

THE SONGBIRD PM4 CENTER-FIRE

[VERSION 1.1]

MANUAL



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INTRODUCTION

The Songbird PM4 Center-fire is a single-shot handgun that can be made using a 3D printer and hardware store parts. The PM4 Center-fire is a modified version of the Songbird PM422 by James Patrick, which was made for use with 22 long rifle ammunition only. However, the Songbird PM4 Center-fire is designed for use with all Center-fire handgun ammunition.

A metal barrel or metal pipe is required to complete the PM4 Center-fire, as well as a metal roofing nail, which is used as the firing pin. If this firearm is built correctly, with a barrel that allows a spent casing to be removed easily, the operator may be able to achieve a shot-to-shot time of five seconds or less. This allows the PM4C to be used as a self defense tool for people who may not have access to a better tool such as a semi-auto firearm.

This manual will take you through the process of making the Songbird PM4 Center-fire.

JAMES R. PATRICK AND THE SONGBIRD DESIGN

James R. Patrick developed the Songbird handgun design after he was inspired by the work of Defense Distributed and the Liberator handgun. The original goal of the Songbird project was to create a single shot handgun that could be fully 3D printed, except for the rubber bands which power the firing mechanism. This project was successful with a Songbird 3D printed plastic barrel lasting two shots. James continued modifying and upgrading the Songbird design, releasing several different designs along with other firearm projects, such as the Washbear 3D printed revolver designs, which can be found on the internet today. James Patrick and his family, along with other 3D printed firearm developers in the United States, were threatened by Federal Authorities in mid-to-late 2010. James, along with some of the other threatened developers, haven't released any designs since. Today, the homemade firearm community across the world is now larger than it has ever been. The last Songbird design that James released was the Songbird PM422, and now the Songbird design lives on with the release of the Songbird PM4 Center-fire.

SONGBIRD PM4 CENTER-FIRE RECOIL PAD/ RECOIL PAD FRAME

In this file pack there are two options for the PM4C frame: the recoil pad frame and the regular frame. The purpose of the recoil pad is to improve the durability of the center-fire frame when used with more powerful handgun calibers. The recoil pad is a flexible piece that is glued into place behind the barrel and allows the barrel to move more freely upon firing, as well as helping to evenly distribute the load. The recoil pad can be constructed by simply 3D printing it with flexible filament, or by using the included 3D printed "recoil pad mold". To build a recoil pad with the "recoil pad mold" you must print both pieces and then secure them together using a vice, a C clamp, tape, etc. Use a flexible glue to cast a recoil pad with the mold (use of mold release lubricant may be required).

NOTE: The recoil pad does not work with barrel type 2, unless the 3D printed barrel is also printed in flexible filament.

NOTE: It is recommended to use the recoil pad frame with the recoil pad for better durability and frame life. It is highly recommended to use the recoil pad frame for shooting magnum calibers.

SONGBIRD PM4 CENTER-FIRE REQUIRED PARTS

REQUIRED 3D PRINTED PARTS:

- One Songbird PM4C reg frame or recoil pad frame.
 - If you choose the recoil pad frame, a recoil pad is required.
 - If you choose to cast your recoil pad in flexible glue, print the two parts of the recoil pad mold.
- One Songbird PM4C Barrel (3D printed). See the Barrel and firing pin construction chapter for more information on which barrel you need.
- One Trigger - One Trigger pin - One Frame cap
- One Hammer - One Hammer pin - One Firing pin retainer
- One Barrel 2 retainer (ONLY if barrel 2 is used)

REQUIRED NON 3D PRINTED PARTS:

- One Firing pin. See the Barrel and Firing pin construction chapter for information.
- One metal handgun barrel blank or metal pipe with correct dimensions. See The Barrel and Firing pin construction chapter.
- Two rubber bands (three rubber bands if barrel 2 retainer is used)

PRINTING

Printing the Songbird PM4 Center-fire requires a print bed that has at least a 10" by 6" (254mm by 152.4mm) printing bed. Use plenty of support material, and print all parts with 100% infill. Make sure your printer is tuned properly with the filament you are using for this project. Use of a skirt or raft is not required, but it is recommended when printing the frame to help prevent warping.

- Print the frame on its right side.
- Print barrel standing on its rear end. It's recommended to print the barrel in flexible filament.
- Print barrel 2 retainer on its front face (if barrel 2 is used).
- Print trigger and hammer on their right sides.
- Print pins on their side (not standing up) for maximum strength.
- Print the firing pin retainer on its front (flat side). It's recommended to print the firing pin retainer in flexible filament.
- Print recoil pad on its face (flat side).
- If casting the recoil pad, print recoil pad mold pieces (2) on their bottom/flat side. Infill density is operator's choice (100% infill not required).

SONGBIRD PM4C BARREL AND FIRING PIN CONSTRUCTION

BARREL CONSTRUCTION

To construct a Songbird PM4C barrel you must first have two things: a metal barrel and a 3D printed barrel. Both barrels are combined to create your Songbird PM4C barrel. The metal barrel can simply be a metal pipe, it could be a homemade ECM barrel or it could be a commercially made handgun barrel blank.

METAL BARREL

First lets cover the feasibility of a metal pipe for the PM4C barrel. If you choose to use a metal pipe as your PM4C barrel, be aware that the accuracy of this firearm will decrease by several orders of magnitude, and the pipe **MUST** meet some very important standards:

NOTE: Due to the requirements, using a metal pipe as a barrel is not recommended.

1. The ammunition must fit into the pipe in a way that it can slide in enough to prevent case blowout, while not going too far that your firing pin cannot hit the primer. So basically the barrel must have a chamber that is made with an ECM technique or drilled into one side.

2. The pipe must not have an outer diameter that is larger than 0.8 inches, or 20.32mm.

3. The pipe must be made of a steel alloy that is strong enough to handle the extreme pressure. There are a lot of steel alloys that are strong enough to handle the pressure, but many will expand over time, or start to crack and eventually violently burst. So if you do choose to use a steel pipe for this project, it is highly recommended to use one of the many steel alloys that are used in the firearms industry today.

4. It must be longer than 3 inches or 76.2mm.

5. It must be less than 51 caliber (0.51 inches or 12.96mm inner diameter or less).

If you choose to use a rifled barrel blank or ECM barrel for this project, the barrel must have an outer diameter of 0.8 inches (20.32mm) or less, and be longer than 3 inches (76.2mm). The caliber must be 51 or less (0.51 inches or 12.96mm inner diameter or less).

NOTE: When a round is chambered into your metal barrel it must be flush with the rear of the barrel or protrude back from it.

3D PRINTED BARREL

Now that we have a metal barrel, we can now choose a 3D printed barrel. There are three types of 3D printed barrels for the Songbird PM4C:

NOTE: The Songbird PM4C barrel types are different than the Songbird PM422 barrel types.

Barrel type 1: This is a very basic 3D printed barrel that is meant to be modified in order for it to stay in place. An example of a modification that would make this barrel fit in the PM4C would be wrapping the outside in tape until it fits snug into the frame of the handgun. In this example the barrel is friction fit into place in the frame.

Barrel type 2: This 3D printed barrel is held in place by another 3D printed piece called the barrel 2 retainer. A rubber band holds the barrel 2 retainer in place which holds the 3D printed barrel in the frame.

Barrel type 3: The third barrel type is meant to be 3D printed in a flexible or semi-flexible filament. This is because this 3D printed barrel uses a set of prongs that bend and then snap into place when you push it into the frame of the handgun. When the operator needs to remove the barrel from the firearm for reloading, they simply pinch and push the prongs, releasing the barrel from the frame.

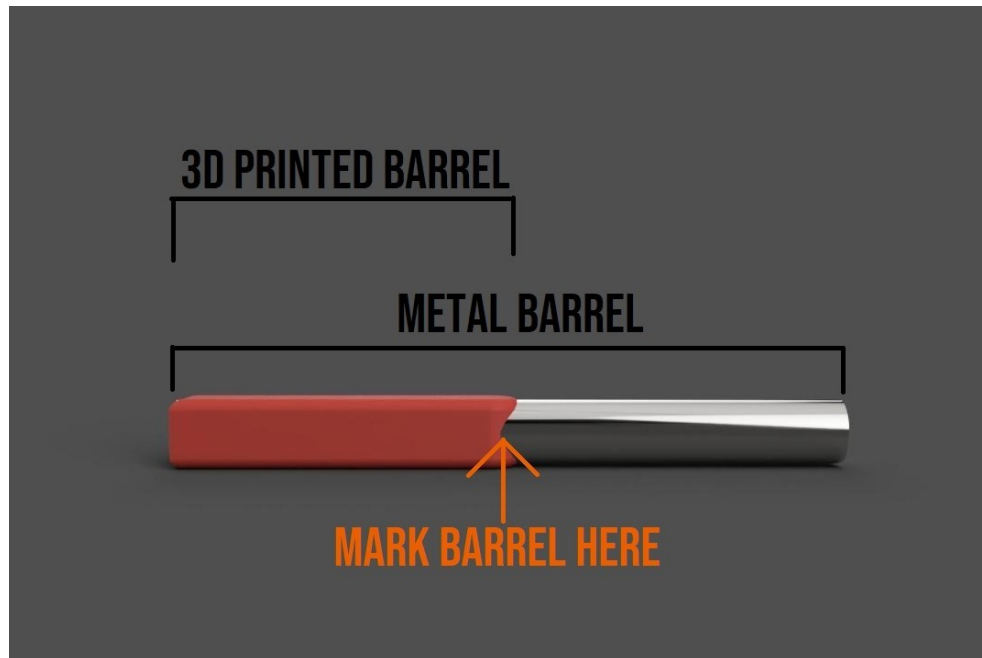
Once a 3D printed barrel type is chosen, you must then choose the size of its inner diameter or ID. The goal is for your metal barrel to fit snug to the inside of your 3D printed barrel. If the outer diameter (OD) of your metal barrel is 0.8 inches, then pick the 0.8 inch ID 3D printed barrel. If you are using Ivan's ECM barrel, then use the 16mm ID 3D printed barrel. If your metal barrel has an outer diameter that is not listed as an ID on one of the 3D printed barrels, then you must modify one in a computer aided design software or

print one that has an ID that is slightly too small, and then drill it out to the size you need. Here is an example; If you have a metal barrel with a 0.667 outer diameter, then print a 3D printed barrel that has an inner diameter of 0.6 and then after it's printed, drill the inside to around 0.68. Remember, the goal is for your metal barrel to fit straight and snug into the 3D printed barrel.

METAL BARREL CUT AND INSTALLATION

Now that you have a 3D printed barrel and a metal barrel that fit together, it's time to cut your metal barrel to size. Keep in mind that when you have a round in the chamber of your metal barrel, the back of the case may protrude out the back of the barrel.

Slide your metal barrel into the 3D printed barrel, with the chamber end of your metal barrel at the back of the 3D printed barrel. Then put a dummy round or a live round into the chamber, and push it, along with the metal barrel, forward until the back of the round is flush with the back of the 3D printed barrel. Now you can mark the metal barrel where it first protrudes from the front of the 3D printed barrel. The marking should be behind the front/tip of the 3D printed barrel (see image).



Where you have the mark is where you will cut your barrel. You can cut your barrel in many different ways, with a special pipe cutter, hacksaw, grinder etc. It doesn't have to be perfect, but try to cut as close to your marking as you can. If you make a sloppy cut, you can clean it up with a file or a rotary tool.

Now that your metal barrel is cut to size, install it back into the 3D printed barrel and insert a dummy round or live round into the chamber. Then push the round and barrel forward until the round is flush with the back of the 3D printed barrel, and check to make sure the metal barrel is not extended out of the 3D printed barrel at the front. If it is, grind or cut it down until it isn't.

If the metal barrel's size is now correct, you can now glue it permanently into the 3D printed barrel. Almost any glue can work for this job, but J-B Weld or epoxy is recommended. The barrels are glued together in the same position as you used to find where to cut the barrel. Insert a dummy round or live round into the chamber of the metal barrel and slide the round and metal barrel into the 3D

printed barrel until the back of the round is flush with the back of the 3D printed barrel. This position is where the metal barrel must be glued into place. Make sure not to get any glue into the inside of the metal barrel or onto the outside of the 3D printed barrel. Once your glue dries, the Songbird PM4C barrel is complete.

FIRING PIN CONSTRUCTION

The Songbird PM4 Center-fire uses a modified carpentry nail as a firing pin, and is very simple to make. Although successful use of a 3D printed firing pin has occurred, use of a 3D printed firing pin is not recommended due to its poor reliability and short lifespan.

To construct a PM4C firing pin you will need a metal nail that is at least 15mm (0.59 inches) long, with a 2.5mm to 2.8mm (0.098inch to 0.11inch) shank diameter, and a head diameter of 5mm to 8mm (0.2inch to 0.31inch). This nail will need to be cut to a length of 14.5mm +/- 0.5mm (0.57 inches +/-0.02 inches) using a hacksaw, grinder, rotary tool/Dremel tool, etc. If the nail is too short, it may cause light primer strikes or may not hit the primer at all. If the nail is too long, it could scrape the barrel and bullet casing during loading (making the barrel harder to load into the firearm), or it will prevent the loading of the barrel into the firearm completely. Once the nail is cut to the perfect size, a pointed tip must be constructed. This can be achieved by grinding the sides of the tip at a 45 degree angle with sand paper, a grinder, rotary tool/Dremel tool, etc. During the process of grinding the tip of the nail to a point, be careful not to reduce the length of the nail, because as previously stated, the length of the nail is imperative.

Once the nail has been cut and the tip has been ground into a point, the Songbird PM4 Center-fire firing pin is now completed. **13**

SONGBIRD PM4 CENTER-FIRE FRAME COMPARTMENT AND GENERAL ASSEMBLY

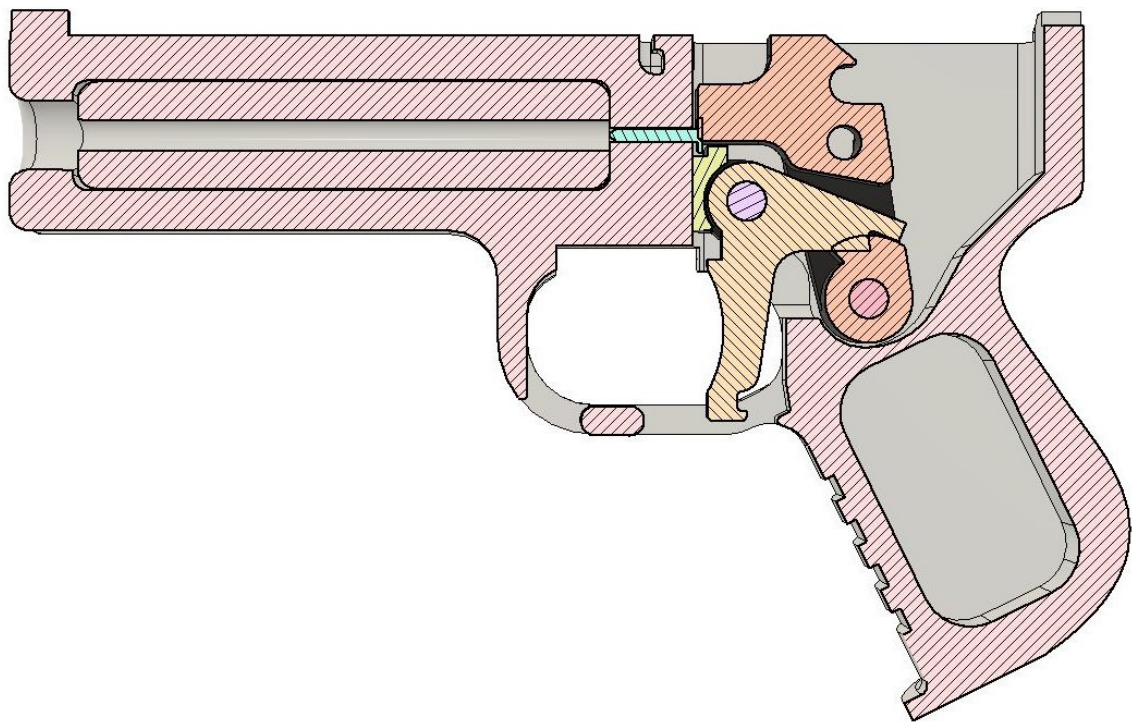
NOTE: See the included Songbird PM4C General Assembly document for a more visual look at the PM4C general assembly.

FRAME COMPARTMENT

In some countries, states, provinces, and/or counties across the world, the Songbird PM4C is only legal if the builder/operator secures a certain amount of metal into the frame of the firearm. This is the purpose of the compartment in the PM4C's frame. If the PM4C builder/operator chooses to comply, they can glue the required amount of steel into the frame compartment, located in the grip of the firearm. Whether the builder/operator chooses/needs to glue any metal into the frame compartment or not, they should glue the frame cap over the compartment to complete the frame. This can be accomplished with almost any glue. After the frame cap gluing process, when the glue has dried the frame is ready for assembly.

SONGBIRD PM4C GENERAL ASSEMBLY

The Songbird PM4 Center-fire is one of the easiest firearms to assemble, made of only 11 to 15 parts (depending on the frame type, barrel used, etc.). Before assembly, make sure all surfaces, holes, curves, and cracks are smooth, and without burrs or other unwanted material. Remove any unwanted material with sand paper, metal files, a rotary tool/Dremel tool, etc.



Start the assembly by inserting the firing pin from the back of the frame (see the firing pin highlighted in blue in the picture above). The firing pin should be able to freely move forward and aft. If the firing pin is hard to insert into its position, or refuses to be inserted at all, then the hole may have been printed too small. This may happen if your printer wasn't properly tuned before the printing of the frame. There are two ways to fix this issue. The first way would be to insert a small needle file or drill bit into the firing pin hole and grind the sides of the hole, as symmetrically as possible, until the firing pin can be inserted and move freely. The second way to fix this issue would be to grind the shank of the firing pin (nail) with a file, rotary tool/Dremel tool, etc. as symmetrically as possible, until the firing pin shank is a small enough diameter that it can be inserted into the frame and move freely.

NOTE: During assembly, some or all 3D printed parts may need sanding/filing in order to fit together. This could be caused by many different 3D printer phenomenons.

Next in the assembly is the firing pin retainer (see above image, the firing pin retainer is highlighted in yellow). Insert the firing pin retainer into the frame behind the firing pin with the flat side facing forward. The flat side should be touching the wall of the frame with the tab on top behind the firing pin, and the holes on the firing pin retainer lined up with the trigger pin hole in the frame.

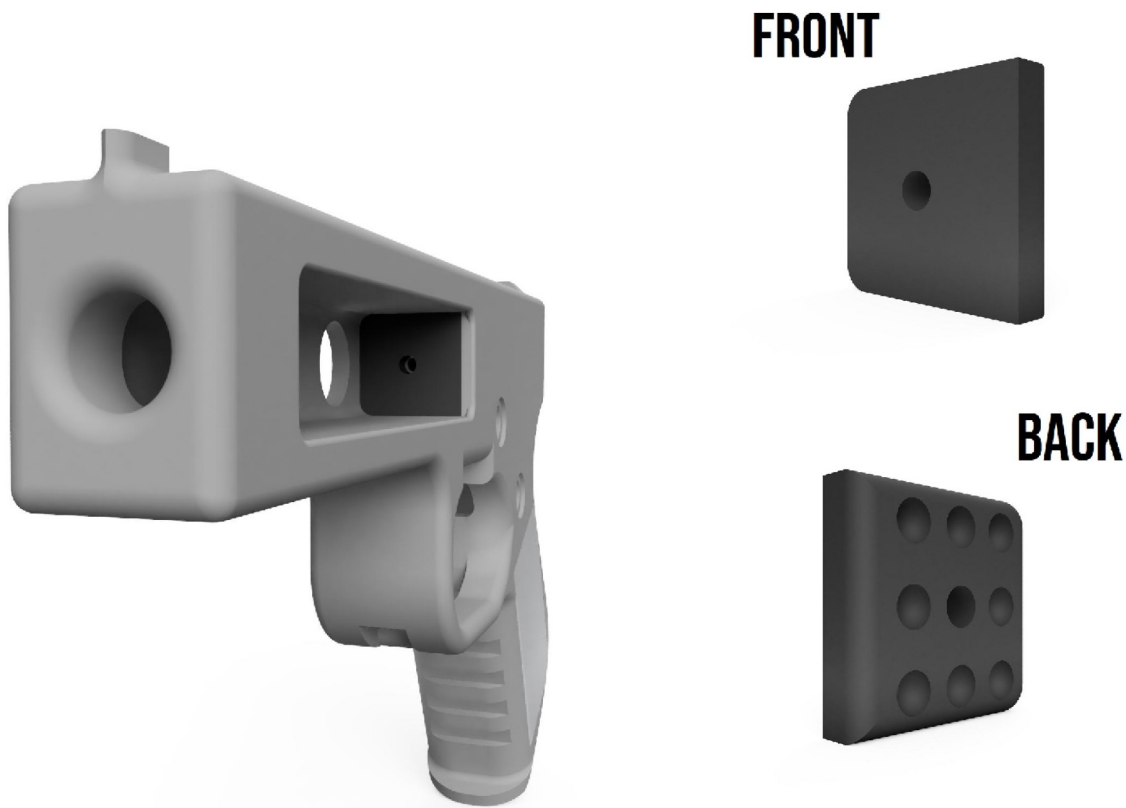
Now we can insert both the trigger and hammer into the frame at the same time.

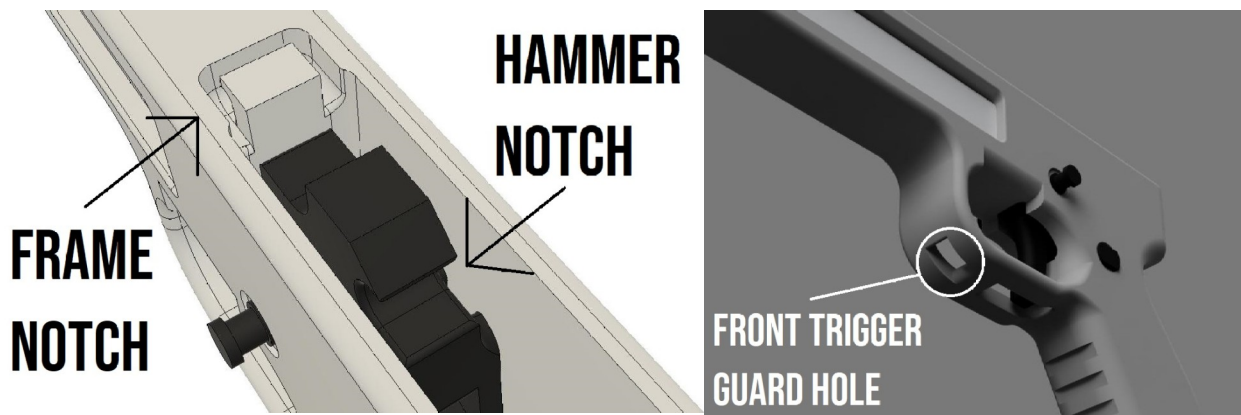
Do this by inserting the back of the trigger into the hammer from the front (see image on right). Then you can slide both into the frame with the trigger pin hole in the trigger, lined up with the trigger pin hole in the frame and firing pin retainer.



We can now slide the trigger pin into the trigger pin hole in the frame, trigger, and firing pin retainer. Then slide the hammer pin into the hammer pin hole in the frame, and the hammer itself. If you would like to secure the hammer pin further, you can use a safety pin, paper clip, bent straight pin, etc., to slide through the hole that is on one side of the hammer pin, and lock it in place.

If you are assembling the recoil pad frame, you can now install the recoil pad. To do this, all we have to do is glue it into place at the back of the barrel chamber (almost any glue works for this application). First we can apply a small amount of glue to the back of the recoil pad (the side with nine holes) and/or the inside of the frame where the recoil pad is to be installed. It is extremely important that glue does not touch the firing pin or the firing pin hole during the recoil pad installation, use extreme caution. Now, we can insert the recoil pad into its position with the front (flat side) facing the front of the firearm and the curved edges facing the firearms right side. Push firmly on the front of the recoil pad to make sure it is seated all the way into its position. After the glue has dried, the recoil pad should not extend out of its housing. The recoil pad should be flush with the corner of the barrel housing.





At this point, all that's left to do is install the hammer rubber band and the trigger rubber band. Install the hammer rubber band by looping it around the notch in the hammer and the notch in the frame. The hammer rubber band has to be pretty tight, so you may need to fold the rubber band and then loop it back into place. To install the trigger rubber band, push one side of the band through the front hole in the trigger guard and loop it around the notch in the bottom of the trigger. Then, stretch the other side of the rubber band and loop it around both sides of the trigger pin. If you have a small rubber band for the trigger band, you can push one side through the front hole in the trigger guard and loop it around the trigger notch like before, but then take the other side and attach it to the trigger notch as well but without tucking it through the front trigger guard hole.

The Songbird PM4 Center-fire is now assembled and ready for testing at the range.

SONGBIRD PM4 CENTER-FIRE USE AND ADJUSTMENTS

DRY FIRE TESTING

The Songbird PM4C is now assembled. Before the firearm is tested with live ammunition, it should first be tested by dry fire. For this testing the barrel should not be inserted. Now pull the hammer back until the trigger clicks and locks the hammer in position, and fire by pulling the trigger. This action is safe to do with the PM4C, it should feel and sound pretty smooth. If the trigger or hammer is rubbing against anything, you may need to remove the firing mechanism, file or sand the required parts, and re-install. The trigger should be harder to pull than other firearms, as this will guarantee a hard enough hit to set off bullet primers. If the trigger is too easy to pull, de-cock the firearm and adjust the hammer rubber band accordingly. Next it would be a good idea to again check the fitment of the firing pin. Make sure it isn't too loose around the sides but can slide back and forth very easily. Lastly, check to see if the amount of protrusion from the inside of the frame is correct for the firing pin tip. When the firing pin is pulled all the way back, the tip should not protrude out of the frame and into the barrel chamber. When its pushed forward it should stick out around roughly 5mm (0.19 inches). The Songbird PM4C is now ready for live fire testing.

LIVE FIRE TESTING

Now for the fun part: live fire testing. If you live in an area where gunfire or loud noises are frowned upon and you don't have access to any other area, you may want to use a suppressed bullet trap. Check to make sure there are no obstructions in your barrel and load a round. Pull the hammer all the way back and then let it rest on the trigger, then make sure the firing pin is out of the way of the barrel. Insert the front of the barrel into the firearm first and then slide in the back and lock it into place. If you are using barrel type 2, you will need to lock the barrel in place with the barrel 2 retainer. Do this by sliding the retainer into its position, which is under the barrel inside the trigger guard, and secure it with another rubber band using the two tabs on either side. The Songbird PM4C is now ready to fire. Pull the trigger. If it fires, great! If the hammer drops but does not ignite the primer, you want to check the primer on the bullet case first. Take the barrel out and check to make sure the primer was even hit by the firing pin. If the primer was not hit by the firing pin, then this means either the firing pin is too loose in its housing, making it hit off center, or it means the barrel is off center. Correct this with a new firing pin or barrel. If the primer was hit but it didn't ignite, this means you need to tighten your rubber band so that the hammer hits harder. At this point the Songbird PM4 Center-fire is complete and in working order.