

# CSV Pneumatic Antenna Launcher Assembly Instructions



2019 CSV19 Antenna Launcher with Mini Coaxial Reel and Launch Balls  
Barrel Painted with Krylon Fusion Safety Blue

*Revised for the Threaded Valve design March 2010, Updated November 22, 2019*

## Introduction

These are the instructions for assembling the new model threaded Pneumatic Antenna Launcher kits which started shipping in 2010. You can tell if your kit is threaded by the main valve. If it is threaded on the input and output ports then the kit is threaded. Otherwise the ports will be smooth inside for cementing. For information on assembling the older solvent-socket design, see <http://www.antennalaunchers.com/csv19/csv19asm.html> for the pre-2010 instructions.

These instructions cover several sizes and variations of CSV (Compact Sprinkler Valve) Antenna Launcher. The number following the designation refers to the overall length, so CSV17's are about 17" long while CSV19's are 19". The pressure chambers are either 3" or 4" in diameter. Special longer models also can follow these instructions, the differences are just barrel and chamber length. The photos will include different models and variants of launchers so may not be exactly like the parts you have.

## Order of Assembly

The order of assembly has been changed in this set of instructions to better align the barrel and chamber to the new Barrel-Chamber Spacer. Do not mix these instructions with earlier instructions that may be in a different order.

## Miscellaneous

I changed my callsign from WB6ZQZ to W6AKB after our Field Day group ([www.hsfdg.org](http://www.hsfdg.org)) tried to use it one year. So you may find either callsign on documents or labels. Eric WD6CMU was a collaborator on the initial conceptual development of Pneumatic Antenna Launching, and he made the mounts for the Saunders Zip Reels for many years. Unfortunately those reels are no longer produced, if you have one take good care of it. The new 3D Printed Mini Coaxial Reels work quite well and take less space to store. More detail on Antenna Launcher history and development can be found at [www.AntennaLaunchers.com](http://www.AntennaLaunchers.com).

3D Printing has added a number of new parts to improve our Pneumatic Antenna Launchers, and it has also added a number of tools and holders that we use in the production of pre-assembled launchers. Some of those tools and holders will be visible in the photos. Other than the ball holding tool included in the Super Kits, these tools are not included in the launcher kits.

## Feedback

These instructions are under development. Use this document with care. If you have any questions contact us and get them resolved before proceeding. Please send questions or feedback to sales at akbeng dot com. Pictures and video clips will be added as this document matures. Thanks for your patience and help!

## 2019 Update

The instructions are being moved to Google Docs format and updated. The launcher design has not changed since 2010, but some of the parts (and the order of assembly) have been updated. Depending on when your kit was prepared (and which kit variant was purchased) the parts may differ. Contact us if you want to update your parts to the current versions before assembly (primarily the trigger strut and barrel-chamber spacer).

Trigger Struts are now provided for and recommended for all launchers (in the past they were supplied only for Super kits). They used to be aluminum, the updated struts are 3D printed plastic with built in washers and flexures to reduce stress. The purpose of the trigger strut is to keep the trigger from rotating on the threads into the valve top.

Precisely fitted Barrel to Chamber Spacers are now provided and recommended for all launchers, in the past they were supplied only for the four inch diameter chamber models (and they were simple spacer blocks not precisely fitted). Spacers have been redesigned with custom 3D printed plastic to match the curvature of both the barrel and the chamber and have the proper spacing to match the fittings. They have internal slots to accept a large cable tie and provide better support for the barrel and chamber.

## Assembly Preparations

### Parts Inventory

It is advisable to inventory the Launcher parts both to familiarize you with the parts and to insure that all parts are present. Refer to the packing list and verify the parts against these instructions.

Inspect the parts for damage or cracks. Do not use damaged parts - replace any bad parts before assembly.

### Tools and Supplies



Fusion Single Step, Purple, Clear Primer and PVC Cements from Oatey

A pressure rated PVC Pipe Cement system should be used. The type of available cements and primers vary by locale. In our area Purple Primer is required for plumbing code, and this combination insures an excellent cement bond that can be easily inspected. Clear primer is available and avoids the purple stains, but is harder to see and use. Recently single component cement that does not need a separate primer has become available. This is easier to work with and we now use this on the launchers we assemble. Throughout the rest of this document we

will refer to PVC Primer and Cement for consistency. If you are using a single component Cement then skip the primer steps.

## Threads and Sealing

The threaded joints in the launcher are National Pipe Threads (NPT) which are tapered. They get narrower as they go deeper in the hole. They are not self sealing, sealant is required. Pipe sizes refer to nominal inside diameter and small sizes have much larger threads than the pipe sizes called out. So 1/8" NPT threads are about 3/8" diameter, and 1/4" NPT threads are about 1/2" diameter.

Teflon tape is provided with the Super kits for sealing threads. This works and is safe to ship, but you may prefer to use Rectorseal Number 5, or other quality sealing paste as long as it is compatible with plastic, brass and compressed air.

## Safety

Always work with cement, primer and paint in an area with adequate ventilation. Read and follow the instructions on the PVC cement, primer, thread sealant and paint. Wear eye protection when building and using the launcher. Do not work near an open flame or other ignition sources. Do not smoke near cement, primer and paint as they are extremely flammable.

## Organize and Prepare Work Area

Insure the work area has good ventilation. A fan is recommended to blow fresh air and push fumes away.

Make sure there is adequate lighting in the work area.

Make sure that the work surface is protected from the solvent cement, primer and paint. Layers of paper or cardboard should be spread on the work area.

Protect your good clothes from cement, primer and paint splatter. Wear old clothes or a shop coat or apron and old shoes.

Print out the instructions or set up a computer nearby to use. Insure the computer is safe from any primer, cement or paint splatter.

## Preparing the PVC

Remove any tape or stickers from the PVC in the areas that will be painted or cemented. Labels, tape or stickers in other locations may be left or removed, it is up to the builder.

Wash the PVC parts with detergent and warm (not hot) water and rinse well. Pot scrubbers (such as Brillo pads) may be used on the barrel and pressure chamber pipes (but are not recommended for shiny parts such as PVC fittings).

Make sure that PVC is clean and dry before painting or cementing.

Be very careful about test fitting the PVC parts, do not force them together or they may become stuck. The tapered fittings will slide together easily when lubricated by the cement but when dry they can become very difficult to separate.

## Painting

Painting is optional. If you don't plan to paint then skip this section and jump down to Initial Assembly.

PVC can be painted if the proper preparation and paint is used. Krylon Fusion works well if allowed to dry sufficiently to become fully hardened. If you choose to paint the Barrel it is best to paint it before assembly. The pressure chamber and U sections are better painted during assembly after cementing to prevent reactions with the paint. Mask off the areas to be cemented (a bit under 2 inches from the end(s) on barrel and chamber) to prevent painting the surfaces to be cemented.

Make sure the paint dries according to the manufacturer's instructions before handling or cementing the parts. Fusion recommends 7 days to protect against chipping and scratching.

## Initial Assembly

### Introduction to PVC Solvent Cementing

PVC joints are strongest if the PVC Primer is used (and the PVC is clean, dry and tightly fitted). Primer (if used) and then Cement is applied and the parts are joined and held for a short period of time while the cement 'sets'. It is important to hold long enough that the parts don't "back out". Review the Manufacturer's instructions for your PVC cement and primer to use it correctly.

If you are using the purple primer - it stains, so it pays to think which way the primer will run (downhill) and orient the part so the runs are not staining the visible portions. Keep your fingers clean and use absorbent paper on the work surface to catch the drips. Nitrile exam gloves may be used to keep the cement and primer off the skin.

## Preparation

In the next step you will be locating some items and setting them aside.



Ball Holding Tools and Loop Kit

If you have a Super kit locate the Launch Ball Loop Kit and Ball Holding Tool and set these aside. Shown above are several different versions of the Ball Holding Tool. Whichever one is in your Super Kit it is designed to hold the ball and prevent it from rolling while you are working on it. The preparation of launch balls is covered after the launcher build instructions in this document. The Loop Kit is nylon covered stainless steel wire and crimp tubes sufficient for making six launch balls.

## U Assembly



Barrel Endcap, Upper Elbow, Elbow Joiner pipe, Lower Elbow, Threaded Bushing

Locate the Upper and Lower Elbows, the Elbow Joiner Pipe and one Threaded Bushing, as well as the Barrel Endcap. Note that the upper and lower elbows are the same material but the upper has been modified so that it fits fully into the round hole bored into the Barrel Endcap. Determine which end fits easily and fully into the barrel endcap. There is usually a raised bump that is ground away to allow the endcap to sit properly on this elbow. **Mark this end** to keep track of it and **do not** install the threaded bushing on this end. Set the Barrel Endcap aside, **do not** attach it to the “U” at this time. The bushing will go into the opposite end of the U later in this section.

Find the seams on the elbows (on the end with the lettering). One end has two ridges along the sides from the casting of the part as well as the lettering. The ridges are used to precisely align the elbows when the U is assembled. These ends are joined by the Elbow Joiner Pipe.



Prime the inside of the Upper Elbow on the end with the text. Take care to orient the part so the primer runs downhill inside the elbow and keep the outside of the elbow primer free.

Prime half of the Elbow Joiner Pipe. This half will be installed in the elbow.

Apply cement inside the Elbow on the end with the text (that you already primed).

Apply cement to the primed half of the Joiner Pipe.

Seat the Tube into the seamed end of the Upper Elbow and hold it until it sets.

Prime the inside of the Lower Elbow on the end with the text. Take care to orient the part so the primer runs downhill inside the elbow and keep the outside of the elbow primer free.

Prime the half of the Elbow Joiner Pipe that is sticking out of the Upper Elbow.

Apply cement inside the Elbow on the end with the text (that you already primed).

Apply cement to the primed half of the Joiner Pipe.



Slide the Lower Elbow fully onto the Joiner Pipe and quickly align the seams to make the U flat. Pushing it down hard against a flat surface can also help align it, but it must be done immediately, before the cement sets. Clean off excess cement oozing out of the joint.



“U” Elbow Seams Lined Up

Verify which end of the U goes into the barrel endcap (the Upper Elbow). Install the bushing into the other end (the Lower Elbow) in the next step.

Prime the inside of the lower elbow and the outside of the Threaded Bushing. Apply cement to the inside of the Elbow and the outside of the bushing. Seat the bushing fully into the Elbow and hold until set. Set the U assembly aside to dry at least an hour before handling.



## Barrel Endcap Assembly



Locate the Barrel and Barrel Endcap. Prime the end of the Barrel and the inside of the Endcap. Apply cement inside the Endcap. Seat the barrel fully into the Endcap and hold until set. Set aside to dry for at least an hour before handling.

# Pressure Chamber and Valve Assembly

## Introduction

Now you have had experience with PVC Solvent Cementing. In the next steps you will be assembling the more critical joints that have continuous pressure when the launcher is pressurized. Leaks in these joints will cause the pressure to fall off, so minimizing this leakage is especially desirable. Make sure to use PVC primer and sufficient cement on both surfaces to facilitate full depth seating and adequately seal the joint.

The following steps will no longer call out the primer and cement application in detail but you should continue to use the recommended procedures for assembly.

## Pressure Chamber assembly



Locate the pressure chamber rear endcap (3-4" endcap with bored hole), a threaded outlet bushing that fits this hole, and bushing support tube that fits over this bushing on the inside of the endcap. The size of the endcaps varies with different launchers, so the photo may not be exactly the parts you will be using.



Install the rear chamber endcap outlet bushing into the bored endcap from the outside. Use PVC primer and plenty of cement.

Install the bushing support tube on the outlet bushing from the inside of the endcap. Use PVC primer and plenty of cement. Set this aside to dry for at least 60 minutes before it is handled.



Locate the pressure chamber pipe and forward endcap (same size endcap without a bored hole), and the pressure chamber pipe. The size of these parts varies with different launchers (three or four inch), so the photo may not be exactly the parts you will be using.

Draw a pencil line  $1\frac{7}{8}$  " from each end around the pressure chamber pipe. Use this line to guide the application of primer and cement to the end of the pipe to keep it inside the endcap when assembled.

Install the pressure chamber pipe to the forward endcap. Use plenty of PVC primer and cement for this large joint. Insure this pipe is fully pushed into the endcap. Hold until set. Allow the pressure chamber components to dry for at least 60 minutes before proceeding to the next step.





Install the pressure chamber pipe and forward encap assembly to the rear endcap assembly. Use plenty of primer and cement for this large joint. This completes the cementing on the pressure chamber. Set aside the Pressure Chamber to dry undisturbed for 24 hours before drilling and tapping. You may continue with other steps below.

## Barrel to Endcap Assembly



Install the Barrel into the Barrel Endcap using PVC Primer and Cement. Prime both parts but use cement only inside the Barrel Endcap. Insure that the Barrel is fully seated into the Endcap. Hold in position until set.



At this point the U, Pressure Chamber and Barrel to Endcap are complete and only one PVC cement joint remains, and that will be left for later to insure the best alignment between the barrel, chamber and spacer.

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## Trigger Assembly



Unthread and remove the flow restrictor from the tip of the trigger, if it is there. In the photo above it is the tube with transverse large holes on the upper end of the blow gun. Discard this part. If the flow restrictor is left on the trigger it will reduce the performance of the launcher.

Drill a hole in the tip of the trigger to mount the strut using a  $7/64$ " bit located about  $5/16$ " from the end of the trigger on the side as shown below. Make sure that the metal chips from the drilling process do not get into trigger, after drilling shake them out. Screw the self tapping screw through the trigger strut and into the hole with the text facing away and upright with the trigger pointed upward.



Remove the screws holding the main valve top to the valve body. Set aside the valve top, screws, rubber diaphragm and spring. They will be reinstalled later.

Unthread the brass elbow from the valve top.

Use teflon tape (or sealing paste) on the adapter tube threads. Thread the trigger to the trigger adapter tube, and the adapter tube into the brass elbow. Tighten finger tight and continue 1½ to 3 turns until aligned as shown. With the trigger on the table and the strut upward, the trigger elbow's male threads should point up perpendicular to the table.



Use teflon tape (or sealing paste) on the brass elbow threads. Carefully thread the trigger elbow into the valve top. **DO NOT CROSS THREAD.** Turn in about two and a half turns and align as shown, with the trigger over the large circular ring in the valve top and clearing all six of the screw mounting holes. Avoid turning too deep into the valve top. The trigger may or may not be snug, the strut will hold the alignment later when assembly is complete.



## Drill and Tap Pressure Chamber

***\*\*Insure the Pressure Chamber has dried for 24 hours before proceeding on this step\*\****

There are two or three locations to drill and tap in the chamber. If you have a pressure relief valve to install (included in Super kits) it will require the third hole. If there is no relief valve there will be only two holes to drill and tap. All holes must be drilled and tapped into the plastic in areas where it is double-thick. This provides more support and depth for the threads.



CSV19 Pressure Chamber Marked Up

Position the chamber with the outlet toward the left as shown above. Choose (or make) a line down the length of the chamber, the barrel will sit over this line. In the photo above, there is a blue line on the chamber that is used for this example. Measurements are from this line, and

from the edges of the endcaps. 1½" outward from the edges of the endcaps and 1¾" downward from the center line locate two holes F and G for Fill Valve and Gauge as shown.

If you have a safety pressure relief valve a third hole goes to the left rear (upward), 1¼" on a CSV19 or 1" on a CSV17 from the centerline and 1½" from the edge of the endcap. This is marked S in the photo above.



Drill the holes initially with a small bit and then enlarge to 5/16". Make the holes perpendicular to the chamber tube. A drill press is good but it can be done with a hand drill. Go slowly and carefully. If possible use drill bits designed for plastic, but wood or metal bits will also work. (Note - if the tap won't start into the hole a slightly larger hole may be required such as size "R" or 11/32".)



Tap these holes with a  $\frac{1}{8}$ " NPT (National Pipe Thread) tap (included in Super kits). Keep the tap straight in the hole and run it in only about  $\frac{2}{3}$  of the way in to make the tapered hole tight enough (if the tap is run deeper it will loosen the fit). Using a couple drops of oil on the tap makes the threads cut cleaner. Use the normal procedure for tapping - 1 turn in,  $\frac{1}{2}$  turn back, etc.

After tapping clean the Pressure Chamber of all bits of PVC. Use a shop vac, compressed air or water rinse to get it clean. Get the tank as clean as you can, any bits of plastic that remain may foul the valves and make leaks later on. Dry the tank if water was used.

## Tank Valve and Gauge Installations



Apply teflon tape (or thread sealing paste) to the threads of the Schrader Fill Valve, Pressure Gauge, and (if applicable) the optional Pressure Safety Relief Valve.

Install the Fill Valve in the threaded hole farthest away from the Tank Outlet, toward the front of the tank. Proceed with care to avoid cross threading. Tighten finger tight, then using an appropriate wrench tighten 2 more turns.

Install the pressure gauge in the threaded hole near the outlet (in line with the fill valve) finger tight. Tighten the Pressure Gauge carefully about 2 more turns using a thin wrench, stopping with the gauge aligned as desired. Avoid trapping the wrench and damaging the gauge.

If applicable, install the optional Pressure Safety Relief Valve into the remaining threaded hole. Tighten finger tight, then 2 more turns.

### Install Main Valve

Apply two turns of teflon tape (or thread sealing paste) to each end of the chamber to valve short threaded joiner pipe.

Thread the short pipe into the chamber outlet finger tight.



Thread the main valve onto the joiner pipe finger tight, insuring the flow arrow is pointing away from the pressure tank. Continue 2 turns further and stop with it lined up. The seam in the valve should be lined up with the line drawn earlier (under where the barrel will sit), and the open side of the valve pointed to the side where the pressure gauge is located.



## Install Trigger



Place the diaphragm and spring on the Main Valve oriented as shown in the photo. The holes in the diaphragm and valve top will line up when it is correct. The spring points away from the valve body (and snaps onto a nub on the diaphragm).



Set the valve top in place on the diaphragm oriented so the holes all line up.

Insert the first screw into one of the holes in the valve top. Hold the valve top down against the valve.



Turn the screw backwards gently till it clicks. Then turn the screw gently forward so it follows the existing threads (easy to turn) and avoid cutting new threads in the plastic (hard to turn). Tighten till the screw just touches the plastic of the valve top.

Repeat for the opposite screw, then do the remaining 4 screws.

Alternately tighten the six screws evenly until the rubber diaphragm is just slightly squeezed. Do not overtighten.

## Pressure Test



Inspect the Launcher. Look for cracks or other damage. If the launcher is damaged it will have to be repaired or destroyed. Do not apply pressure to a damaged launcher.

Use Safety Glasses and Hearing Protection for the following steps.

Fill the pressure chamber to approximately 40 psi. Wait one minute for the pressure to stabilize and refill to about 40 psi if it has dropped. New launchers may initially drop in pressure as the valve seats. Disconnect the pressure source and note the actual pressure.

After 5 minutes read the pressure gauge again. If the pressure has dropped more than 5 psi see the following section on Leak Repairs.

Increase the pressure to the maximum pressure (80 psi for the CSV19 and 90 psi for the CSV17). Allow to sit at maximum pressure for 10 minutes to complete the pressure testing.

Bleed the pressure down by gently depressing the core pin of the fill valve inward.

## Leak Repairs



Leaking in the Main Valve Threads

If the launcher is holding pressure skip this section and proceed to Final Assembly below.

If the launcher is leaking the first step is to determine where the leak is. The best way to find a leak is to immerse the pressurized chamber in water. The only part that water will damage is the pressure gauge - the scale inside is cardboard and not protected against water. Don't submerge the plastic part of the gauge.

If the leak is in a cemented joint it may be difficult to repair. You can try to soak some PVC cement into the leak area. If that doesn't work the best thing is usually to get replacement plastic parts and remake the chamber.

If the leak is in threads try tightening them slightly, if that doesn't work (or is impractical due to alignment requirements) then disassemble, clean the threads, redo the sealant and reassemble. Consider the sealant used and insure it is the correct type for plastic and/or metal and compressed air, and that it was properly applied. Good paste sealants like RectorSeal number 5 or PTFE paste may seal better than teflon tape.

If the leak is coming through the main valve (or around the diaphragm edges) the valve can be disassembled and cleaned. Remove the strut screw on the barrel endcap to free the trigger, then the six screws in the valve top. Clean the diaphragm and valve seat. Reassemble.

If the leak is in the main valve or tank outlet threads disassemble, clean off the sealant, apply new sealant and reassemble. If the threads are damaged replace that part. If the short pipe breaks off and is difficult to remove we can supply a smaller pipe to cement into the broken part to remove it, contact us for details, or find a broken pipe extractor tool.

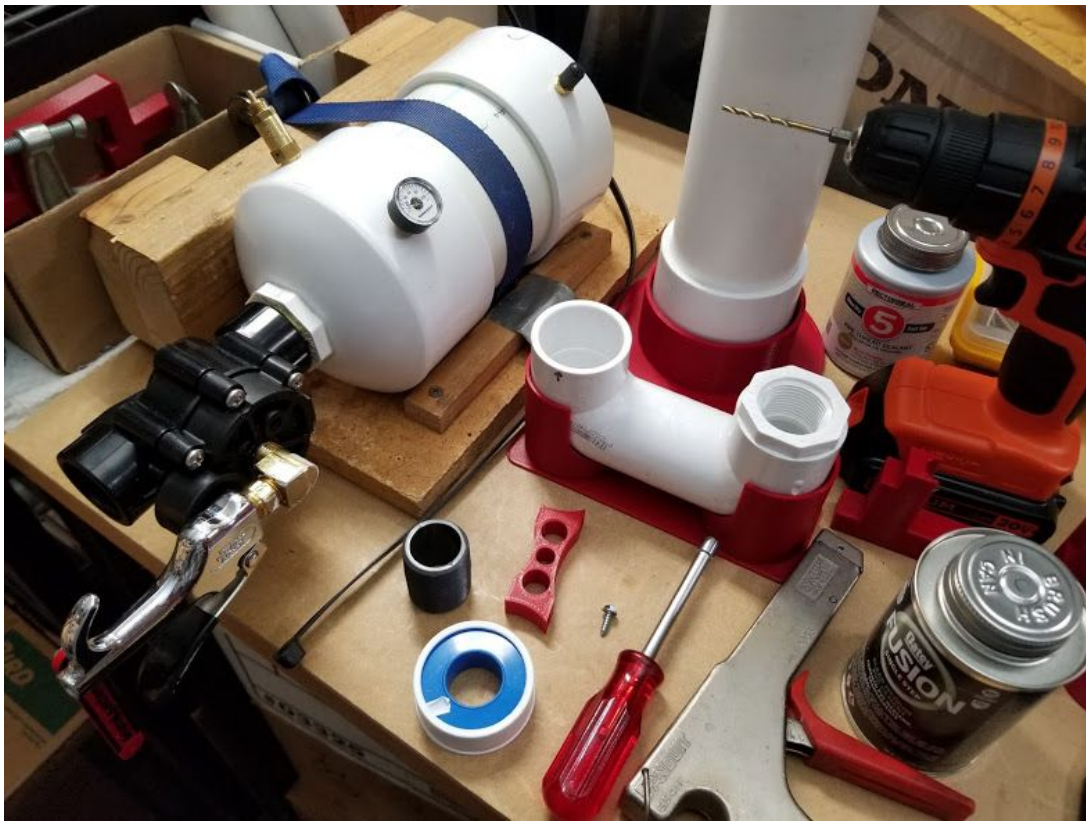
If the leak is coming through the trigger valve it should be cleaned out and retested, if it still leaks it must be replaced.

If the leak is coming through the pressure relief valve it should be disassembled and cleaned. During reassembly maintain the number of threads showing above the locknut as this determines the pressure relief setting.

If the 1/8" NPT threads into the plastic are damaged they can be drilled out and retapped to 1/4" NPT and a bushing installed, or remake the chamber with new plastic.

After making repairs repeat the Pressure Test.

## Final Assembly



Apply teflon tape (or sealant) to both ends of the gray short threaded PVC pipe. Thread it into the valve outlet finger tight. Tip the trigger up to vertical and swing the strut up out of the way. Thread the PVC "U" onto the PVC pipe finger tight. Get a good grip on the main valve and the "U" and turn it on a few more turns, stopping when it is up and parallel to the valve top.



Sit the barrel-chamber spacer onto the chamber pipe toward the forward endcap. Sit the barrel on the spacer and make sure the curvatures match the barrel and chamber. Slide the barrel endcap over the upper end of the “U” as far as it will go without forcing it. The barrel should sit fully onto the spacer and be straight and parallel to the chamber pipe. Mark the elbow lightly with a pencil around the edge of the endcap.



Remove the barrel from the "U". Apply Primer to the forward part of the "U" elbow beyond the line, and to the inside of the bored edge of the barrel endcap. Apply cement to the elbow forward of the line and reseat the barrel onto the elbow, sliding and twisting it back to the line. Insure the barrel is straight and sitting on the spacer and allow this to dry overnight.



## Strap Barrel to Chamber

After the Barrel Endcap to-"U" joint has dried install the large cable tie through the slot in the spacer, around the barrel, through the slot in the other side of the spacer, around the chamber and through the locking end of the cable tie. Position the cable tie ends behind the chamber and tighten it. Use a Cable Tie Tool to tension and cut the cable tie flush (or pliers and a sharp utility knife).





## Trigger Strut to Barrel

The Trigger Strut provides support for the trigger to keep it from moving on the threads and developing a leak.

Position the strut on the endcap as shown. Drill a 7/64" hole in the endcap near the back edge through the strut hole. The old metal struts used loose washers to space the strut to clear the thumb trigger lever, the newer plastic struts have washers built in. Install the strut screw through the free end of the strut, then into the barrel endcap. Tighten till the strut is just snug. Do not overtighten.





## Label Installation



CSV19 Complete

Clean the barrel and position the launcher for the label installation.

Peel the backing from the Label.

Apply the label to the barrel at the location shown.

## Ramrod Assembly



The ramrod assembly is friction fit. The end was a bushing on the older models, the newer units have a 3D printed ball pusher that resembles a funnel. The two piece ramrods for the PADS kit also include a coupler to join the halves. None of these parts need to be cemented, just friction fit them so they may be easily disassembled for storage. Pipes may be gray or white, and some bushings have hex flats on them while others do not and printed parts vary in color, so your parts may differ.

## Reel Assembly, Installation and Use

### Zip and Mini Coaxial Reels

NOTE - DO NOT cement the reel mounting tube to the launcher barrel. This is designed to be a friction fit for convenient removal during storage and winding operations.

If you have a Zip Reel or a Mini-Coaxial Reel it friction fits over the end of the barrel. Do not make it tighter than necessary as it may be difficult to remove. If it is too loose some masking or electrical tape may be used inside the coupling to tighten the fit. It is most convenient to remove the reel while winding the line back on, and when storing the launcher.

### Rewinding the Coaxial Reels

To properly wind the line back onto the Zip or Mini Coaxial Reels, hold the reel in the left hand by the barrel mounting tube. Wind the line with the right hand, effectively reversing the path the line follows when it flows off the reel during launching to avoid twisting the line. DO NOT rotate the reel to wind the line. This will introduce twist. DO NOT wind the line on the reel with too much tension. This may damage the reel. Wind the line with just enough tension to hold it in position. Distribute the line over the reel to facilitate smooth feeding during launch. (Note that Zip reels are no longer manufactured and cannot be replaced if damaged).

## Fishing Reel Mount Assembly



If you have a fishing reel mount (included in Super kits that don't have Coaxial Reels), attach the reel foot to the reel mounting tube. Use the supplied hose clamps to hold the foot to the tube as shown. Best performance is with reels that have large fixed spools such as ocean spinning reels.

## Launch Ball Preparation



Collect tools and supplies.

Cut wire loop material into six inch lengths using a wire cutter.

Put tennis ball into safety holding tool.



Cut a slot with utility knife.

Mark and punch holes for the loop on either side of slot.



Push one loop's ends into the holes.



Fish loop ends out through the slot.



Slip crimp tube on the ends and crimp it tight.

Push the crimp inside and funnel 2 oz of sand into the ball.



Repeat for all six launch balls.

Glue the slits closed.



Go forth and install antennas!!



### Further Information

For further information on using and troubleshooting consult the Pneumatic Antenna Launcher User's Manual at [www.akbeng.com/info](http://www.akbeng.com/info).

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