

# Control Syringe Assembly

This instruction manual outlines how to assemble a single control syringe unit. Control syringe units can then be used to construct a larger control syringe system depending on how many control syringes are needed. If you have questions regarding specific information regarding the servo motors follow this link: <https://www.pololu.com/product/3425>.

Similarly, if you have questions regarding specific information regarding the Adafruit 16-channel PWM/Servo Shield, visit the link here:

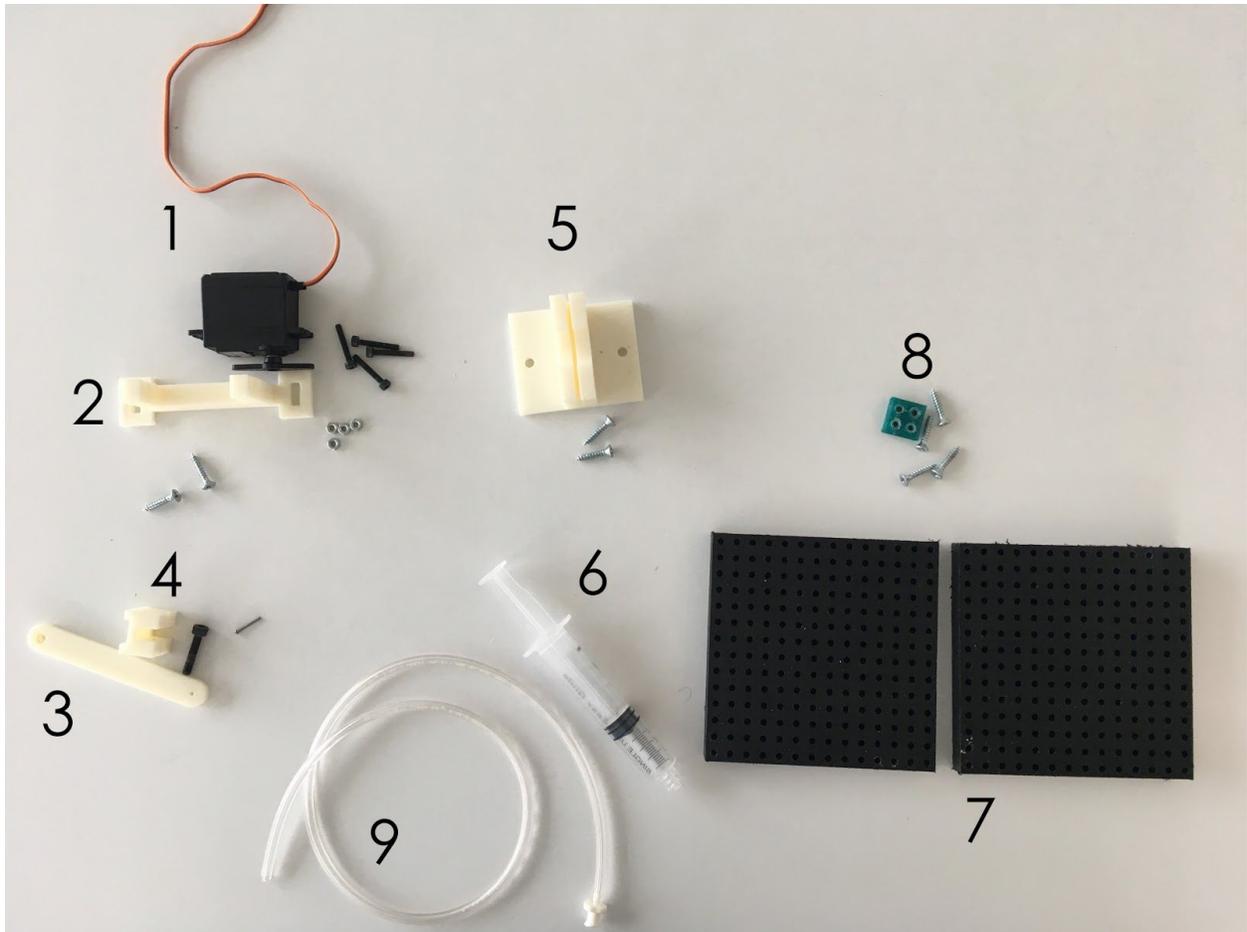
<https://learn.adafruit.com/adafruit-16-channel-pwm-slash-servo-shield>.

Before assembly, ensure that you have the following pieces:

Part	Description	File Name	Quantity
Servo Motor Holder	Holds servo motor in place	servo_holder	1
Piston Arm	Translates servo motor to linear translation	piston_arm	1
Syringe Attachment	Connects syringe to piston arm	syringe_attachment	
Syringe Holder	Holds syringe in place	syringe_holder	1
Base Connector	Connects bases	//can use any fastener available	1
Base	Control syringe unit is housed	MEC	2

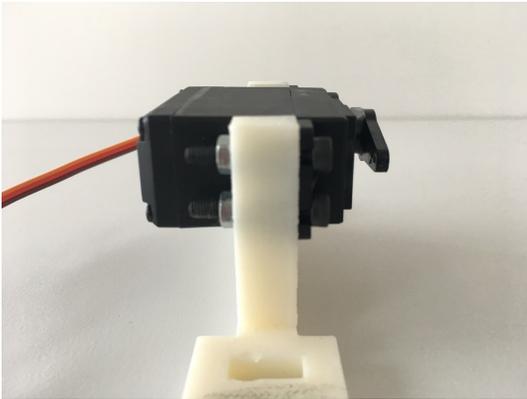
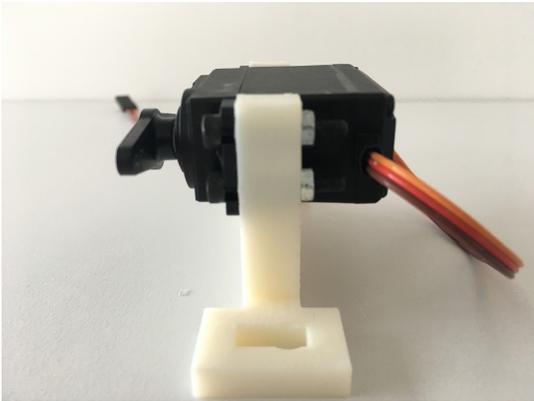
Part	Description	URL	Quantity
Servo Motor	Moves syringe to actuate valves	<a href="https://www.pololu.com/product/3425">https://www.pololu.com/product/3425</a>	1
12 mL Syringe Luer Lock	Applies +/- pressure to actuate valves	<a href="https://www.amazon.com/Monoject-12ml-Syringe-Only-Luer/dp/B01ETSZPHG">https://www.amazon.com/Monoject-12ml-Syringe-Only-Luer/dp/B01ETSZPHG</a>	1

PVC Tubing	Connects syringe to valve port	<a href="https://www.grainger.com/category/pvc-tubing/tubing/pipe-tubing-and-fittings/plumbing/ecatalog/N-ax5Z1z0qn3x#nav=%2Fcategory%2Fpvc-tubing%2Ftubing%2Fpipe-tubing-and-fittings%2Fplumbing%2Fecatalog%2FN-ax5Z1z0nzy5Z1z0nzyfZ1z0qn3xZ1yzqjw7Z1z0mbuk">https://www.grainger.com/category/pvc-tubing/tubing/pipe-tubing-and-fittings/plumbing/ecatalog/N-ax5Z1z0qn3x#nav=%2Fcategory%2Fpvc-tubing%2Ftubing%2Fpipe-tubing-and-fittings%2Fplumbing%2Fecatalog%2FN-ax5Z1z0nzy5Z1z0nzyfZ1z0qn3xZ1yzqjw7Z1z0mbuk</a>	1
Luer Lock Adaptor	Used to connect syringe to tubing	<a href="https://www.amazon.com/Cole-Parmer-AO-45505-04-Male-luer-Nylon/dp/B003NV2T34/ref=sr_1_2?ie=UTF8&amp;qid=1539737446&amp;sr=8-2&amp;keywords=luer+lock+adapter">https://www.amazon.com/Cole-Parmer-AO-45505-04-Male-luer-Nylon/dp/B003NV2T34/ref=sr_1_2?ie=UTF8&amp;qid=1539737446&amp;sr=8-2&amp;keywords=luer+lock+adapter</a>	1

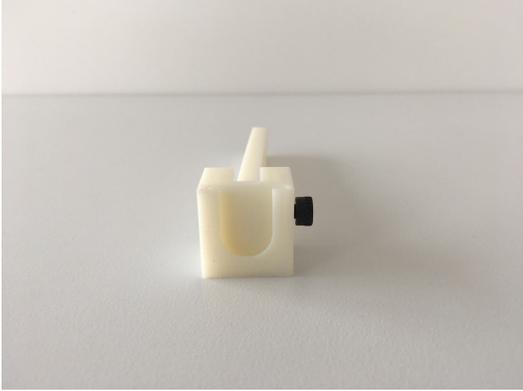


1. Servo Motor
2. Servo Motor Holder
3. Piston Arm
4. Syringe Attachment
5. Syringe Holder
6. 12mL Syringe w/ Luer Lock Adapter
7. Base
8. Base Connector
9. Tubing

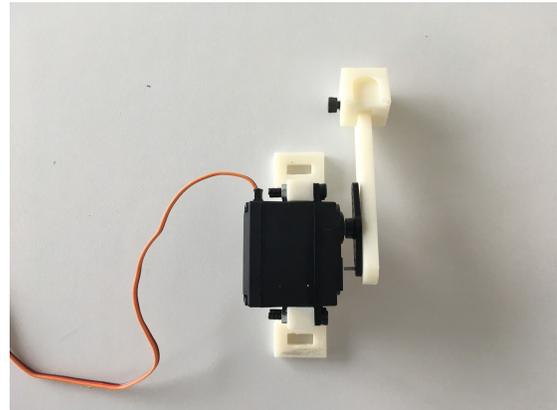
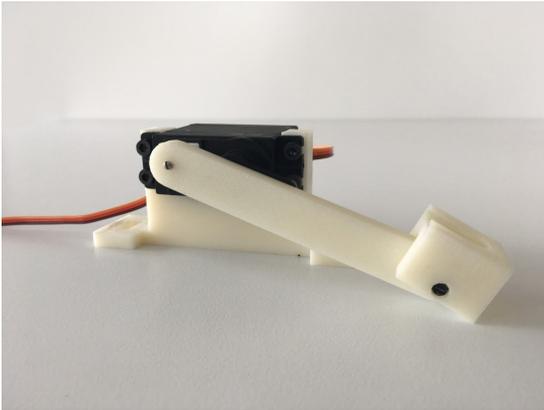
1. Slide servo motor (1) into the servo motor holder (2). Screw in place by using the hex nut. Ensure that servo motor is tightly secured.



2. Place piston arm (3) into syringe attachment (4) on the side that has the hole for the screw. Put screw through syringe attachment and piston arm and secure by screwing on hex nut. Piston arm should be able to rotate freely about the screw so do not tighten all the way.

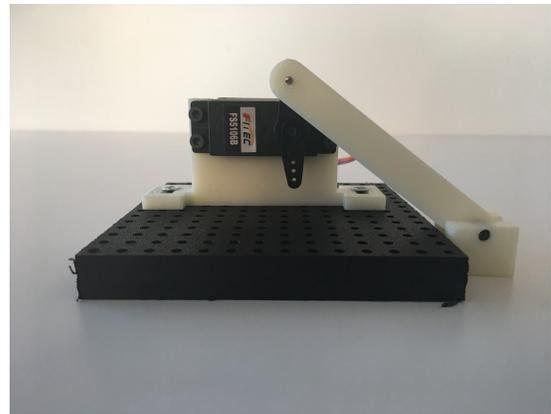
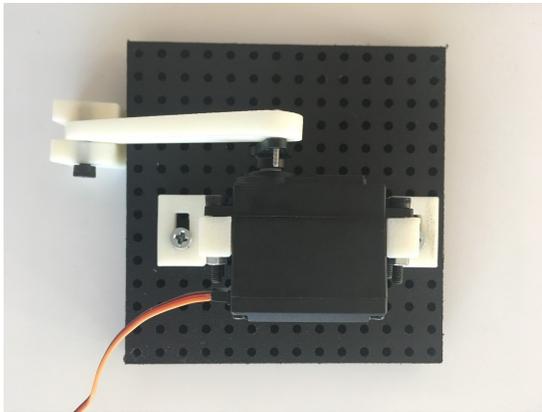


3. Using screw that came with servo motor (1), attach piston arm (3) to the servo horn. Attach to the hole on the tip of the horn as shown below. When screwing in apply slight pressure due to initial lack of threading in the hole. Also make sure that the "U" shape in the syringe attachment (4) is facing up.

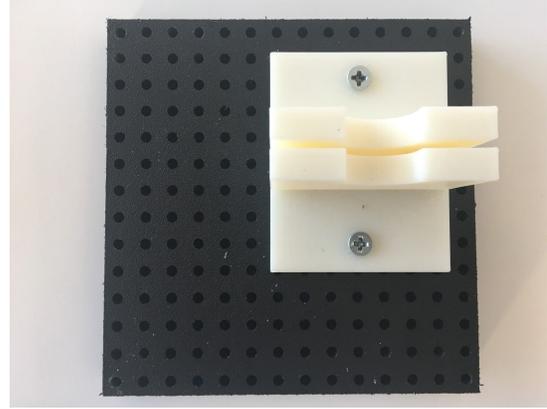
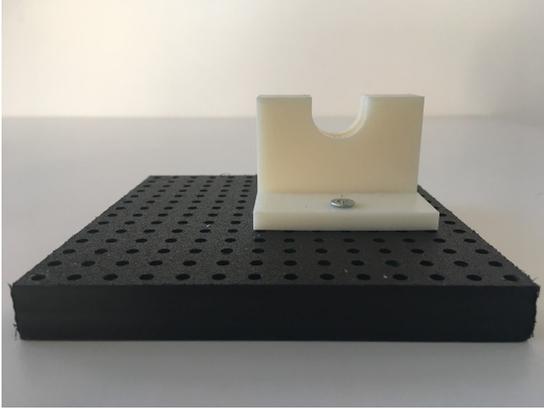


4. Connect the Adafruit 16-channel PWM/Servo Shield to the Arduino following the instructions with the shield. Once connected connect the motor to the shield and upload the Reset program to set the servo motor position to origin. This step ensures that the following placement of the servo motor and syringe holder is correct.
  - a. Resetting to origin should place the servo motor horn vertically 90 degrees. If it is horizontal remove the horn and replace it at a 90 degree angle.

5. Screw servo motor unit onto one of the bases (7) as shown below. Screw one end onto the second column of holes and the other on the third to last column on the other end. The row placement doesn't matter as long as both ends are on the same row.



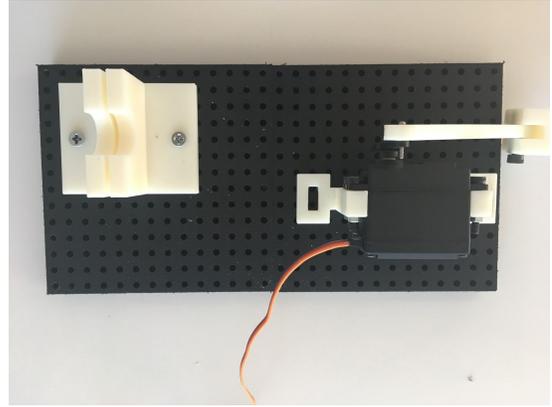
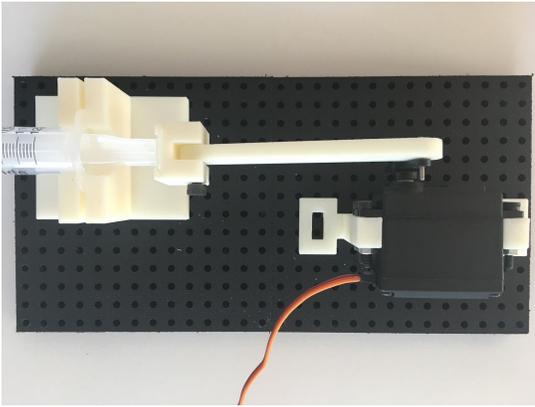
6. Screw the syringe holder (5) onto the other base(7). The placement of the syringe holder should align with the piston arm (3) on the other base.



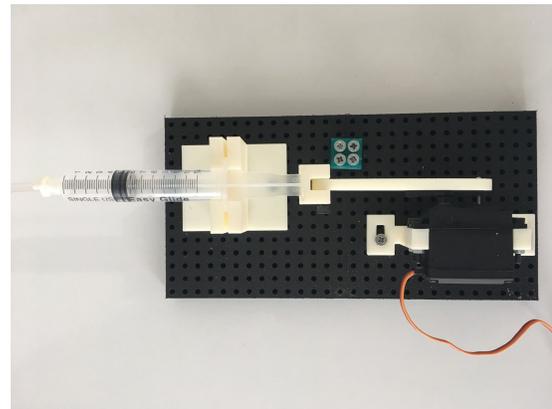
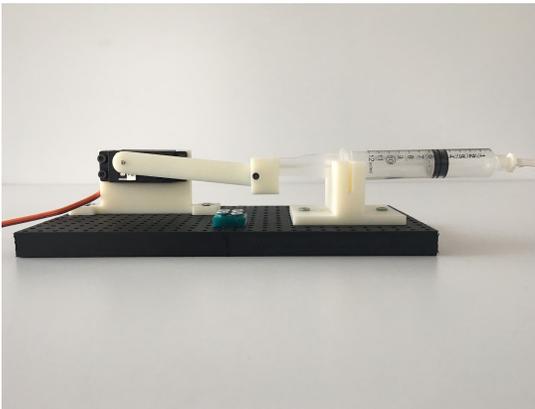
7. Connect the tubing (9) to the syringe (6) via a tube connector. Twist on the tube connector onto the syringe and push into tubing, ensuring that fit is tight.



8. Align the two halves of the control syringe unit so that the piston arm (3) is lined up with the syringe holder (5). Slide the assembled syringe into the syringe attachment (4) by sliding the plunger of the syringe into the slot on the syringe attachment. Swing over the now connected syringe over to slide the "wings" of the barrel into the syringe holder (5).



9. Connect the two bases using a base connector (8).



10. Connect the servo motor to the Adafruit 16-channel PWM/Servo Shield on the 0th pin.

11. Congratulations! You've constructed a control syringe unit. These units can be connected in parallel depending on how many you need for your experiment. Just move base connectors so that they are connecting adjacent control syringe units at all connecting junctions. You can also use other pieces that have screw holes, such as syringe holders, to connect control syringe units. Connect additional units to the Arduino using the other servo pins on the shield. Follow TERRA Adaptor guidelines when constructing. Below is an example of a 4 control syringe units connected together.

