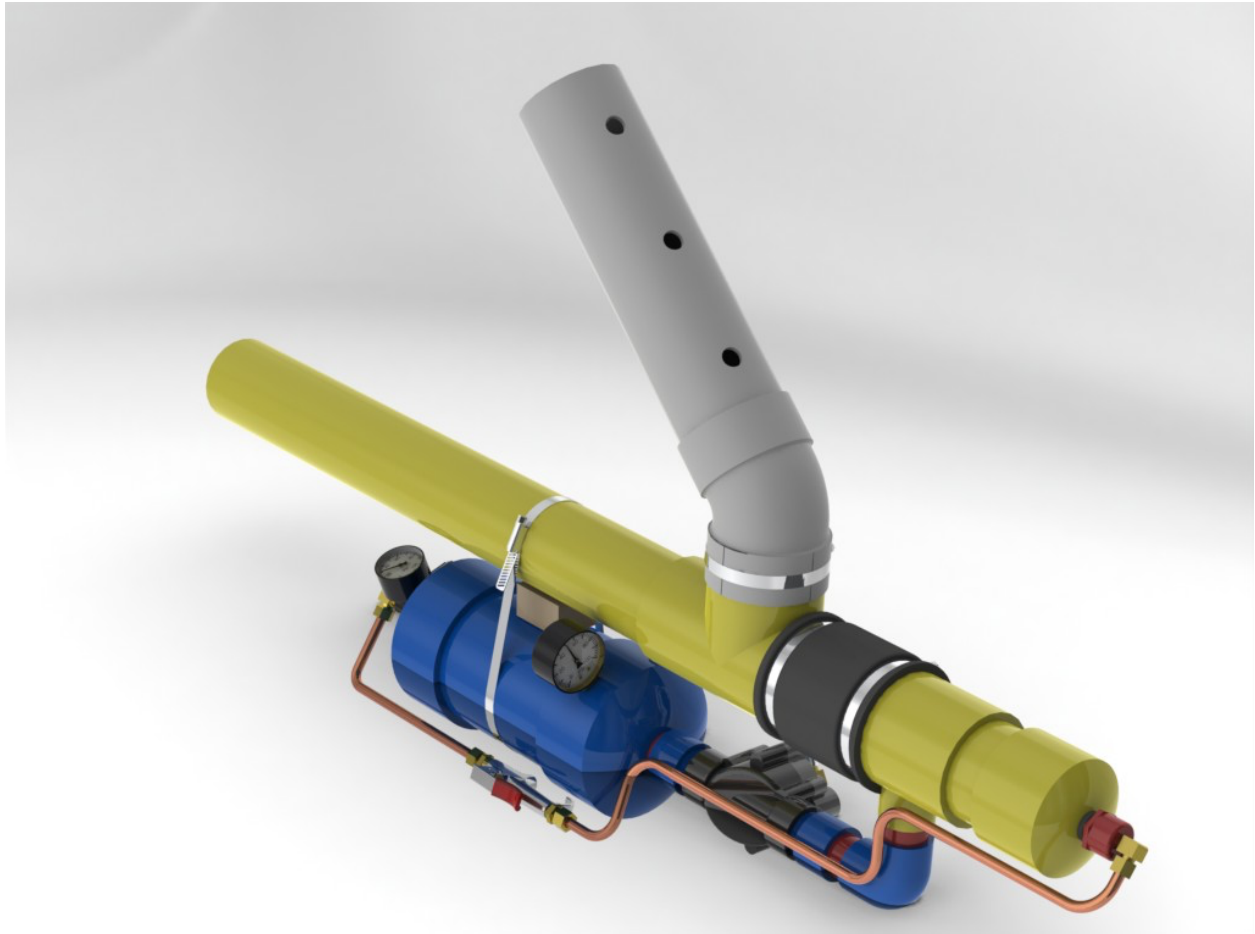


# Auto-feed Tennis Ball Cannon Assembly Instructions

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## **Introduction:**

These are assembly instructions and blue prints for The Auto-Feed Tennis Ball Cannon (AFTBC). Its unique auto feed design allows for rapid firing tennis balls without manually loading each one. The design is based on using commonly available tools and supplies to keep the cost at a minimum. Enjoy!

# Auto-feed Tennis Ball Cannon Assembly Manual

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## Operation:

The TBC uses a common air compressor to continuously charge the TBC air tank. The hopper is filled to hold the tennis balls. The bolt valve moves the “bolt” (made from a pop up sprinkler and PVC reducer) forward and which loads a tennis ball from the hopper into the barrel and seals the air passage. While that bolt valve remains pressed by the operator, (and the AFTBC is aimed in a safe direction) the firing trigger valve is pulled which causes the flow of air from the tank through the sprinkler valve through the bolt firing the tennis ball out through the barrel. Release of the bolt valve allows the next tennis ball to be loaded into the receiver and the processes starts over again. This design allows continuous, rapid fire of the tennis balls.

## Supplies:

Most supplies can be obtained from hardware stores such as ACE, Home Depot and Lowes. Items that you may not find there include:

1. The barrel for the AFTBC, it uses a thinner wall PVC pipe called Class 200, necessary as its inner diameter is the perfect size for tennis balls. Schedule 40 or Schedule 80 2.5” tube will not work as they are too thick and tennis balls won’t fit down the barrel. You can find Class 200 PVC from irrigation supply stores if not available at your home improvement store.
2. 100PSI Pop off valve. This valve releases air pressure if the tank pressure exceeds 100PSI. This is available at places where air compressor supplies are sold, as well as e-bay.
3. Low pressure air regulator with gauge. This regulator adjusts the air pressure circuit to the bolt that loads the tennis balls into the barrel. If the pressure regulator were not there, the bolt would be forced forward at full pressure causing damage to it. Again, this is available at places where air compressor supplies are sold as well as e-bay.

## Tools:

The TBC can be easily constructed using common hand tools, such as saw, electric drill, round file etc. Of course, if you have access to more capable machining tools such as drill press (or even lathe) the easier and more precise the hole cutting will be. An electric miter or chop saw with a fine blade works very well to cut the tubing square and a Dremel tool/small high speed grinder will be faster and easier than hand tools.

## Working with PVC:

1. Always work in a well-ventilated area.
2. Always use new pipe.
3. Always use Purple Primer on all joints (both outside and inside of contact areas) before assembly, this ensures proper adhesion of the PVC cement. Follow label instructions for best results.
4. Join parts with up PVC Cement, press together until seated, turn 1/8 turn and hold fast for 30 seconds. Again, follow label instructions for best results.

# Auto-feed Tennis Ball Cannon Assembly Manual

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## WARNINGS:

1. NEVER POINT THE TENNIS BALL CANNON AT ANY PERSON, ANIMAL OR ANYTHING THAT CAN BE INJURED, BREAK, DENT OR BE HARMED BY A TENNIS BALL MOVING AT HIGH SPEED.
2. ALWAYS USE NEW PIPE, IT WILL NOT BE BRITTLE AND WILL CEMENT WELL.
3. NEVER, EVER EXCEED 100 PSI PRESSURE IN TO THE CANNON. ALWAYS USE THE 100PSI POP-OFF VALVE INHERENT IN THIS DESIGN.

## **Assembly**

The assembly of the Tennis Ball Cannon (TBC) is broken down into 4 major steps:

1. Pressure tank Assembly
2. Barrel Assembly
3. Receiver Assembly
4. Bolt Assembly

And two minor steps for use:

5. Alignment and Fixing of Bolt Assembly into Receiver Assembly
6. Plumbing of Gauges & Low-Pressure Circuit

Once these first 4 main units are assembled, aligned and fixed, the plumbing and relief valves required to operate the bolt (loads tennis balls) and the main air valve will be assembled in the last two.

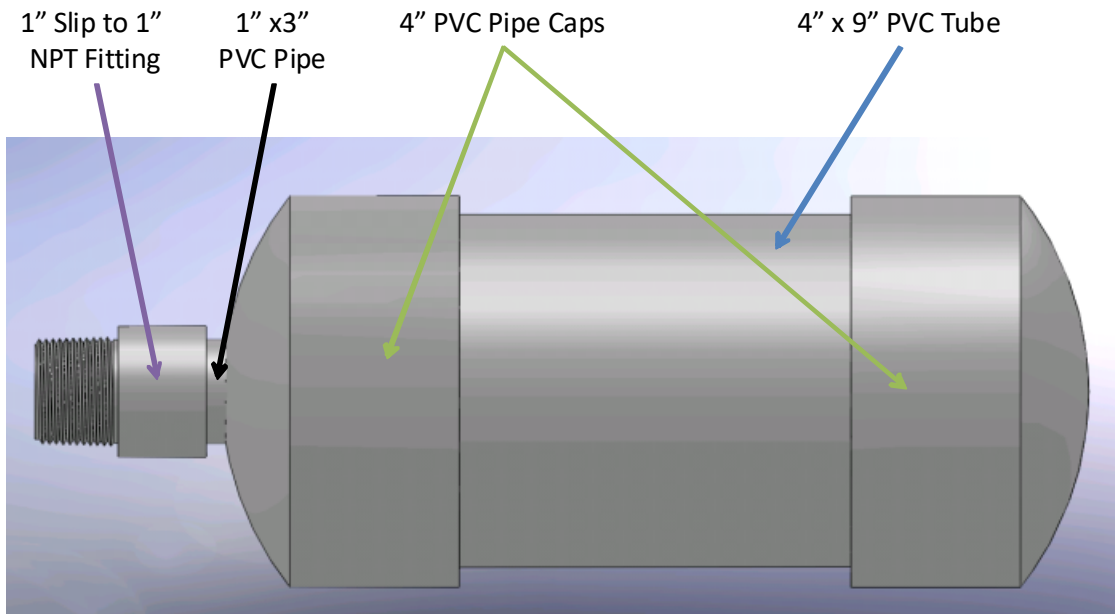
# Auto-feed Tennis Ball Cannon Assembly Manual

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## Pressure Tank Assembly

The pressure tank is constructed from 4" PVC Schedule 40 Tubing. Since this reservoir holds the compressed air, care must be taken to make sure that all joints are tight and sealed.

### Finished Tank Assembly



### Tools Needed:

1. Hand saw or electric chop/miter saw (to cut PVC pipe square)
2. Hole saw (1.25") for electric drill and cylindrical sanding drum (1") or large round rat tail file to make 1.32" hole

### Materials Needed:

1. Qty 1: 4" Round x 9" long Schedule 40 PVC Pipe
2. Qty 2: 4" PVC Pipe Caps
3. Qty 1: 1" x 4" Schedule 40 PVC piece (use the end of the PVC pipe that has been expanded to make a coupling)

OR

- Alternate - Qty 1: 1" x 4" Schedule 40 PVC piece AND Qty 1: 1" PVC Coupler
4. Qty 1: 1" Female Slip to Male NPT Fitting
  5. PVC Primer
  6. PVC Cement
  7. Epoxy Glue

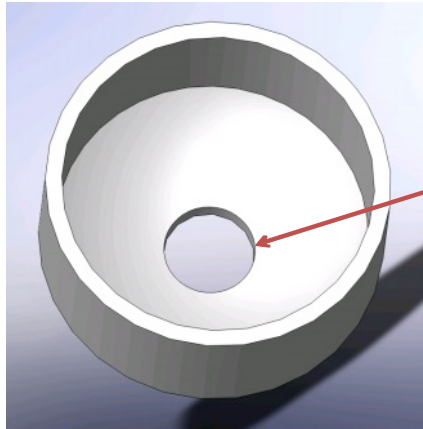
### Assembly Instructions:

1. Cut the 4" Pipe to a 9" length.

## Auto-feed Tennis Ball Cannon Assembly Manual

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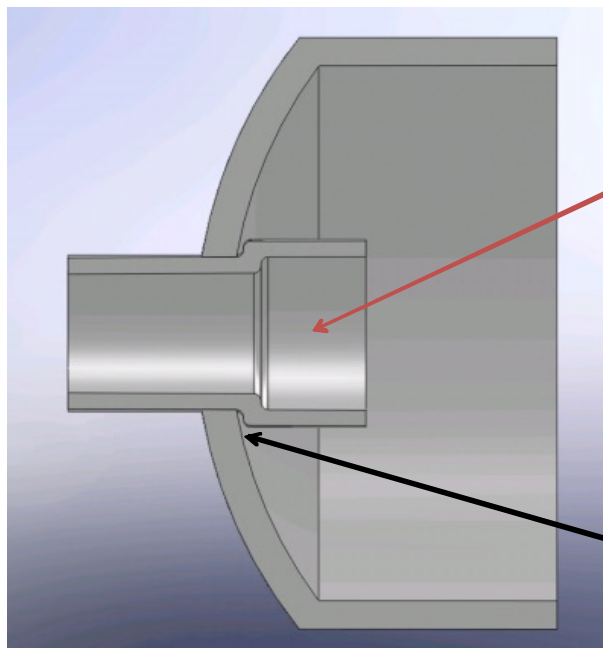
2. Cut the expanded end of the 1" pipe to a 3" length. (Alternate- cut 3" length and prime/glue add 1" coupler)
3. Take one of the 4" Pipe Caps and make a 1.32" hole in the center of the Cap by using 1.25" hole saw and file/sanding drum.
  - Care should be taken to ensure a tight fit for the 1' PVC.
  - This hole should be a clean, press fit for the 1.32" outside diameter of 1" PVC pipe.
  - Remember this must be a clean/snug fit as this tank will hold the air pressure.



Drill hole with 1.25" hole saw and ream to outer diameter of 1" PVC pipe (1.32") with rat tail file or sanding drum.

4. Prime the outside of 1" pipe at expansion joint and inside of drilled/filed/sanded hole in Cap
5. Position the coupler end inside the cup of the cap so that the 1" pipe protrudes through the hole. Cement in place with PVC Cement.

Section View of Tank Cap



Insert 1" PVC Pipe end as shown, prime and cement.

Apply Bead of epoxy around joint here

6. Once dry, apply a bead of epoxy cement around the inside joint to ensure an air tight seal and let dry.
7. Prime and cement the 1" Female to 1" NPT male coupling to the protruding 1" PVC Pipe.

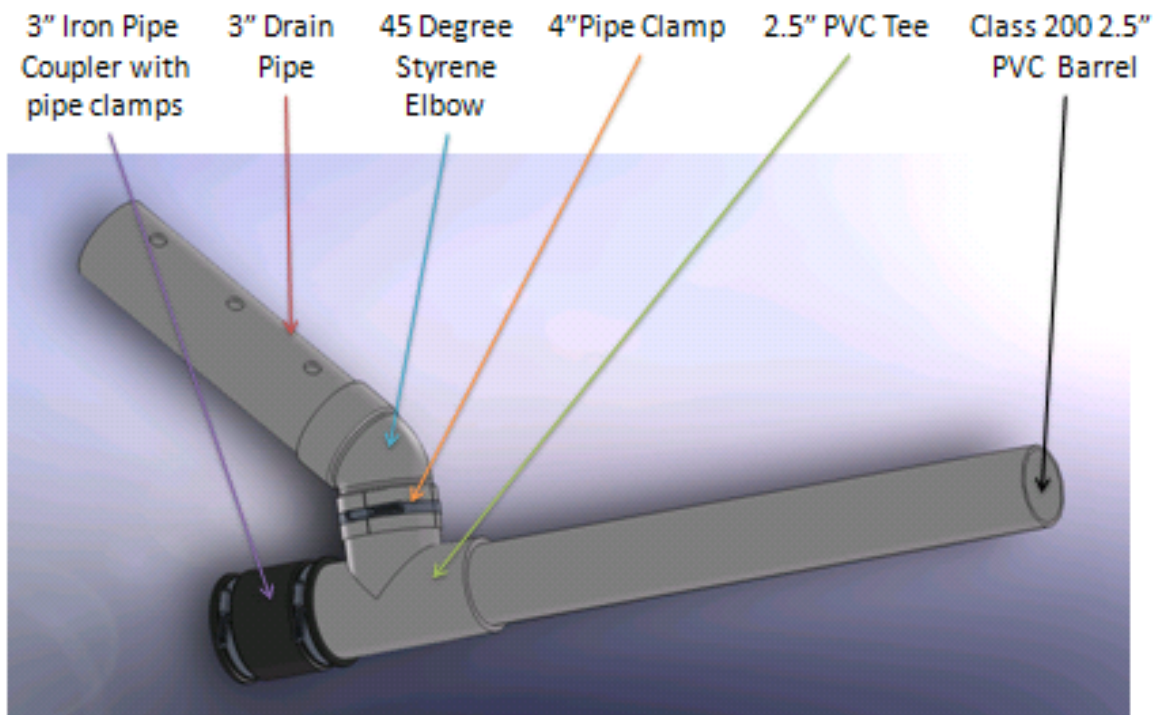
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# Auto-feed Tennis Ball Cannon Assembly Manual

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## Barrel Assembly

The Barrel of the Tennis Ball Barrel Assembly is constructed of Class 200 PVC. Note that this PVC pipe has a **different inside diameter** (perfect for tennis balls) than commonly available Schedule 40 pipe. If standard Schedule 40 pipe is used, the tennis balls will not fit into the barrel. This pipe is available from specialty irrigation stores and will fit standard Schedule 40 couplings. The tennis ball hopper is made from another material, styrene, commonly used for drainage and available at Home Depot/Lowes that looks like PVC but is much thinner wall.



### Tools Needed:

1. Hand saw or electric chop/miter saw (to cut PVC pipe square).
2. Flat blade screwdriver (for Pipe Clamps).

### Materials Needed:

1. Qty 1: 2.5" x 24" long Class 200 PVC Pipe (you can make this barrel longer or a bit shorter if desired).
2. Qty 1: 2.5" x 2.5" x 2.5" PVC Tee.
3. Qty 1: 3" Styrene Drain 45 Degree Elbow.
4. Qty 1: 3" x 12" long drain pipe (this can be longer or shorter depending on how many tennis balls wanted in hopper, and can have the holes in side of tube- this allows you to see if balls are in hopper).

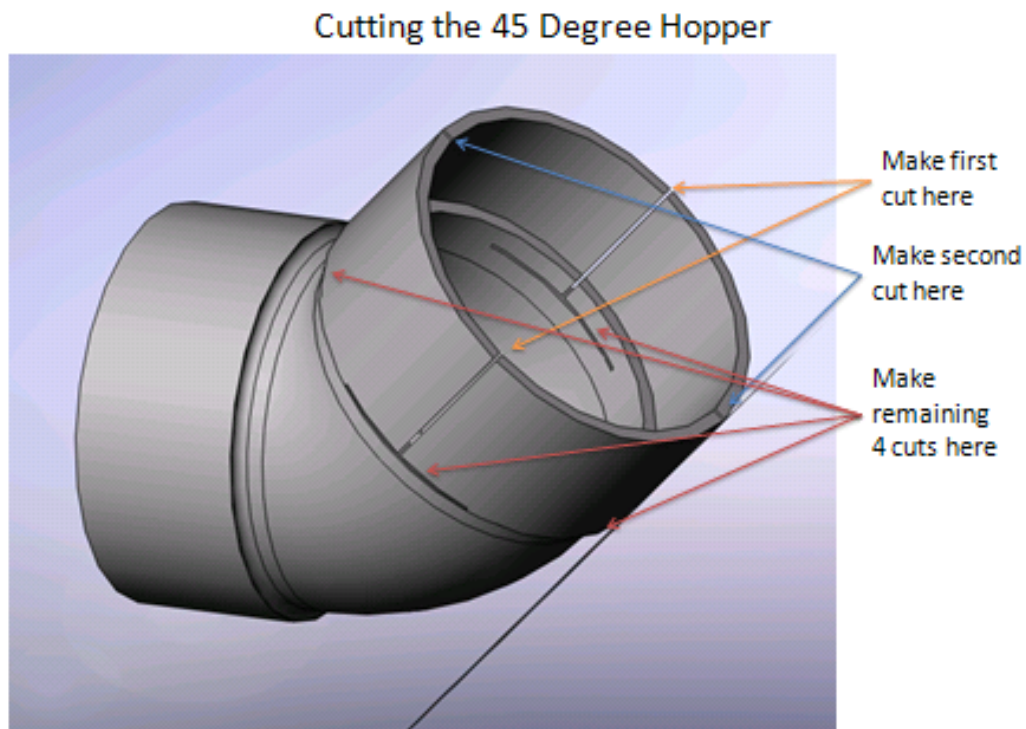
# Auto-feed Tennis Ball Cannon Assembly Manual

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5. Qty 1: 4" Stainless hose clamp.
6. Qty 1: 3" Rubber Cast Iron Pipe Coupler (this is a rubber tube 4" long with 3" inside diameter and two hose clams on the end).

## Assembly Instructions:

1. Cut the 2.5" Class 200 PVC pipe for the barrel into a two foot length (or desired length based on preference).
2. Prime one end of barrel and one of the straight ends of 2.5"
3. Cement barrel to Tee and let dry.
4. Attach the rubber 3" Cast Iron Pipe Coupler to the opposite end of where the barrel entered the 2.5" tee and tighten one of its hose clamps around 2.5" Tee.
5. Make the 3" elbow fit the angled end of the 2.5" tee:
  - a. Take one end of 45 degree elbow and using hand saw cut perpendicular to the tube from top edge down to base of coupler, rotate the coupler 90 degrees and cut again. This will give you four slots in the end of the elbow.
  - b. At base of elbow, where the cuts stopped, make four cuts perpendicular to the original four cuts (do not cut through! Just make slots about 1"). You should now have something that looks like the following picture:

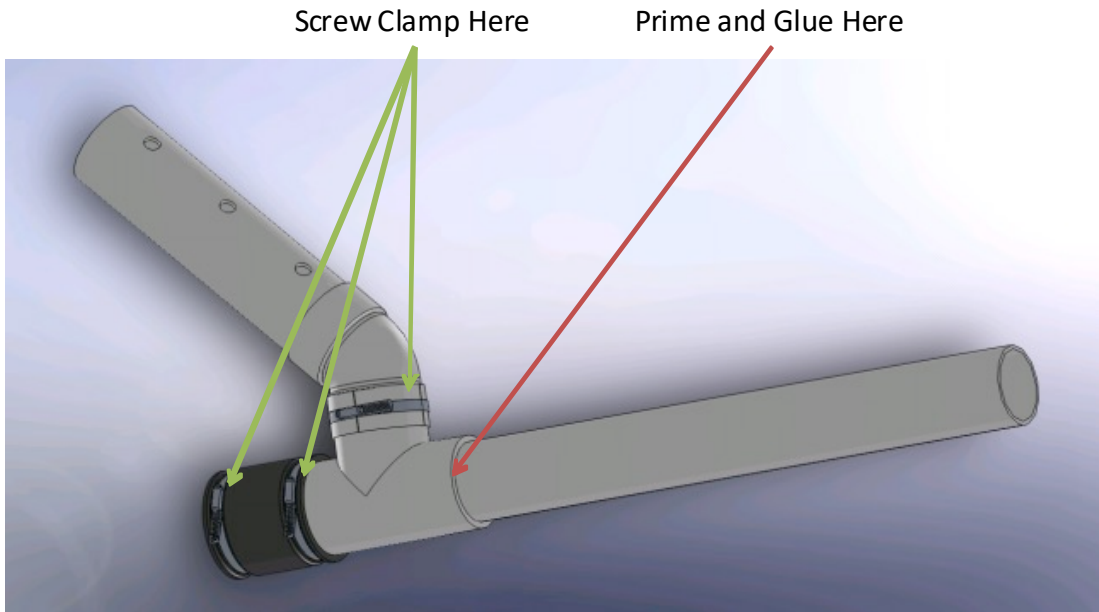


6. Now that the slots are cut, this will fit over the top of the 2.5" tee. To secure, attach and tighten the hose clamp with a screwdriver.
7. Attach the rubber Three Inch Iron Pipe coupler to the opposite end of where the barrel meets the Tee and secure the hose clamp with a screwdriver.

# Auto-feed Tennis Ball Cannon Assembly Manual

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The barrel Assembly is now complete, put aside for later, it should look like this:





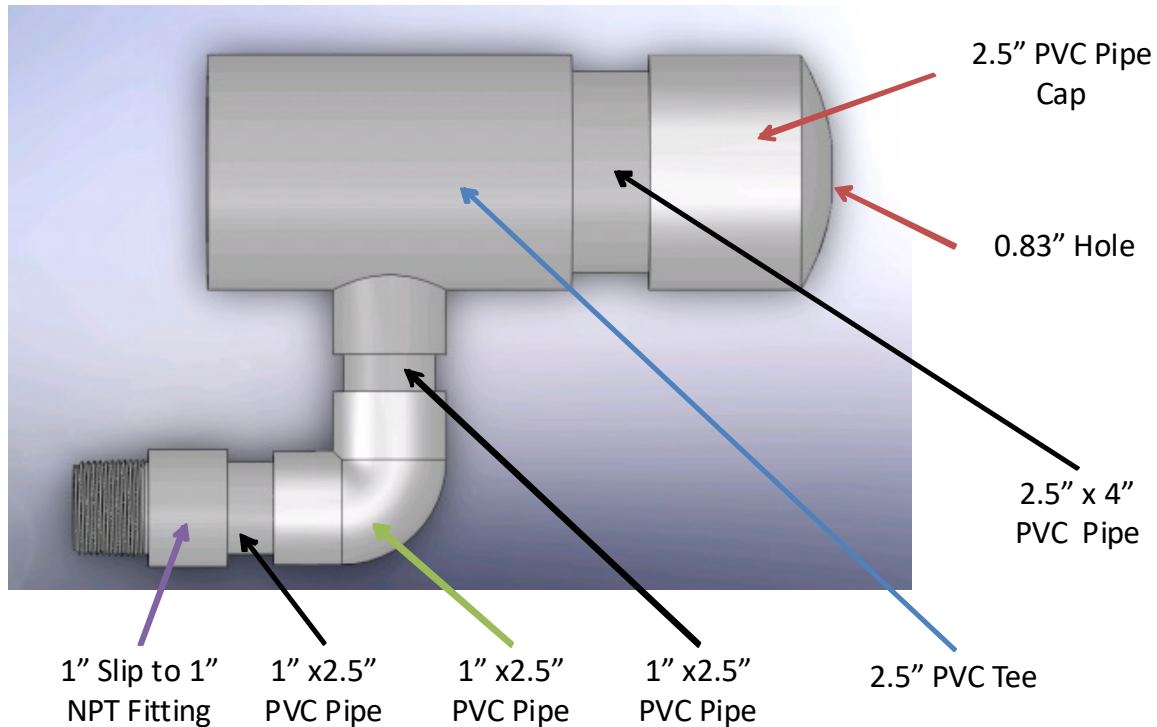
# Auto-feed Tennis Ball Cannon Assembly Manual

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## Receiver Assembly

The Receiver Assembly houses the bolt that feeds the tennis balls into the barrel. It is constructed of Schedule 40 PVC Pipe.

### Receiver Assembly



### Tools Needed:

1. Hand saw or electric chop/miter saw (to cut PVC pipe square).
2.  $\frac{3}{8}$ " hole saw and round rat tail file/small sanding drum (Dremel) for hole.
3. Small piece of rough sandpaper (120 grit or so).

### Materials Needed:

1. Qty 1: 2.5" x 4" Schedule 40 PVC Pipe.
2. Qty 2: 1" x 2.5" Schedule 40 PVC pipe
3. Qty 1: 2.5" x 2.5" x 1" PVC Reducing Tee.
4. Qty 1:  $\frac{1}{2}$ " x 2.5" black plastic sprinkler riser.
5. Qty1: 2.5" PVC Cap.
6. Qty 1: 1" PVC 90 Degree Elbow.
7. Qty 1: 1" Female Slip to Male NPT Fitting.

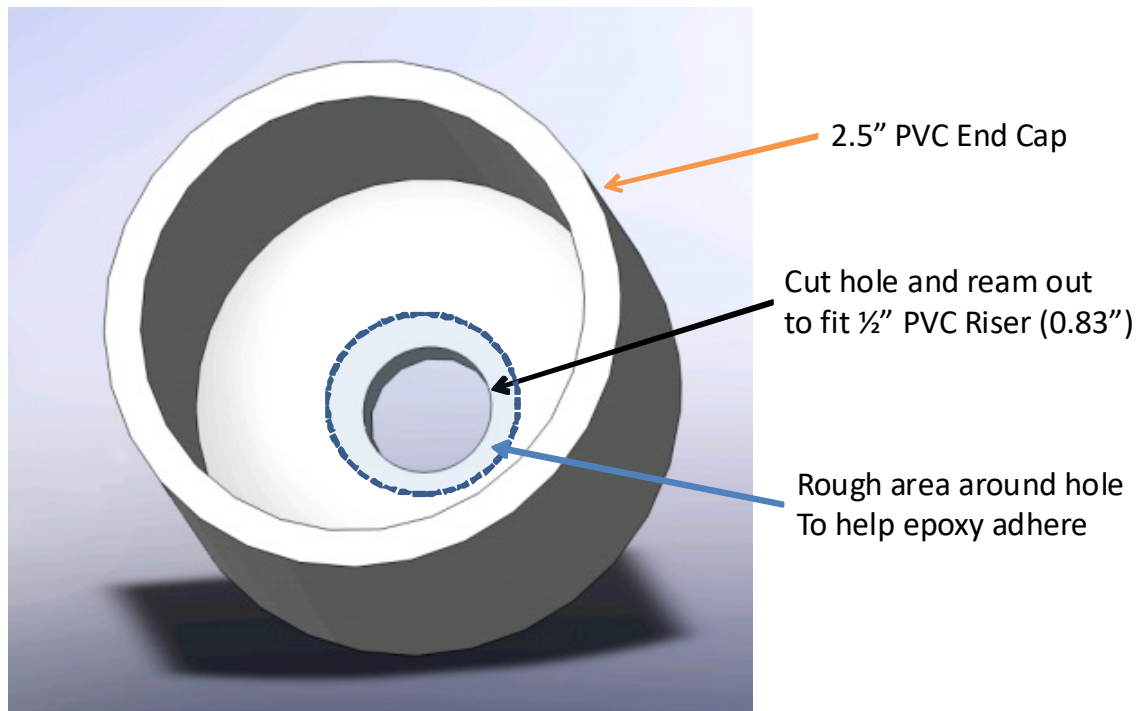
# Auto-feed Tennis Ball Cannon Assembly Manual

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## Assembly Instructions:

1. Cut the 2.5" and 1" Schedule 40 PVC Pipe to appropriate lengths stated above.
2. Drill the center of the 2.5" PVC cap with  $\frac{3}{4}$ " drill and ream with file/sanding drum (like was done with pressure tank) so that a  $\frac{1}{2}$ " plastic sprinkler riser (0.83") will snugly fit in the hole.
3. Rough out area around hole with sandpaper (this will be for the epoxy at align/fixing stage later).

(NOTE: DO NOT CEMENT OR GLUE BLACK RISER INTO HOLE IN 2.5" PVC YET)



4. Prime and cement the 2.5" Schedule 40 PVC pipe into one end of the 2.5" Reducing Tee.
5. Prime and cement 2.5" PVC Cap with hole onto 2.5" PVC Pipe.
6. Prime and cement 1" x 2.5" Schedule 40 PVC Pipe into 1" end of 2.5" Reducing Tee.
7. Prime and cement 1" 90 Degree PVC Slip Elbow onto 1" Pipe WITH OPENING FACING AWAY from cap with hole
8. Prime and cement 1" x 2.5" Schedule 40 PVC Pipe into 90 Degree Elbow.
9. Prime and cement 1" Female Slip to Male NPT coupler to 1" x 2.5" Schedule 40 PVC Pipe.

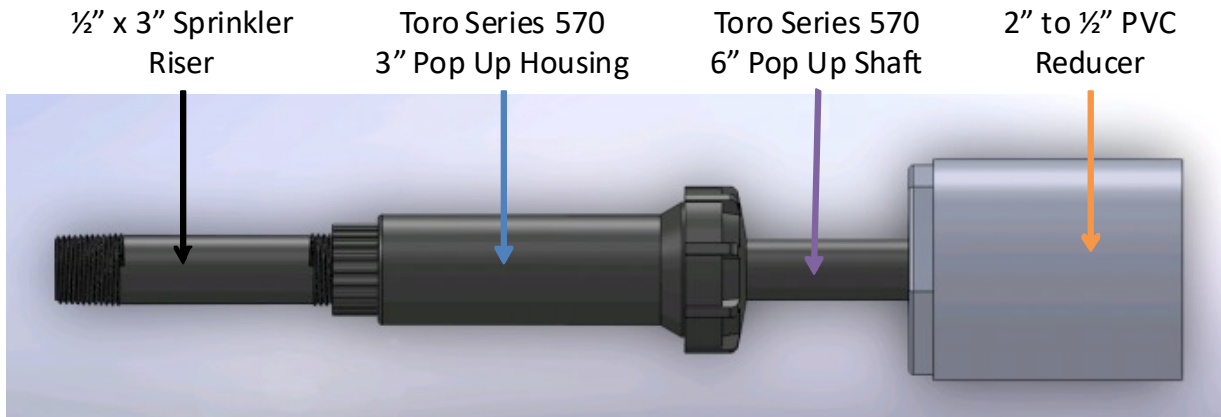
You are now done with the receiver assembly.

# Auto-feed Tennis Ball Cannon Assembly Manual

## Bolt Assembly

The Bolt Assembly fits within the Receiver Assembly. It is responsible for feeding one tennis ball at a time into the barrel. To accomplish this, it uses a standard pop up sprinkler head under air pressure to move a "bolt" forward. This action pushes the tennis ball into the barrel and simultaneously blocks additional tennis balls from coming down the hopper. The "bolt" is made from a 2" to ½" PVC plastic reducer.

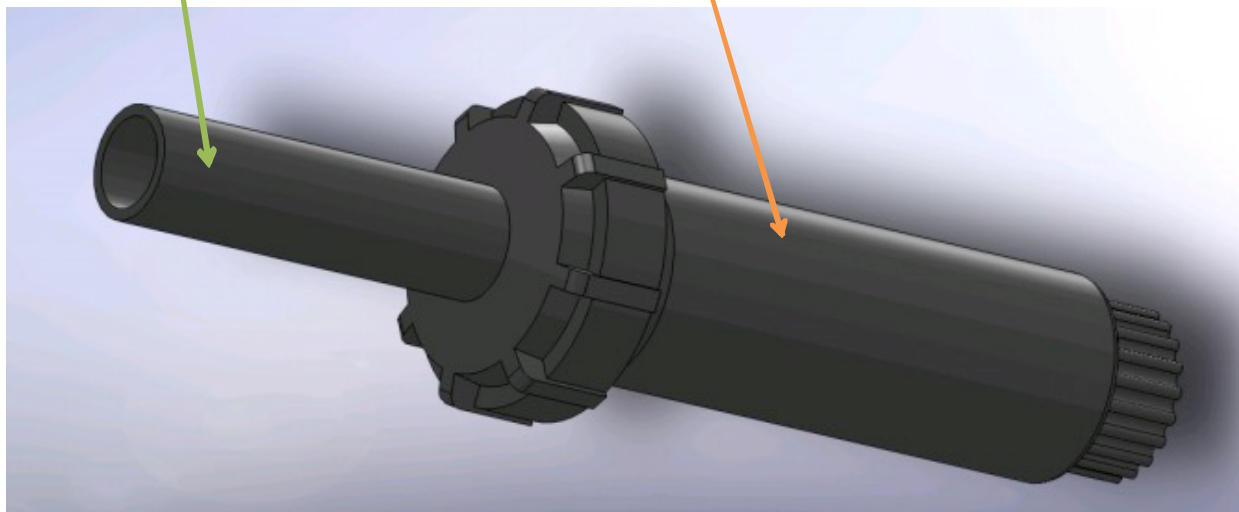
### Completed "Bolt" Assembly



To come up with a long enough shaft, we will combine the two sprinklers into one. Unscrew both heads off the sprinklers. Take the center tube out of the 6" and place it into the 3" housing and re-screw the top back on the 3" sprinkler. You will end up with something that looks like this:

#### Center Pop up from Toro 570 Series - From 6" Pop Up Sprinkler

#### Housing from Toro 570 Series - From 3" Pop Up Sprinkler



# Auto-feed Tennis Ball Cannon Assembly Manual

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## Tools Needed:

1. Dremel tool with cone shaped grinding stone or drill and file

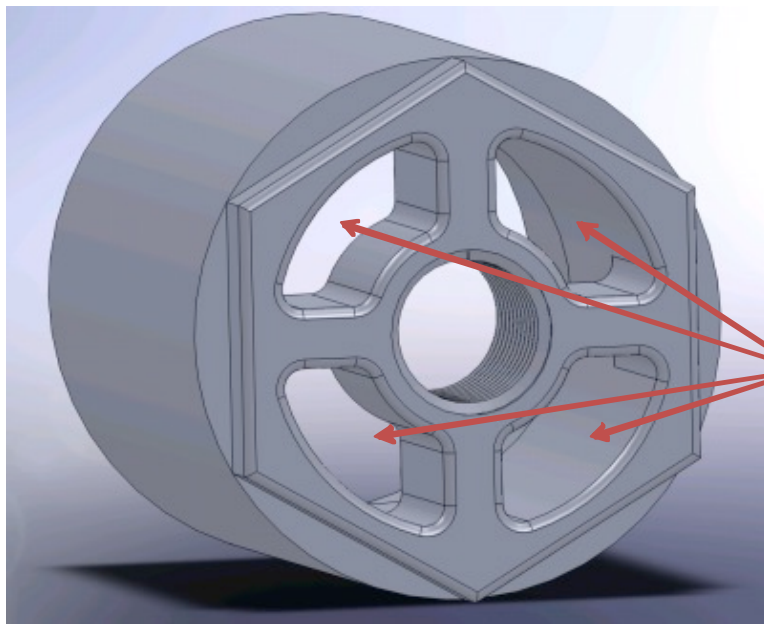
## Materials Needed:

1. Qty 1: Toro Series 570 3" Pop Up Sprinkler
2. Qty 1: Toro Series 570 6" Pop Up Sprinkler
3. Qty 1: 1/2" NPTx3" Black PVC sprinkler riser
4. Qty 1: 2" to 1/2" PVC Reducer (this needs to slide smoothly inside the 2-1/2" Tee)
5. 5 minute Epoxy Glue

## Assembly Instructions:

1. After combining the Toro Pop Up sprinkler heads described above, screw in the 1/2" x3" Sprinkler Riser into the base of the sprinkler.
2. Take the 2" to 1/2" PVC Reducer and verify that it slides smoothly inside the receiver 2.5" Tee of receiver assembly. This should be a loose but not sloppy fit.
3. **IMPORTANT:** The air needed to fire the tennis ball must flow through the bolt. As you will observe, it does not have any openings other than the 1/2" female thread opening. You will need to drill/grind away plastic around this so that the air can pass by. The reducer I used had 4 areas of plastic that were thinner than the rest, so I opened these up:

## Modify "Bolt" (2" to 1/2" Reducer) for Air Flow



Grind out an air path in reducer in these areas for maximum airflow. Since these areas are already thinned, grind/drill them all the way through and smooth out.

4. This next step requires you to make sure that all the pieces are put together on the same axis so that they all line up. Since the shaft on the Pop Up Sprinkler is slightly loose fit inside the 1/2" female threads of the reducer, you will need to cut a shim using thin plastic, say from some food

## Auto-feed Tennis Ball Cannon Assembly Manual

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packaging, and using epoxy, glue the long shaft into the reducer. Stand it up to make sure it does not sag. Again, make sure that it lines up along the axis and does not move while it is drying.

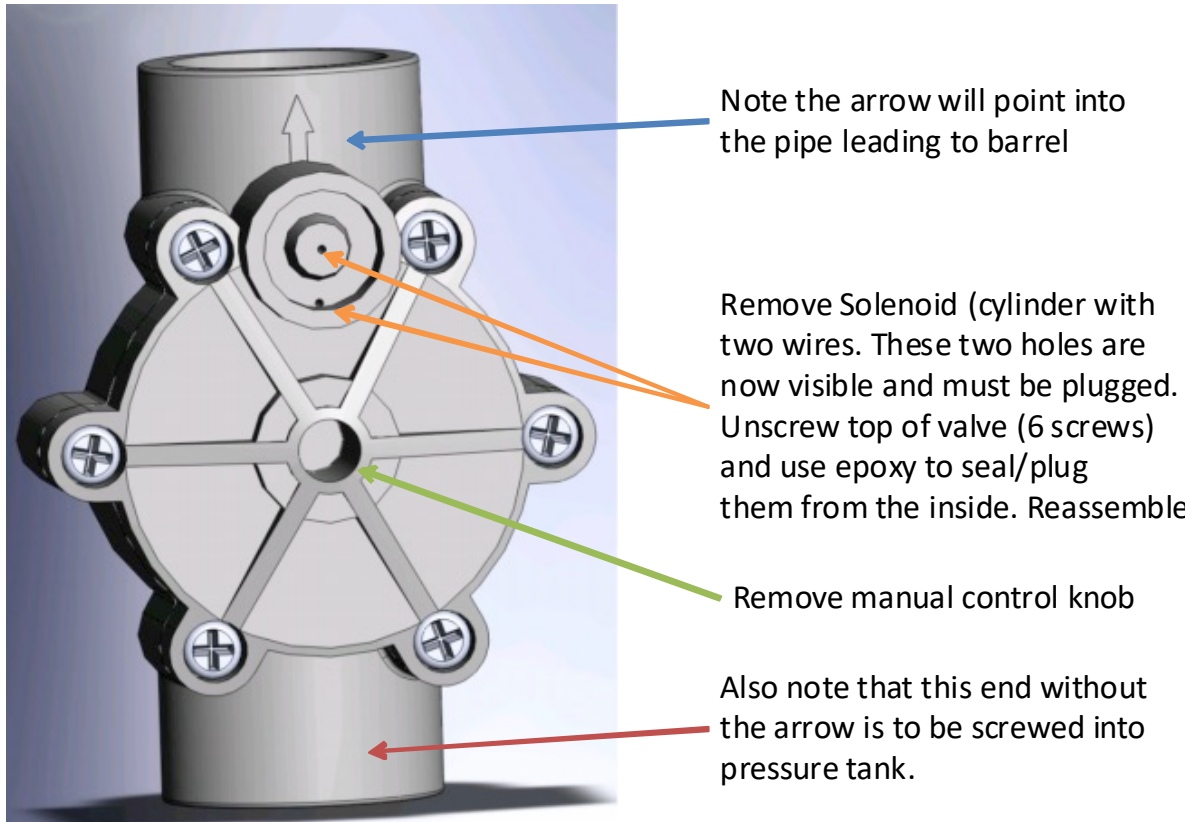
You have now completed the Bolt Assembly, put it aside for now.

# Auto-feed Tennis Ball Cannon Assembly Manual

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## Modifying the Sprinkler Valve

This section describes the modification of the 1" Rain Bird "in line" sprinkler valve so that it will control the release of air.



1. Remove the electrical solenoid by unscrewing it from the valve; this is not needed for the TBC. You will notice that this will uncover two very small holes, one in the center and the other at the edge next to the threads. These need to be plugged and will use a small amount of epoxy to do so using the following process.
2. Unscrew the 6 screws holding the top of the valve to the main valve body. Carefully separate the top and make sure not to damage the rubber seal/valve so that you can see the other side of the two holes that were covered by the solenoid.
3. Mix epoxy and plug these holes.
4. Once the epoxy had dried, reassemble the housing.

# Auto-feed Tennis Ball Cannon Assembly Manual

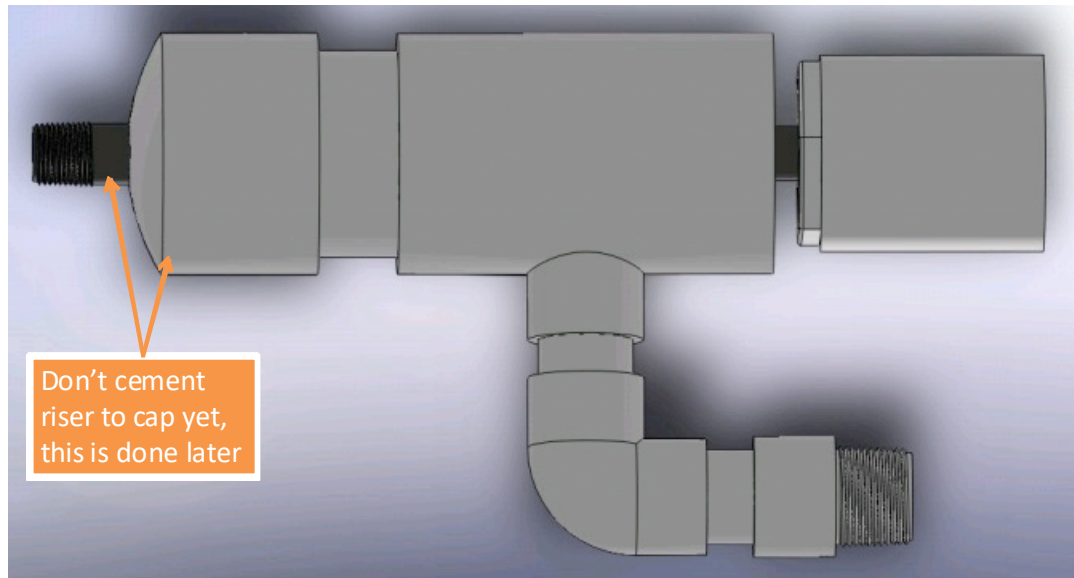
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## Putting the Assemblies Together

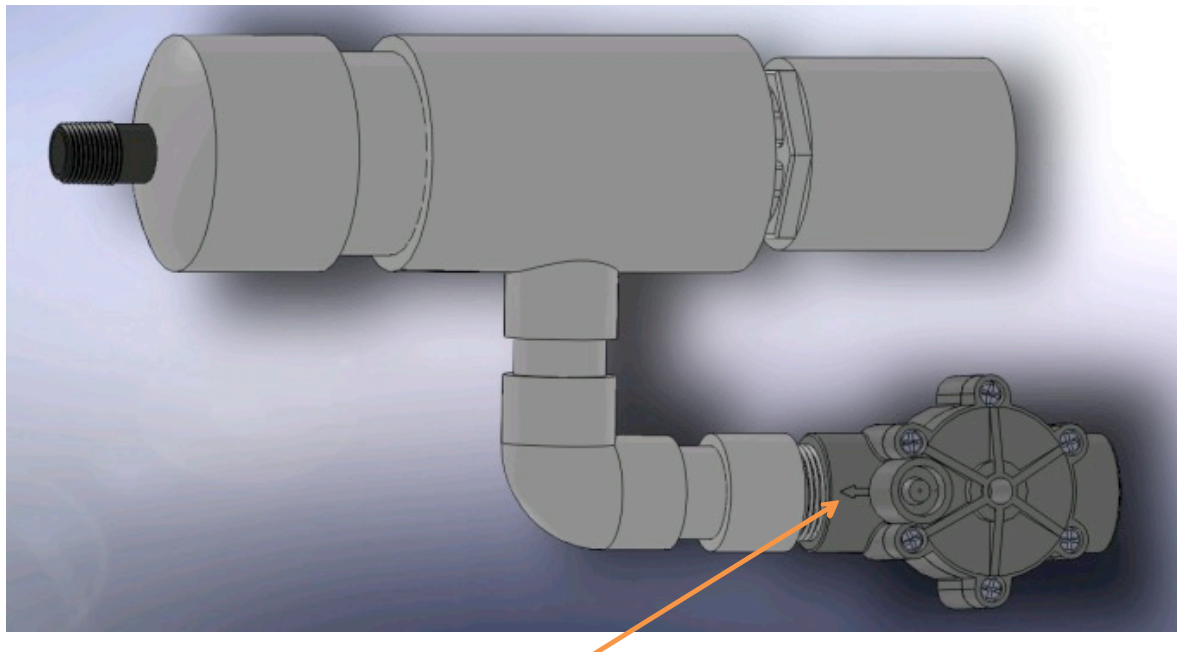
You are now at the point where the major assemblies come together before the final plumbing is done.

1. Insert the Bolt Assembly into the Receiver Assembly, push the 1/2" riser from the Bolt Assembly through the 2.5" End Cap of the Receiver Assembly:

Receiver and Bolt Assemblies Put Together



2. Next add the valve:

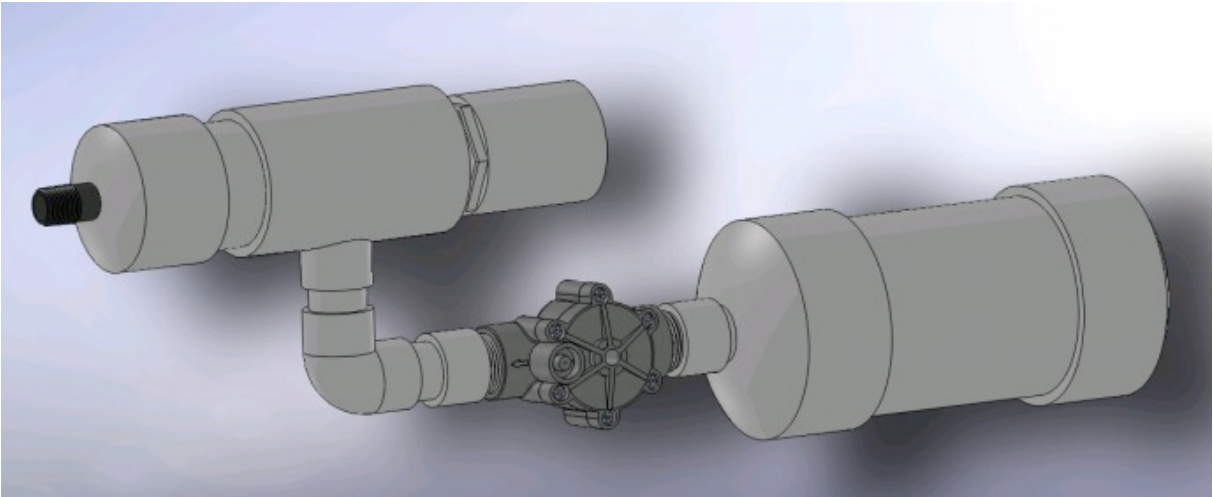


Note: Arrow on valve is pointing to pipe leading to receiver

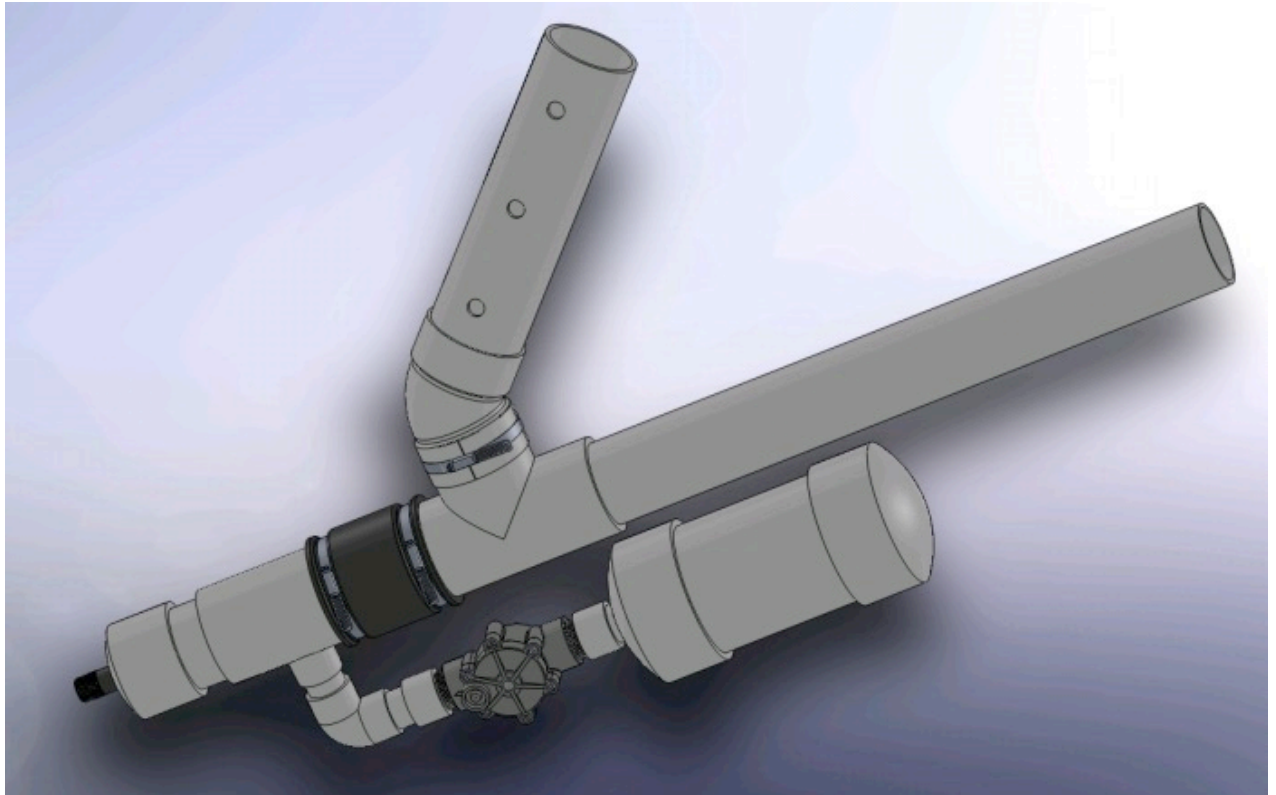
3. Now add Pressure Tank by screwing it in

## Auto-feed Tennis Ball Cannon Assembly Manual

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4. Finally Add the Barrel Assembly by using the 3" Iron Pipe Clamp and tightening the hose clamp





# Auto-feed Tennis Ball Cannon Assembly Manual

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## Alignment and Fixing of Bolt Assembly into Receiver Assembly

This is the most important part of the assembly as this step sets the alignment of the bolt with the receiver. If this is off, the tennis balls may not load easily or when the bolt is pushed forward, the bolt may not seal all the way, causing a loss of air pressure. Please read all of the instructions thoroughly and ensure that you understand them before proceeding.

### Tools Needed:

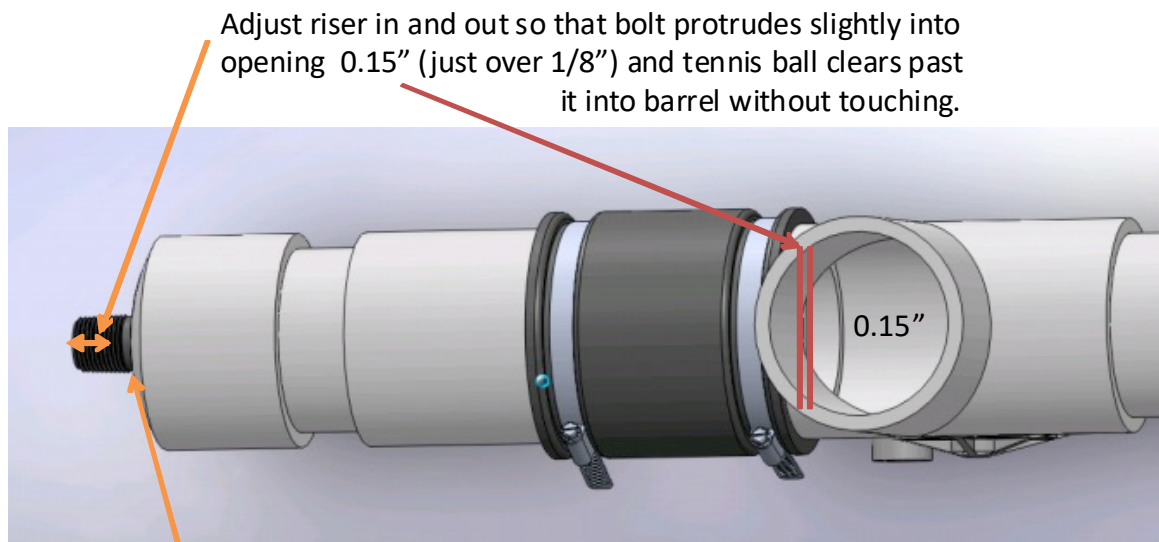
1. Sharpie pen/marker or sharp edge to scribe plastic.

### Materials Needed:

1. 5 Minute Epoxy Cement.
2. Small Popsicle stick or other device to mix and spread epoxy.
3. Small piece of sandpaper
4. Small damp rag (to clean epoxy off)

### Assembly Instructions:

1. Remove tank and valve from receiver assembly, this will make it easier to do the next step.
2. Ensure that the receiver assembly and the barrel assembly are in line with each other and firmly pressed together inside the rubber iron pipe coupling - loosen, adjust, and tighten the hose clamps to keep it there.
3. Remove hopper tube to be able to look down into the feed mechanism. You want the edge of the bolt to be just inside the edge of the down tube:



Adjust riser in and out so that bolt protrudes slightly into opening 0.15" (just over 1/8") and tennis ball clears past it into barrel without touching.

Then mark riser with marking pen or scribe with sharp edge at point where meets cap.

4. Adjust how much the bolt protrudes into the tee area as shown above and mark.
5. Disassemble receiver/bolt from barrel assembly by loosening rear hose clamp.

## Auto-feed Tennis Ball Cannon Assembly Manual

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6. Pull out bolt (sprinkler) assembly from receiver and sand sprinkler riser at mark about ½ inch up to prepare it for epoxy.
7. Mix and apply epoxy to inside of hole in 2.5" cap and to outside of riser up to mark made in riser.
8. Insert bolt (sprinkler riser) through hole until it lines up with mark.

**NOTE: Clean off threads of riser well so that epoxy is not on them, a cap will be threaded on to them later.**

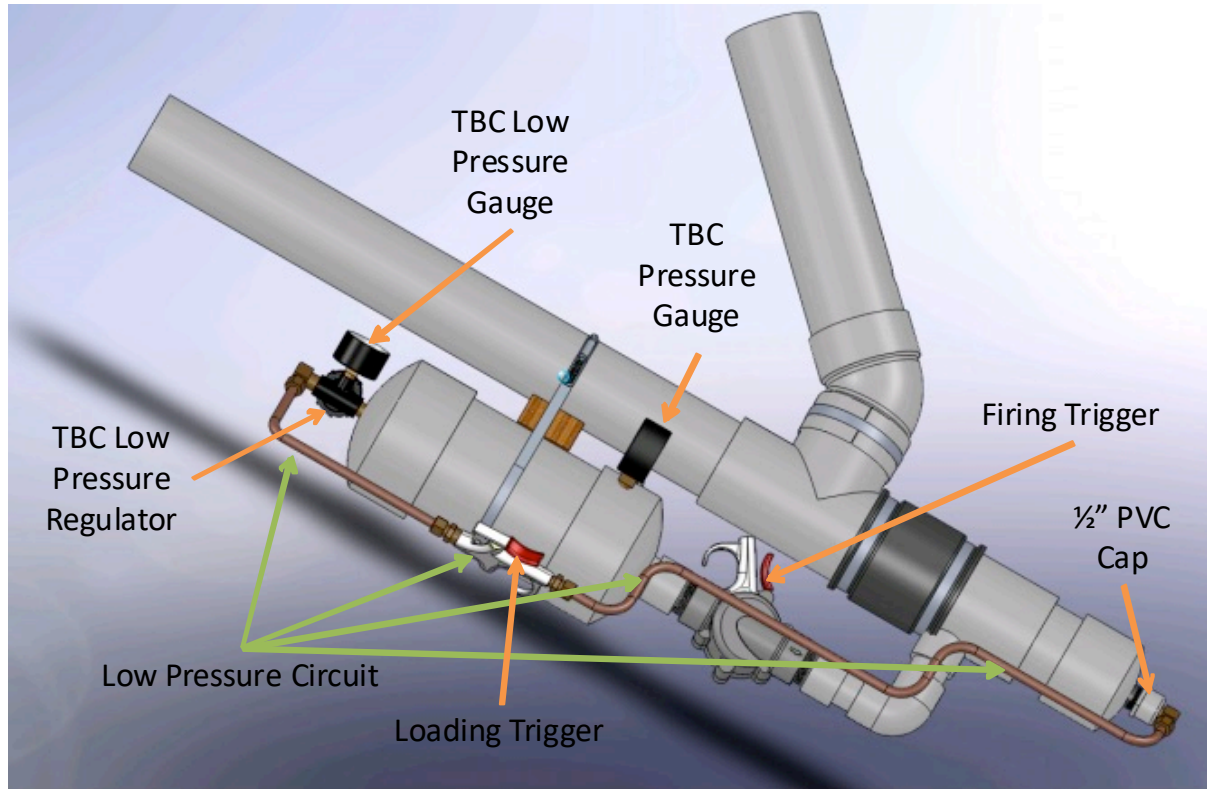
9. Carefully reassemble receiver and barrel assemblies ensuring they are pressing against each other and tighten hose clamp on the Iron Pipe Coupler.
10. Apply bead of epoxy between riser and cap on outside.
11. Let dry and reassemble TBC.
12. Check the space between the tank and the barrel. Insert a wood wedge and secure with 8" Pipe Clamp.

You have now completed the alignment and fixing of the TBC components and are now ready for the last step – final plumbing.

# Auto-feed Tennis Ball Cannon Assembly Manual

## Final Plumbing

You are now at the stage where all the major components are assembled, aligned and fixed. The next part involves drilling and assembling components that route the low and high pressure circuits.



### Tools Needed:

1. Drill and drill bits
2. Open end wrenches/Pliers
3. Tubing cutter

### Materials Needed:

1. Teflon tape for pipe fittings
2. 1/2" PVC threaded sprinkler cap
3. 0-100 PSI Pressure Gauge. (\$4.80 on ebay)



4. 100 PSI Pop off Valve. (\$5.99 on ebay)



# Auto-feed Tennis Ball Cannon Assembly Manual

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5. Air pressure regulator and gauge (4.99 on e-bay)



6. Qty 2: Air blow guns (\$1.99 each on e-bay) :



7. 1/4" Copper tubing  
8. Qty 1: 1/4" OD Comp x 1/4" Mips (used to go into air blow gun base; \$1.35 from plumbingsupply.com)



9. Qty 1: 1/4" OD Comp x 1/8" Mips ( used to replace air blow gun tip) \$1.35 from plumbingsupply.com)



10. Qty 2: 1/4" OD x 1/8" Mips 90 degree (one fits from riser end cap, the other fits in one end of regulator, make sure that this is correct as different manufacturers may have different fittings)



11. Qty 1: 1/4" Close Nipple (This is to connect regulator to 4" cap on tank)



12. Qty 1: 1/4" Industrial QC Plug 1/4" M Style (or 3/8 MIP if you have a large compressor)



13. Qty 1: 1/4" x 4 ft copper tubing (plastic tubing may work just as well, but copper is more rigid and stays where it was bent)

## Assembly Instructions:

**Note: When drilling into the PVC plastic, ensure that you are drilling into thickest areas. Always use the smallest drill bit possible, the metal/brass fittings will self thread. When tightening fittings into PCV, ensure that they are snug (3/4 of thread depth), but do not over tighten or threads may strip.**

**Note: When bending copper pipe work slowly and bend gradually over a wide radius, otherwise the tubing may crimp.**

# Auto-feed Tennis Ball Cannon Assembly Manual

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## *Low Pressure Circuit Assembly*

1. Assemble ¼" close nipple into high pressure side of regulator using Teflon tape.
2. Assemble ¼" OD x 1/8" MIPs 90 degree elbow into other side of regulator using Teflon tape.
3. Drill into end of 4" PVC cap and thread regulator into it. Use caution not to over tighten and strip (thread in ¾ of the way).
4. Drill into the end of ½" PVC cap and thread 1/4" OD x 1/8" Mips 90 degree into it. Again, use caution not to over tighten and strip (thread in ¾ of the way).
5. Assemble the 1/4" OD Comp x 1/4" Mips fitting into the base of one air blow gun with Teflon tape.
6. Remove any tips on the air blow guns, they are not needed and will impede air flow.
7. Assemble the 1/4" OD Comp x 1/8" Mips fitting into the tip on the other end of the blow gun.
8. Position the air blow gun under the tank and measure the distance from regulator compression fitting on 90 degree elbow to the air blow gun with 90 degree bend.
9. Cut the ¼" tubing to that length and carefully bend.
10. Insert tubing into respective fittings and tighten them.
11. Measure the distance around bends from tip of air blow gun to end of 90 degree elbow on ½" PVC cap.
12. Cut the ¼" tubing and carefully bend tubing to hug tank, along valve and along receiver. (wire ties may be used if desired to hold tubing close to pipe)
13. Insert tubing into respective fittings and tighten them.

## *High Pressure Circuit Assembly*

1. Take other air blow gun, remove tip and assemble 90 degree circuit into base with Teflon tape so that it is pointing off to the side of air blow gun.
2. Thread other end of 90 degree elbow into center of sprinkler valve and tighten so it points up and forward.

## *Gauge, Pop-Off Valve and Quick Connect Plug Assembly*

1. Drill and thread Pressure Gauge into tank.
2. Drill and thread Pop-Off Valve into tank
3. Drill and thread Quick Connect Plug into bottom of tank.

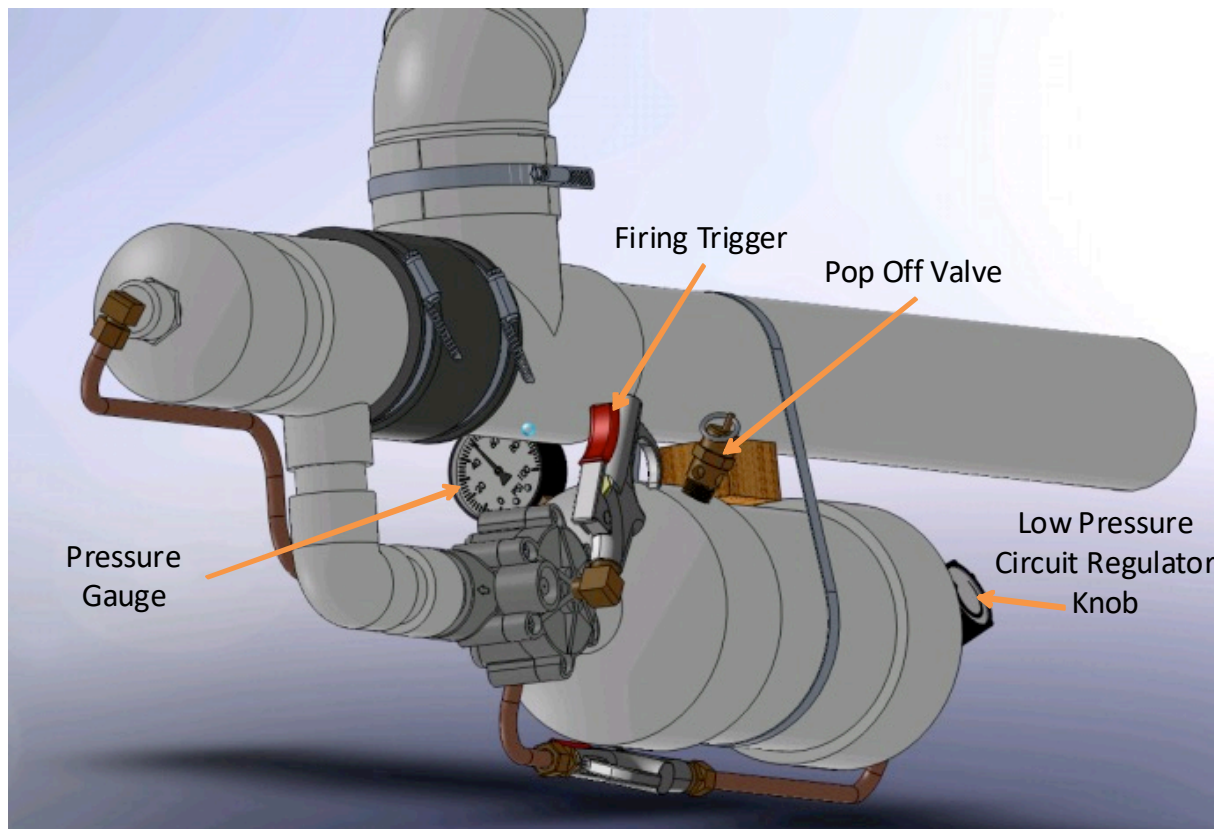
***CONGRATULATIONS, YOU'RE DONE WITH THE ASSEMBLY, NOW FOR THE FUN!***

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# Auto-feed Tennis Ball Cannon Assembly Manual

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## ADJUSTMENTS



1. Now go outside, crank up the air compressor and adjust regulator on compressor to 25 LBS of pressure.
2. Attach Quick Connect to plug on bottom of tank.
3. Verify that the pressure gauge on TBC tank reads the same pressure as compressor regulator.
4. Press and release the air gun on the low pressure circuit (the one NOT connected to sprinkler valve) and make sure that it moves back and forth without issue. (If it does not open/close, make sure the TBC regulator is not tightened completely and open it by unscrew knob until it operates).
5. Next check the firing mechanism, depress the other air gun blower valve and you should hear a pop when the air is released.
6. When it all checks out take the pressure up to 50 lbs on the compressor regulator. Verify that the Pressure Gauge on the TBC tank reads the same.
7. Now adjust the regulator on the TBC so that the regulator gauge reads 25 lbs or whatever pressure around that area that moves the bolt back and forth firmly but not too quickly or forcefully.
8. Load tennis balls.

# Auto-feed Tennis Ball Cannon Assembly Manual

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## **Firing**

Point the TBC in a safe direction, press the low pressure valve and keep pressed and quickly press and release the firing valve launching the TBC. Release the low pressure valve.

Repeat and have fun!