sheet-metal construction, low cost, and an absolute minimum number of parts.

This design was later simplified somewhat and designated the Sten Mk 2. Only the barrel, barrel bushing, bolt, and a few other small parts were machined. The rest were easy-to-produce steel stampings that were spot- or arc-welded together. Simple-to-make parts could be subcontracted to many small producers, helping prevent one air strike from wiping out Sten production.

The approximate cost for the Sten Mk 2 was \$5 each. With Germany poised to invade and conquer, the British immediately adopted it and placed it into production. Efforts were made to reduce cost and manufacturing time even further. A simplified version known as the Mk 3 replaced the steel tube receiver with two pieces of flat steel shaped into half-round sections that were welded together.

The rotatable magazine housing was fixed into position and simply welded to tabs formed in the receiver. The machined barrel bushing was replaced with stamped steel spacers which were arc welded to a simplified barrel and then riveted into the receiver.

These and a few other small changes sped up production and lowered cost, even if it did make the gun look even cruder than ever. There were several variations of the Sten design (Mk 1,2,3,4,5,6) over the years but the Mk 2 and Mk 3 were the most common and are the ones that concern us here.

I have discussed the Mk 2 and Mk 3, but is a Mk 2.5? I made up the name for a semi-auto carbine hybrid of the Sten Mk 2 and Mk 3 submachine guns. I designed it to replicate the Sten Mk 2 by using a spare parts set for the Sten Mk 3.

I collect military firearms and I wanted a semi-auto replica of the Sten Mk 2 for my collection. The *ultra* inflated prices of the registered machine gun market meant a semi Sten was about my only option.

The going rate for a registered full-auto Sten Mk 2 is about \$3,500, and I absolutely refuse to pay \$3,500 for a \$5 gun! Although I have other NFA items, I bought them before the market went nuts (my M16 was about \$450 and my MAC 10 was about \$150 compared to \$7–8,000 now for the M16 and about \$3,000 for the MAC). I am priced out of the legal full-auto market.

Add to that the full-auto paperwork hassles and a semi-auto carbine looks pretty attractive. You may ask why I don't just buy a semi Sten. Unlike the widely available semi-auto copies of the M16, Uzi, AK-47, etc., there are simply no widely available mass-produced semi Stens on the market.

There are some specialty gun makers making small numbers of them, but they are relatively costly. This caused me to look at the DIY build option, since I do have a certain amount of hobby gunsmithing skill.

I did find a manufacturer who made a semi conversion kit for the Mk 2, but it was about \$250 plus another \$250 for a parts set. This was still more than I wanted to invest in that \$5 gun.

Unlike the Mk 2 kits which cost about \$250 and are getting scarce, the Mk 3 kits are widely available and priced in the \$40–\$60 range. I decided that I could figure out a way of duplicating the appearance of the Mk 2 with a Mk 3 kit. In this project I planned to use only a few original parts, so I thought the Mk 3 option was the way to go to keep cost reasonable.

Deciding I wanted a semi-auto carbine was the easy part. I had to figure out a way to duplicate the appearance of the Mk 2 all on my own. There was no information available for this type of project and I was starting with the proverbial "blank sheet of paper."

I bought a couple of Mk 3 parts sets and set about trying to figure something out. BATFE regulations meant it had to be converted to fire from a closed bolt. It also had to be "not readily convertible" to the previous full-auto configuration or be able to accept full-auto parts.

It also could not use more than 10 imported parts on a list specified by the BATFE. Use fewer than 10 parts and you have a plain old semi-auto American-made gun with a few imported parts; more than 10 makes it a prohibited "imported semi-auto assault weapon."

What I came up with would satisfy all the rules and still be relatively inexpensive and easy (depends on how you define easy) to build. I decide that I could use eight of the parts on the list which would get me in under the 10-part rule.

I could use several parts out of the kit that weren't restricted. I could add a U.S.-made fire control group made from modified AR15/M16 parts which are plentiful and relatively inexpensive. The remaining parts I could either make or purchase. Since it is completely legal for individuals to make firearms for their own use (not for resale!), I figured I had it all figured out at this point.

Little did I realize just how much engineering and trial and error work it would require to get a safe and reliable firearm! I had to decide how to modify the existing parts, how and what kind of new parts to make, and how to fit them all together into a functional firearm.

After a lot of head scratching and experimenting, I came up with something that would work. I will explain how I built this project and you can use it for a general guide if you should decide to build one as I have.



Matthews says you can do it with hand tools, but the proper bench tools make it a lot easier. This import lathe and mill combo cost him about \$1,200 and came in handy.

This *should not* be considered a step-by-step process on building this gun. There are just too many variables. The dimensions that I will supply will only be rough guides. Sten parts that were produced by hundreds of manufacturers, and varying tolerances and design changes mean considerable variance in dimensions can occur.

What worked for me may not be exactly right for you. I would consider this an advanced hobby gunsmithing project and you will have to use skill, knowledge and judgment in the building of this project. Test carefully at every stage of construction; don't just put it together, shove in a magazine and pull the trigger.

Much hand-fitting of parts will be needed, and you need to understand how the parts function when you are fitting them. You will need to do some simple metal lathe work and basic milling machine work. Some of the lathe and mill work can be done by improvised hand methods if you don't mind the extra

labor, or you can farm it out to a gunsmith or machinist with the proper gear.

A good drill press can be used for some of the drilling operations if you are especially skilled in its use, but a milling machine will be more accurate. Some of the small turned parts can be made by improvised methods (the poor man's lathe, a spinning drill chuck and a file) if you are skilled in hand-making parts.

I have a fairly well equipped hobby gunsmithing workshop with lathes, milling machines, grinders, welders, hand tools, precision measuring tools, etc., so I used power tools as much as possible but the project can be done without a full machine shop, it just takes longer to work things with hand tools.

Before you can start this project, you need your parts. Listed below are many of the parts I used for the project. I might add that buying more parts than you need is a good idea.

I bought 2 Sten Mk 3 kits and picked out the best parts for the project and saved the extra parts for spares in case I messed up

Sten Mk 2.5 Material List

1-2 Sten Mk 3 Parts Sets

2 feet 4130 seamless chrome-moly steel tubing 1.5-inch diameter x .083" wall thickness

1 foot 4130 seamless chrome-moly steel tubing 1.625" diameter x .058" wall thickness

1 16-inch or longer 9mm Luger barrel. (barrel blank or prechambered barrel from some existing firearm)

1 foot 1.5-inch diameter cold-rolled round stock for bushing and end cap

2 feet 7/32" diameter cold-rolled rod for the recoil spring guide

1 12.75-inch x .041-.045" wire size compression spring for the recoil spring (may be cut out of bulk spring stock)

1 1/2" diameter x 6-inch Grade 5 bolt for raw material for bolt handle

1 1/4" diameter Grade 8 socket head cap screw for raw material for firing pin

1 Extra long (need about 2 inches of shank) 5/64"(.078") high quality drill bit

1 each M16 hammer with spring and pin, AR-15 trigger with spring and pin, AR-15 disconnect and spring,

Approximate cost for these items is \$150.

the best parts. I bought more tubing than required in case I screwed up something and had to do it over.

It's real easy to make a simple mistake that will ruin a part (I know this from experience!). It's nice to have a spare handy to avoid the inconvenience and delays in obtaining new parts.

Besides the previously mentioned power tools (if you choose power over hand work) you will need basic hand tools such as saws, files, hammers, punches, tape measure, drill bits, pliers, vices, etc. The more tools you have, the easier the project, the right tool for the job makes it a lot easier!

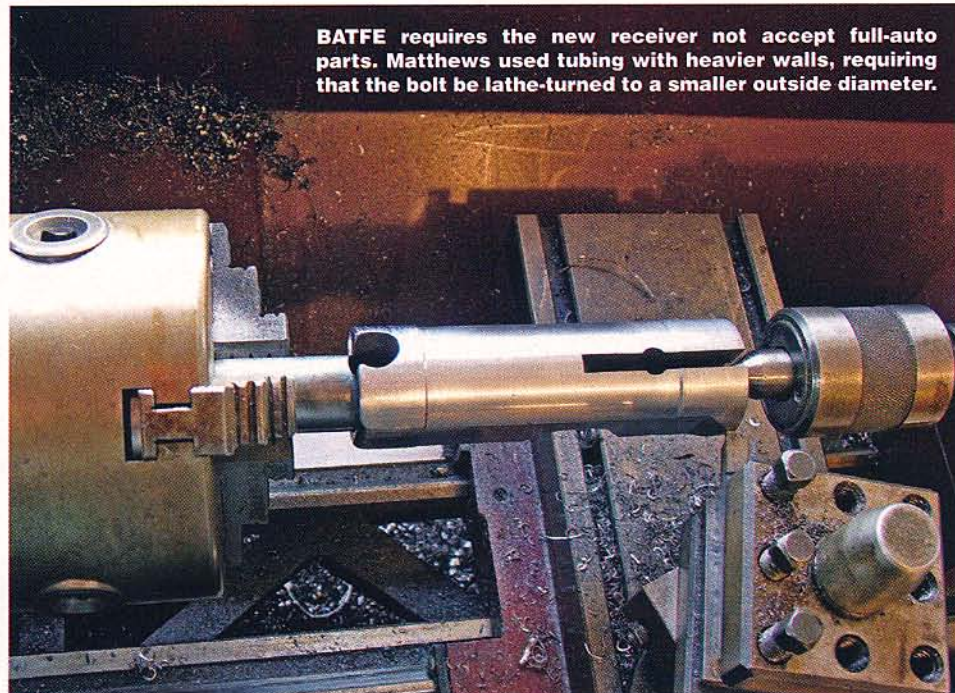
One other *must have* item is a pair of dial calipers graduated in .001". Even though a Sten is very loosely fitted, you will have to make parts that are accurate to a few thousandths of an inch. High-dollar calipers are fine if you have them but some of the cheap (\$20) imported ones will probably get you by on this project.

Reworking the bolt

We are going to start with the most difficult part first, modifying the old Sten full-auto bolt to semi-auto configuration. This modification is the heart of this project. If you can't get this part right, there is no use in making any of the other parts.



The raw materials for this project are a Sten Mk 3 parts set and some 4130 tubing. Some steel parts and an AR-15 trigger unit complete the materials that are required.



BATFE requires the new receiver not accept full-auto parts. Matthews used tubing with heavier walls, requiring that the bolt be lathe-turned to a smaller outside diameter.



The original bolt (r.) shows the fixed firing pin typical of Stens. Matthews needed to replace this with a moving firing pin that would be driven forward by a hammer.

BATFE regulations mean this gun cannot use the original "open bolt" firing system, which incorporated a fixed firing pin in the front of the bolt. It must be converted to a "closed bolt" firing system that features a conventional firing pin. When originally designed in the 1940s, no thought was given to some amateur gunsmith reworking the design 50 years later.

There is barely enough room to fit this modification into the bolt. If you get everything right on the mark, there is just enough room, but not much room for error. As shown in the diagram, we are going to be drilling several holes in the bolt for a firing pin system and a recoil rod and spring setup.

The bolt is soft enough for drilling, but is hardened somewhat so it won't drill as easily as common steel. I started by first filing a flat on the front of the fixed firing pin about the size of the hole I would be drilling (5/64"). I center-punched the exact center of this flat in preparation for drilling.

This location needs to be exactly in the center, so you will have to measure it with your dial calipers. There are only a few thousandths of an inch leeway here, so be sure it is right.

Now it has to be set up in the milling machine or drill press exactly in the line of travel of the quill. If it's not perfectly in line it will start out where you want it but then be off-center at the bottom after you have drilled in an inch or two.

In machinist's terms, it has to be set up in a drilling or milling vise and "indicated in." This indicating procedure is a "machine

shop 101" procedure. It is a basic setup process that is taught to anyone learning the machining trade.

I will only briefly explain it; if you don't understand how to do it, get yourself a basic machine shop text book and study the process. Use a dial indicator held in the drill chuck or milling machine collet with a holder. Place it against a straight side of the part (front, back or sides).

As you lower the quill, you align the part so that there is no movement of the dial. This indicates the quill is staying straight in reference to the starting point.

If you start exactly in the center of a properly indicated part, then the finish point will also be exactly in the center. Do this on both the X and Y axes (front-to-back movement and side-to-side movement).

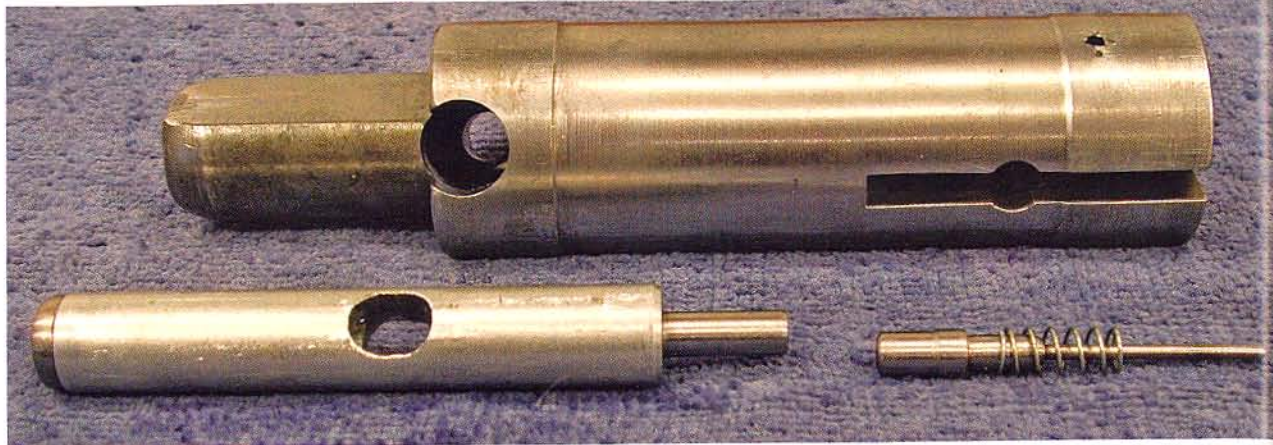
Once the part is indicated-in precisely, reposition it so that the center-punched starting point is exactly centered under the drill or mill quill.

This is also a basic machine shop procedure that you can learn from a machine shop manual. Once everything is located, clamp it down (make sure nothing moves when clamping) and spot drill the punched hole location with a center drill.

Be sure to spot drill only a small spot that is smaller than the final drill size. You don't want to spot drill a hole that is bigger than the hole you will be drilling!

Drill the hole with a 5/64" (.078") drill about 1½ inches deep (see print for depth). Run your drill fast and use a light feed to prevent walking off center, also use plenty of oil to get a smooth finish.

Once this hole is drilled, file off any remaining material on the bolt face so that it is smooth on the front. Now turn the bolt over



To help prevent slam-fires, Matthews made the firing pin in three parts, with the large piece at left in aluminum to save weight. He also added a firing pin spring.

and a drill a larger hole exactly in the center from the rear to meet the smaller hole.

You have to go through the whole "indicating in" procedure again to get the two holes to meet. Once set up, drill the larger hole as detailed on the bolt drawing. This centered passageway will be where the firing pin will be installed after it is made.

When I drilled the larger hole I used a 1/4" (.250") drill, which was slightly larger than I should have used. This resulted in me having an opening on one side of the passageway where the bolt was at its thinnest. It still worked OK but you may want to reduce the hole size by 1/64" to leave some material for a sidewall.

If you do reduce the size, you will have to adjust your firing pin diameter accordingly.

Before I could drill the recoil spring hole on the top rear of the bolt, I had to mill some material off of the extension on the rear of the bolt. I used a milling machine but it could also be ground or filed off. I machined it to the listed dimensions.

To avoid double the work setting up, you may want to have this machining done first so that you can drill the spring hole while drilling the center holes. I did it several days after I did the center holes, since I didn't have that part of the project figured out yet.

Mark your drilling point as per the bolt print. This is going to be a very deep hole, so you will need a standard drill and an extra long drill. Use the standard length drill to begin, then switch to the longer one. The setup for this hole will also have to be "indicated" as the other holes were to keep the drilling exactly straight.

It's not as critical as the other holes, but you need to make it fairly straight. You need to keep it from drilling through the upper side of the bolt after a few inches.

Once you have drilled the proper sized hole to the depth described on the bolt print, you will then finish drilling through the bolt with a smaller drill to allow for passage of the recoil rod.

Pay particular attention to the depth of the spring hole, as it will be getting very close to the extractor pin hole and you don't want to drill into it. After both holes are drilled, chamfer the ends to ensure smooth operation.

After the holes were drilled, I had to machine off the bottom of the bolt as indicated on the bolt print. This can be done by hand if you don't have a mill. I machined off the full-auto sear catch and also the bottom front of the bolt for hammer clearance.

Some more machining of the bolt bottom may be required later to fine-tune the bolt-to-hammer relationship (in other words, to get things to work). There is one final machining procedure that needs to be completed per BATFE regulations. The new receiver cannot be the same size as the original full-auto receiver. The receiver has to be smaller in internal diameter to prevent the use of the original full-auto parts. The original full-auto Sten receiver was 1.5 inches x .062".

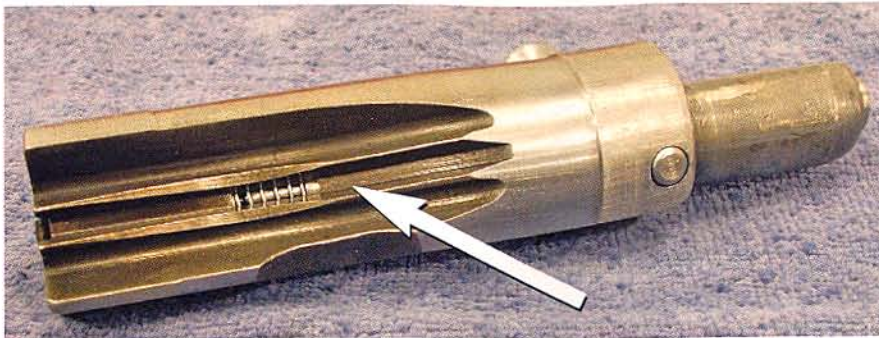
Our new semi-auto receiver will be 1.5 inches x .083". The thicker sidewalls mean the bolt has to be machined to a smaller diameter to fit the new receiver. I chucked up the tail of the bolt in the lathe and used a live center in the firing pin hole in the front of the bolt and removed the material.

Be sure to use a "live center" for this operation since a "dead center" will wear the firing pin hole. Take light cuts, since the odd-shaped bolt may cause the cutter to dig in after passing open space on the bolt.

The bolt is the hardest part of this project and tends to be where mistakes will be made. Before starting, I had a couple extra bolts in case I messed up. I got it right on the first try, but



Modifying the bolt is the most exacting stage of the job. Drilling the hole for the firing pin requires the bolt be very carefully aligned with the drill press quill.



When Matthews says there's just enough room in the bolt, he's not kidding. His drill was oversized and made this cut through the side (arrow). It didn't affect function.

I highly recommend having extra bolts on hand unless you are highly skilled and confident that you will not make mistakes.

The next section, firing pin assembly, while still needing to be made precisely will be much easier and not as easy to mess up. Later sections of this project will be very easy, so if you have made it this far, things will be getting much easier.

Firing Pin Assembly

With the bolt properly modified, it's time to make the appropriate parts to go in it. I needed a firing pin assembly and previous experimenting had indicated that a solid one-piece steel pin would be too heavy and also be difficult to fabricate. Keep in mind that a too-heavy firing pin invites slam-fires with commercial ammunition, and can cause doubling that might invite scrutiny from law enforcement. You want this gun to go off only once with each trigger pull!

Something in two pieces would be lighter and easy to build. I decided to make a short two-piece steel firing pin and a longer three-piece aluminum and steel extension.

I chose aluminum to reduce weight. I made the firing pin to the dimensions specified on the firing pin drawing and press-fit-

ted a .078" pin to the end. The larger part would ride in the 1/4" passage and the .078" pin would extend through to the bolt face.

I used a 1/4" Grade 8 screw for the main part. Grade 8 steel is more than twice as strong as common mild steel and this grade is commonly available at hardware stores.

For the small .078" pin I used the shank of an extra-long high quality drill bit. These are made from a steel known as M-2; it is strong and hard, yet still somewhat flexible.

I turned the body section on the lathe and drilled the .078" hole with a drill bit that due to manufacturing tolerances was about .001" under the .078" size of the piece I was going to use for the pin.

The undersized hole would expand when lightly heated, allow the .001" larger pin to be inserted and then grip it tight when it cooled. The firing pin body also features a return spring to help prevent slam-firing.

Since the rear of this extension would be struck by the hammer, I installed a steel insert made from a Grade 5 bolt to prevent peening after multiple hammer hits. I bored out the aluminum rod and threaded it for the bolt. I then used permanent thread locker and assembled it. I then turned the head off in the lathe in a rounded profile.

On the opposite end I used the same method to form a hard extension on the front to impact the firing pin. Once completed, there may be some hand fitting required to get things to operate smoothly due to size variations between the holes and newly made parts. Once the pieces are assembled and installed in the bolt, the long .078" pin will have to be cut to length to provide for proper firing pin extension.

When pushed all the way forward, the pin needs to extend past the front of the bolt face by .065"-.075". The rear needs to extend past the rear of the bolt extension about .100" when in the retracted position to allow the hammer to drive it forward before

Dimensioned drawings for this project, along with additional photos and builder's notes, are available on CD or paper from Stone Axe Engineering, P.O. Box 125, Dept. SGN, Scott, Ohio, 45886. The price is \$9.95, including shipping. Note that this project is intended for the advanced amateur or professional gunsmith. The nature of Sten Mk 3 parts kits, all of which are more than 60 years old, means there will be inevitable dimensional differences in parts. SHOTGUN NEWS and Stone Axe Engineering cannot be responsible for any accident or injury stemming from improper construction or assembly. If you aren't sure it will work, don't load it!

contacting and being stopped by the extension.

The overall lengths listed on the firing pin drawing should give you enough extra length to hand-fit these pieces. After you have these pieces fitted, you need to pause here and fabricate the bolt handle if you have not done it already. The bolt handle will lock the firing pin and firing pin extension into the bolt.

An oval hole in the firing pin extension will allow the bolt handle to lock the pieces into the bolt but allow for forward and back movement needed for firing pin functioning. After you have made your bolt handle to the drawing specifications, assemble the bolt and firing pin assembly. Press the firing pin assembly all the way forward and use a transfer punch in the bolt handle recess to mark the firing pin extension.

Drill the proper size hole in the firing pin extension. After drilling, file this round hole into an oval shape to allow proper forward and back movement for the firing pin assembly. The firing pin should retract into the face of the bolt about .030" to .050".

The fitting of this assembly is where good hand fitting skills will be needed. The lengths I have listed are oversize to allow you to fit your parts to individual pieces that you made. These figures worked for me, but if you varied too much from the specifications, you may have to alter things to get them to work. If you have got this far successfully, then the rest of this project will be "a piece of cake."