HYDRAULIC ARM
ASSEMBLY Instructions

THIS IS AN EDUCATIONAL KIT—NOT A TOY
This Hydraulic Arm is designed for Children over 10 years old.
It requires ADULT support and surveillance during assembly.
The kit contains sharp and small parts which could be dangerous to small children

NOT SUITABLE FOR CHILDREN UNDER 36 MONTHS OLD
Due to small parts

What is Hydraulics?

Hydraulics is the means by which force and movement are transferred from one point to another via a tube containing liquid. Usually the liquid is oil, but in our case we will be using water. Everyday examples of hydraulic applications are: car hydraulic brakes, construction equipment such as cranes, excavators and dump trucks.

Our model copies an arm, like some types of robot with a gripper. It can move in 4 ways:

1 **Lift** the whole arm can be raised and lowered
2 **Reach** the outer section of the arm extends
3 **Rotate** the whole bracket-arm assembly rotates
4 **Grip** the gripper grips the object to be lifted

Each of these movements is controlled manually by a separate tube with syringes at each end. In industrial applications hydraulic pressure would come from a pump with oil directed to the tubes, known as lines, by control valves.

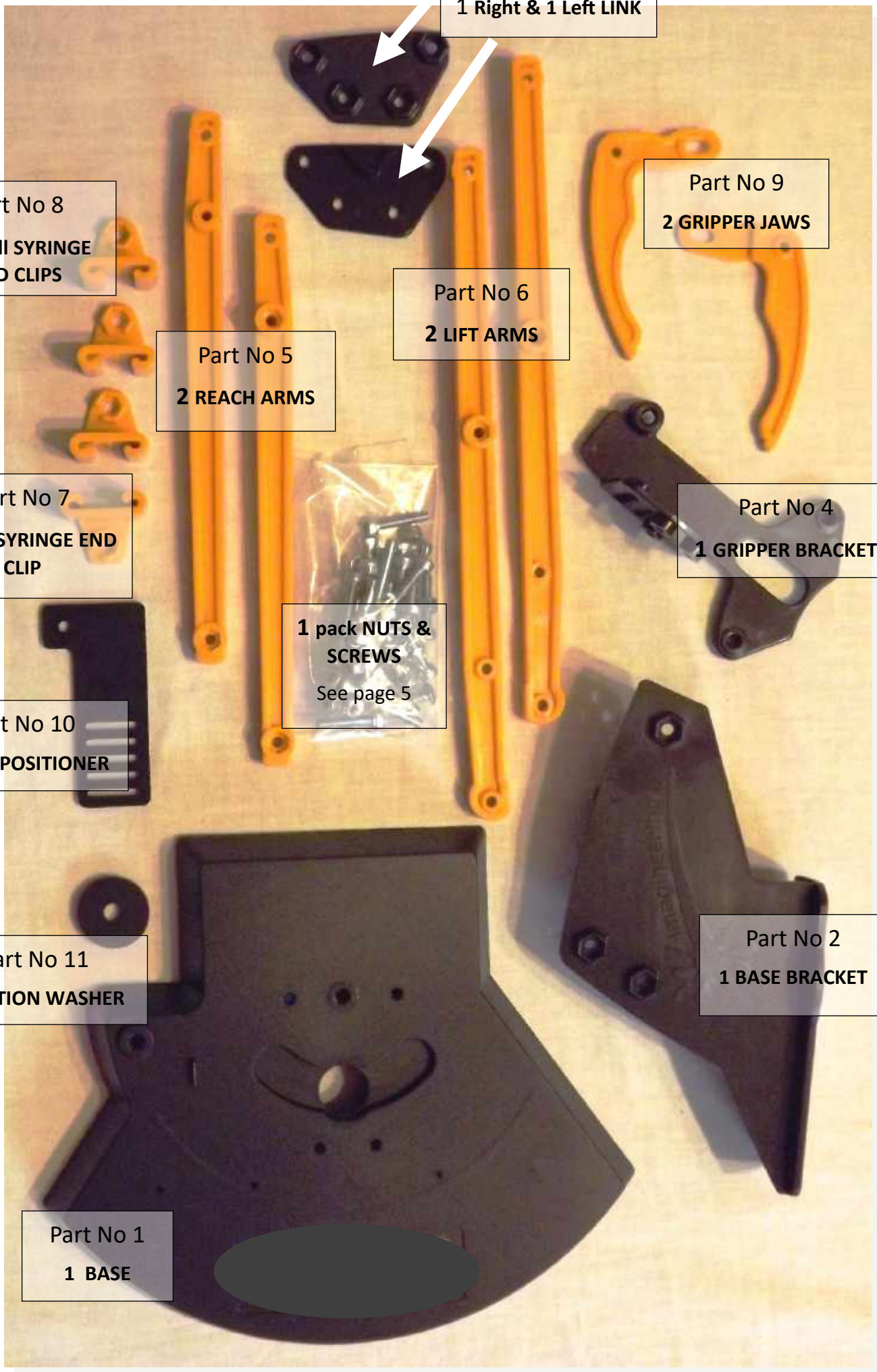
More information on hydraulics can be found in books and on the internet, try:
http://www.youtube.com/watch?v=YlmRa-9zDF8 (Hydraulic and Pneumatic Part 1)
www.science.howstuffworks/hydraulic and www.wikipedia.org/wiki/hydraulics

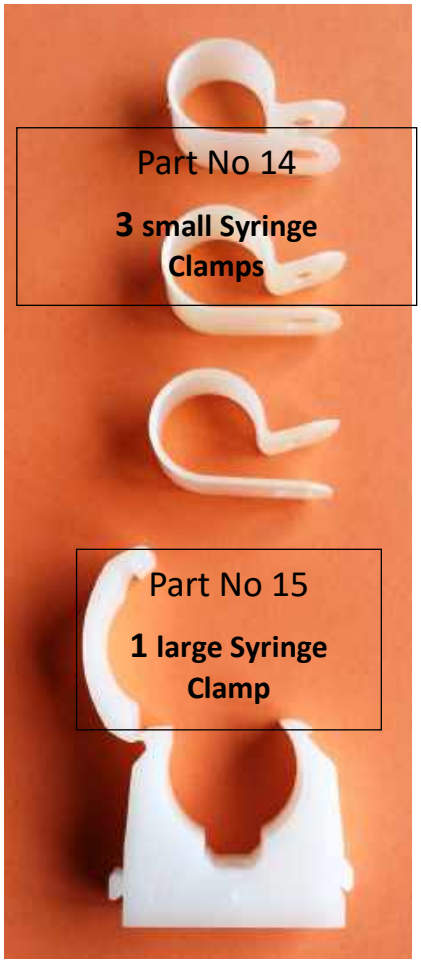
'GOOD PRACTICE'

CHECK YOUR KIT

Tick each item to show your kit is complete

Part No	Description	Quantity	
1	Base	1	
2	Base Bracket	1	
3A & 3B	Right and Left Link	1 of each	
4	Gripper Bracket	1	
5	Reach Arms	2	
6	Lift Arms	2	
7	Large Syringe End Clip	1	
8	Small Syringe End Clips	3	
9	Gripper Jaws	2	
10	Reach Positioner	1	
11	Rotation Washer	1	
12	Small Syringes—10ml	7	
13	Large Syringe—20ml	1	
14	Small Syringe Clamps	3	
15	Large Syringe Clamp	1	
16	Tube		
17	T-Handle 3mm Allen Driver	1	
18	Syringe Holders	2	
19	Syringes Guard	1	
	Nuts and Screws	1 pack	
	'Sticky Dots' for Syringes		





Part No 14

3 small Syringe Clamps

Part No 15

1 large Syringe Clamp

Part No 12

7 small Syringes 10ml

Part No 16

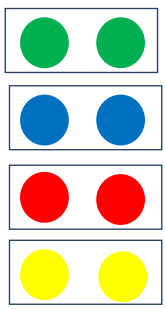
Tube

Part No 13

1 large Syringe 20ml

Part No 17

T-Handle 3mm Allen Driver



Syringe Identification Sticky Dots

Part No 18

2 Syringe Holders

Part No 19

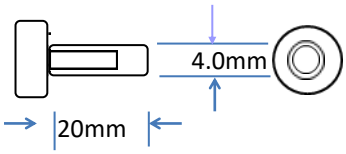
Syringes Guard

NUTS AND SCREWS

METRIC CAP SCREWS

M4  x 20 screw

Side View End View



 ‘Nyloc’ Nut This type of nut is used because it does not come loose.

Contents of this kit *(includes a few spares):*

20 Screws M4 x 20 (used everywhere except for Reach Syringe, and Syringe Holders and Guard)
3 Screws M4 x 25 (used for Reach Syringe Clamp and Clip)
2 Screws M4 x 30 (used for assembly of Syringe Holders and Guard)
25 Nyloc Nuts

TOOLS

In this kit:

✱ Tee Handle 3mm Allen Key

NOTE: NO SPANNER IS REQUIRED

Also required supplied by you:

✱ To cut the tube

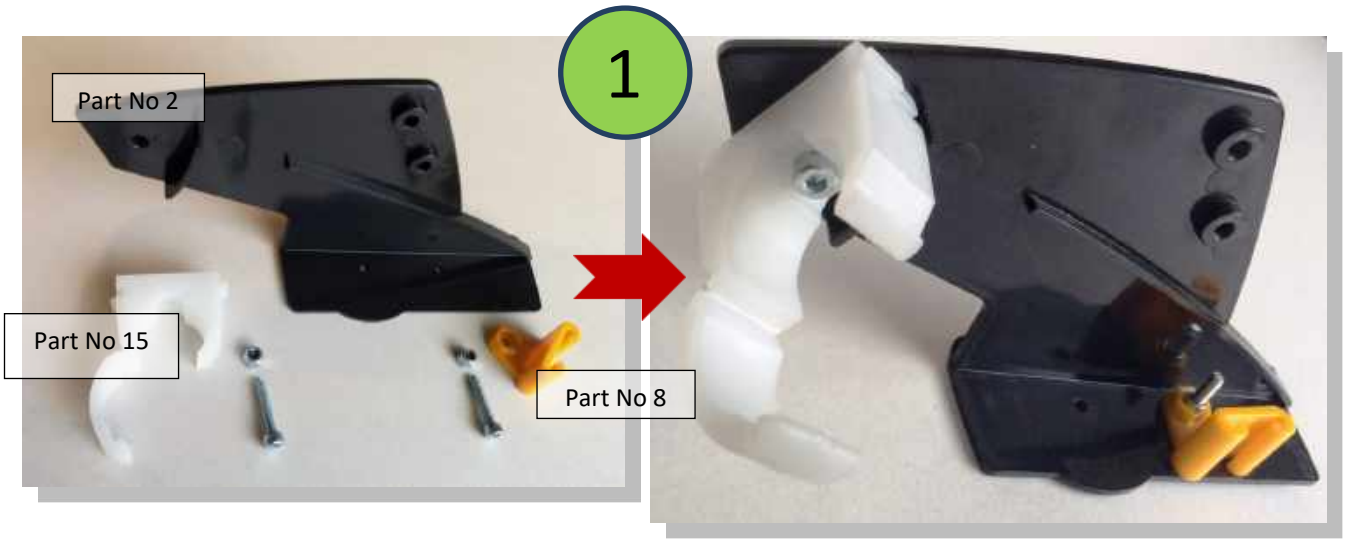
✱ To open Part No 15 ‘Large Syringe Clamp’.

HOW TO TIGHTEN NUTS AND SCREWS

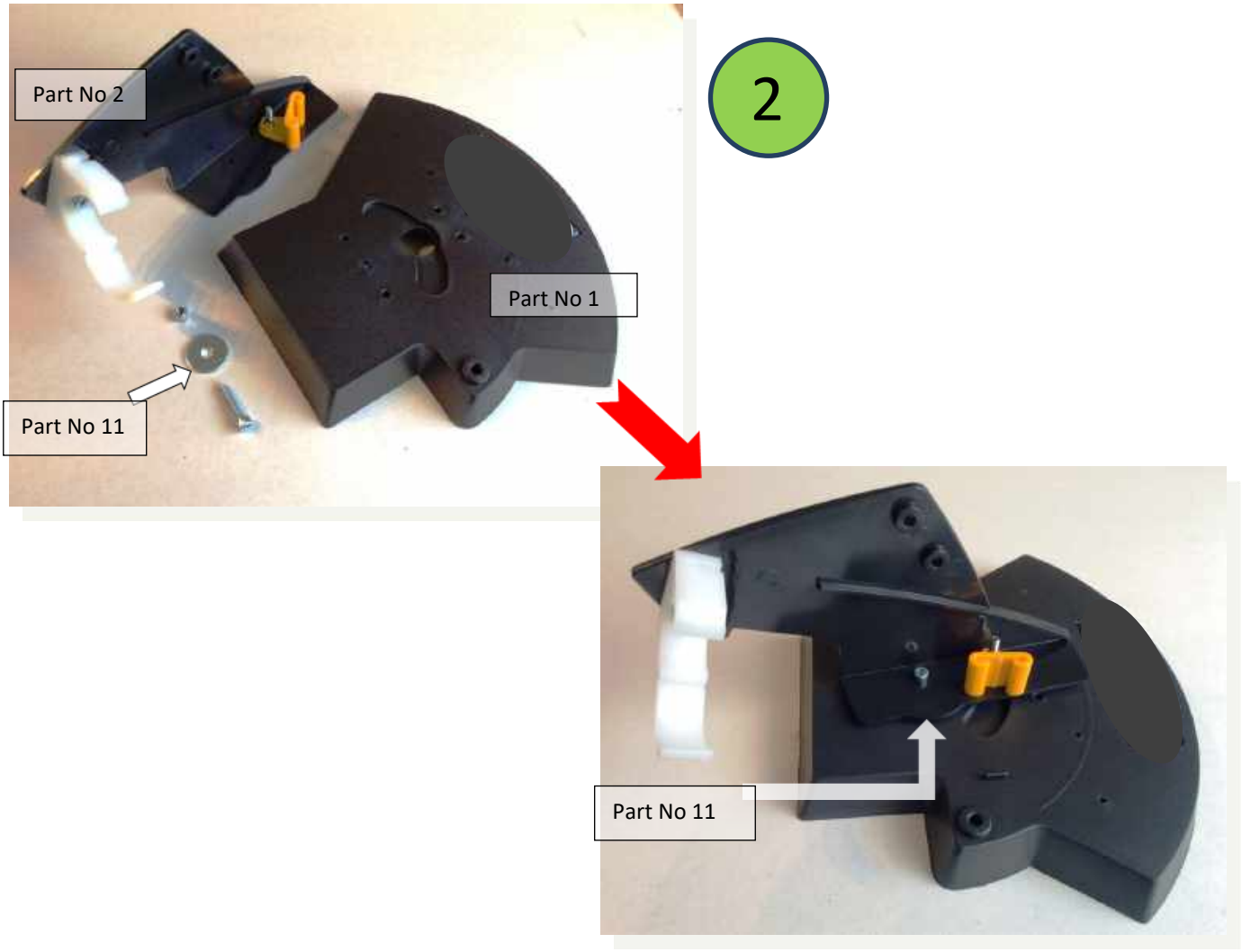
How to tighten a screw and nut:

1. Inserted the screw into the nut from the metal/flat side of the nut, **not** the side with the plastic insert.
2. Turn the screw clockwise. After 2 to 3 turns the screw meets the plastic insert of the nut. Further tightening will be very stiff and require the Allen Key. This is because the plastic provides the friction that will later stop the nut becoming loose and falling off the screw.
3. This is a self-locking design.
4. Now push the nut into the pre-formed hexagonal shape in the plastic part. This acts like a spanner and prevents the nut from turning.
5. Use the Allen Key to turn the screw until the parts are pinched together.
6. Undo the screw by ¼ to ½ a turn. (This is turning the screw anticlockwise).

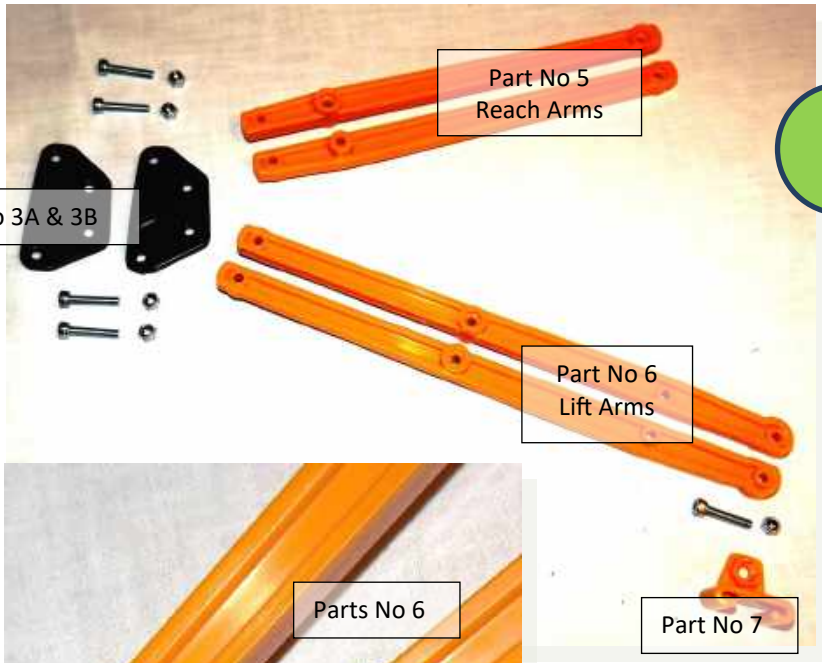
BASE BRACKET SUB-ASSEMBLY



BASE SUB-ASSEMBLY



LIFT & REACH ARM SUB-ASSEMBLY



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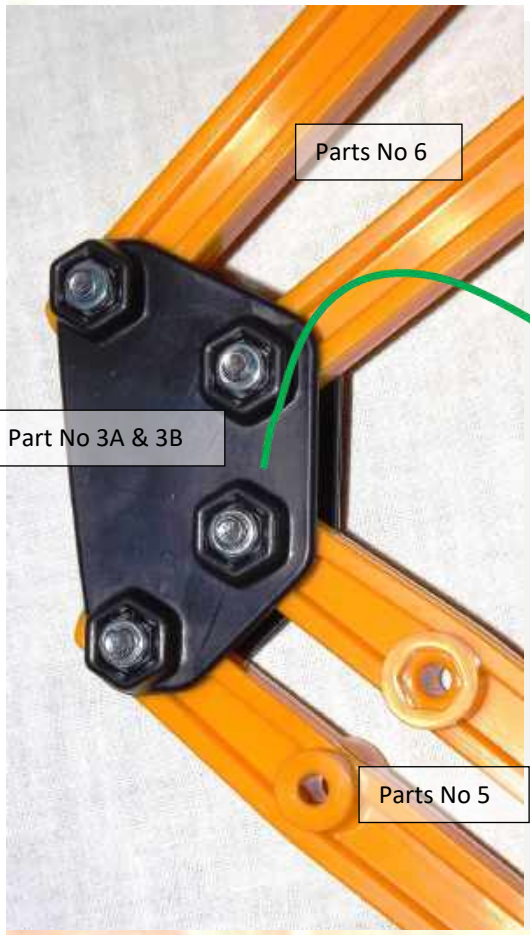
LOOK CAREFULLY:

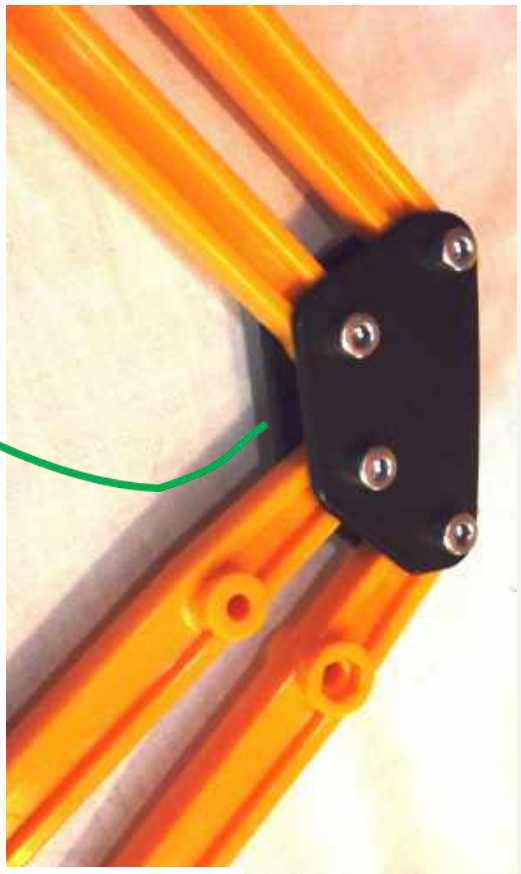
a) Both Lift Arms are the same and both Reach Arms are the same.

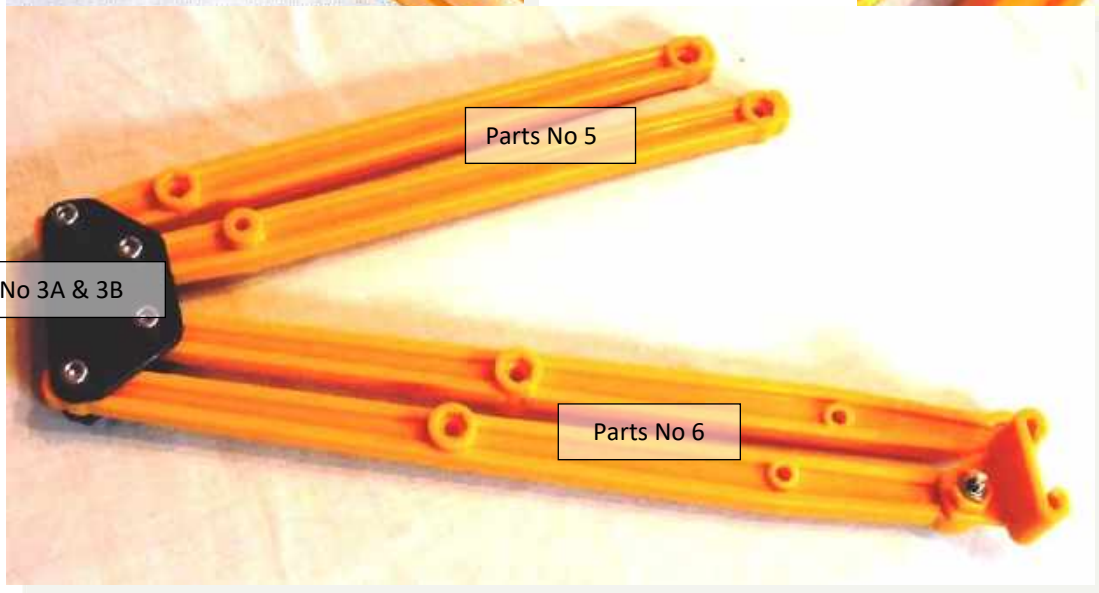
b) Assemble very carefully noting where all the holes are and that the straight sides are flat together.

c) Note the orientation of the Black Link pieces.

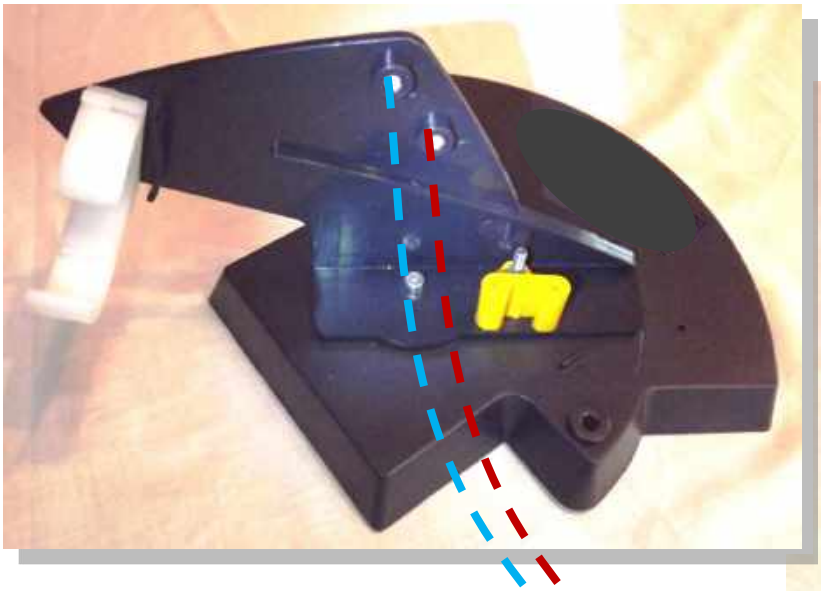
d) When screwed together Arms should move freely.

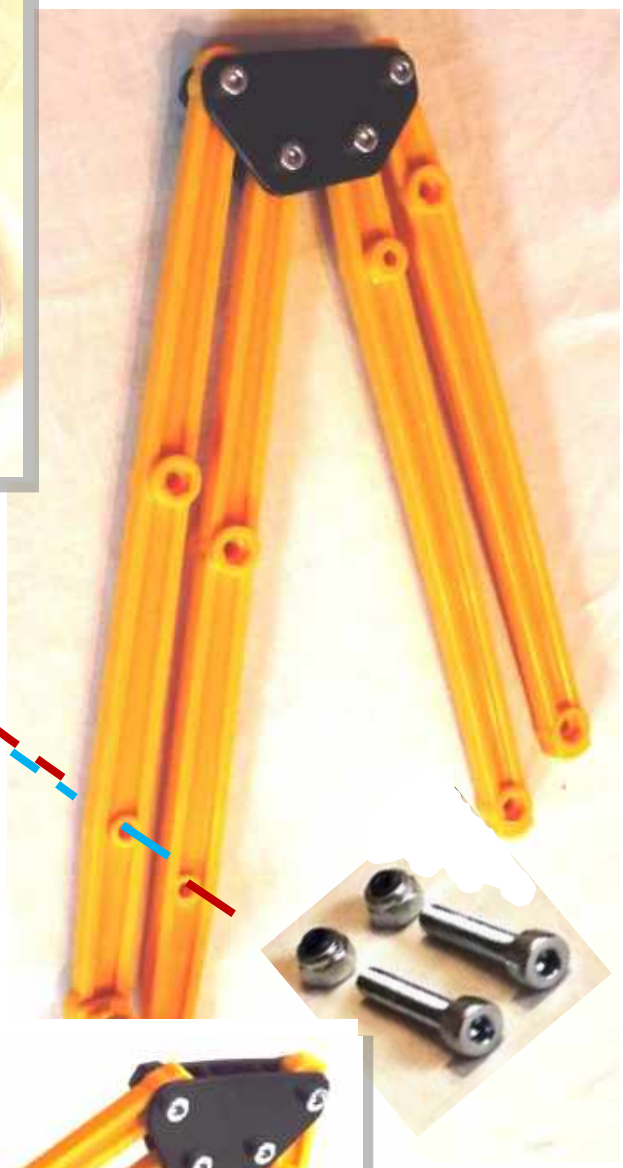






BASE & ARM SUB-ASSEMBLY





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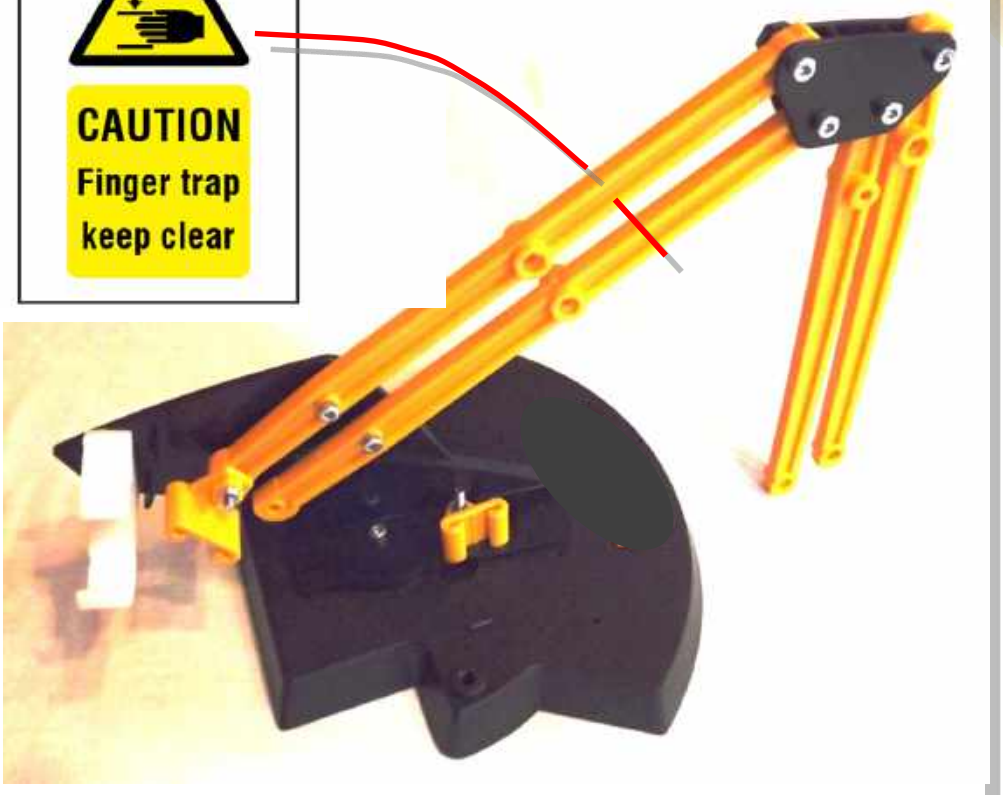
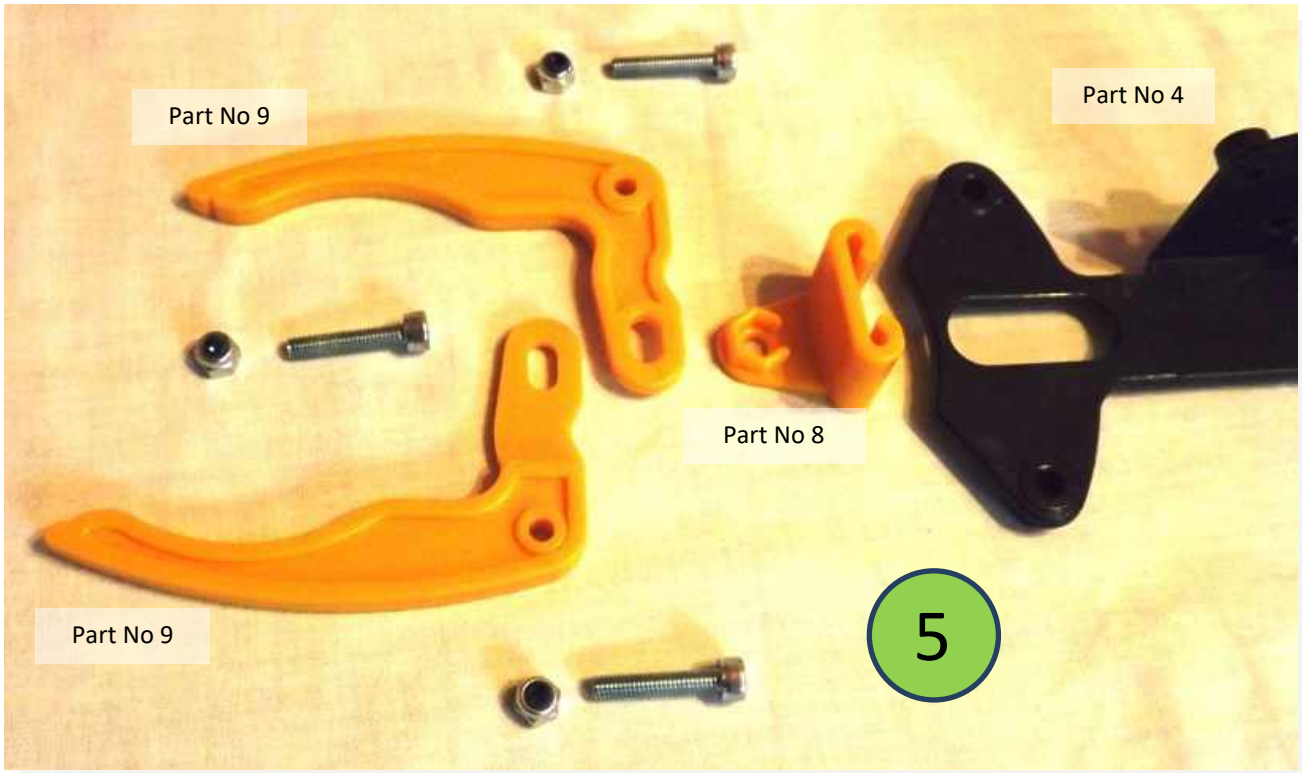
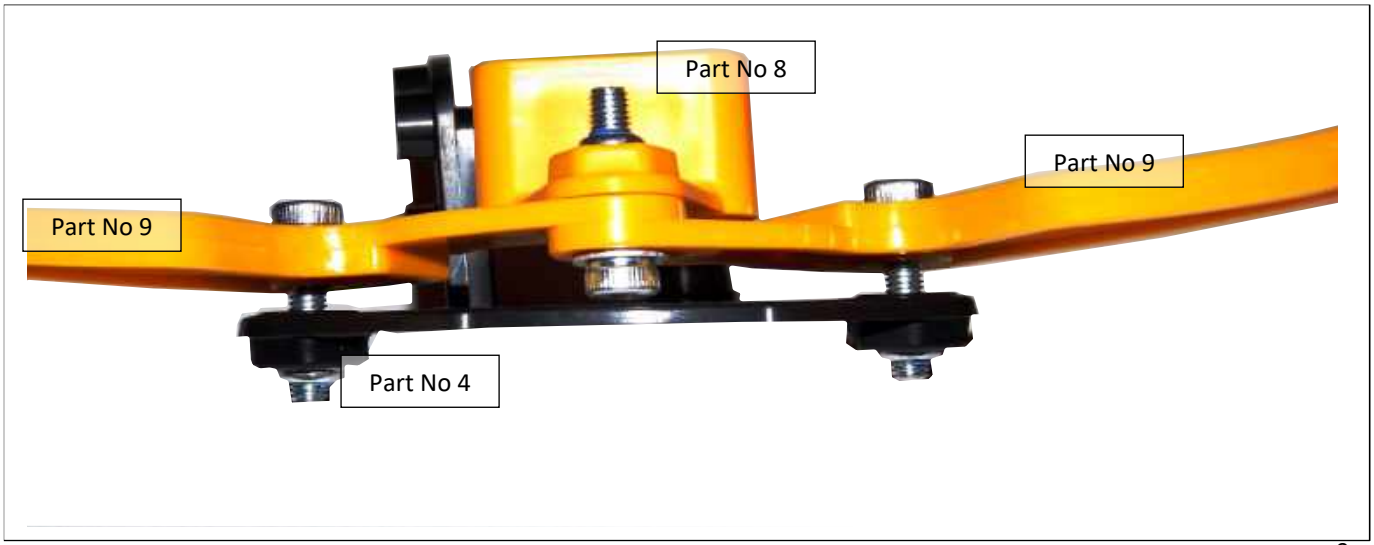
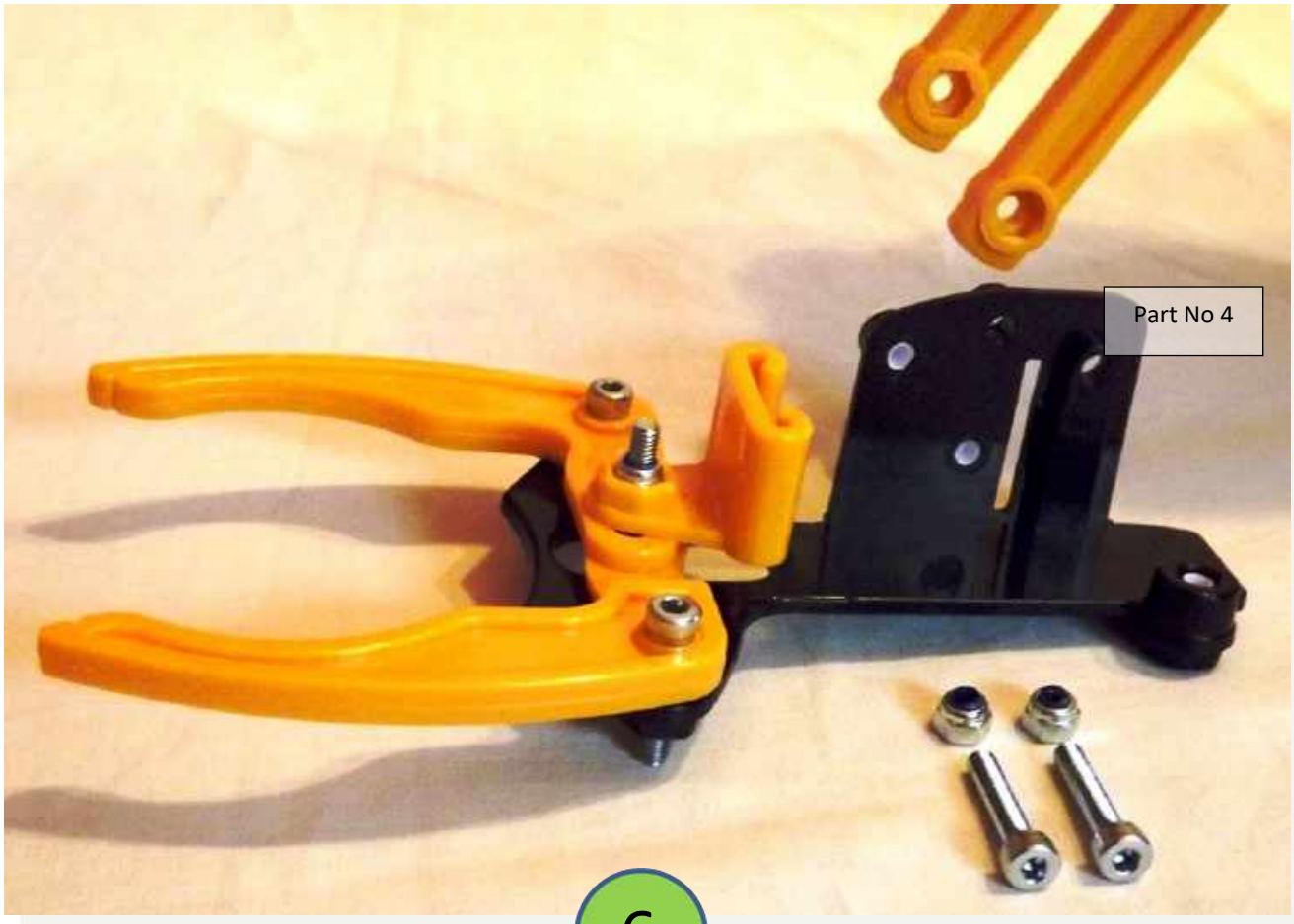


GRIPPER SUB-ASSEMBLY





GRIPPER TO ARM SUB-ASSEMBLY



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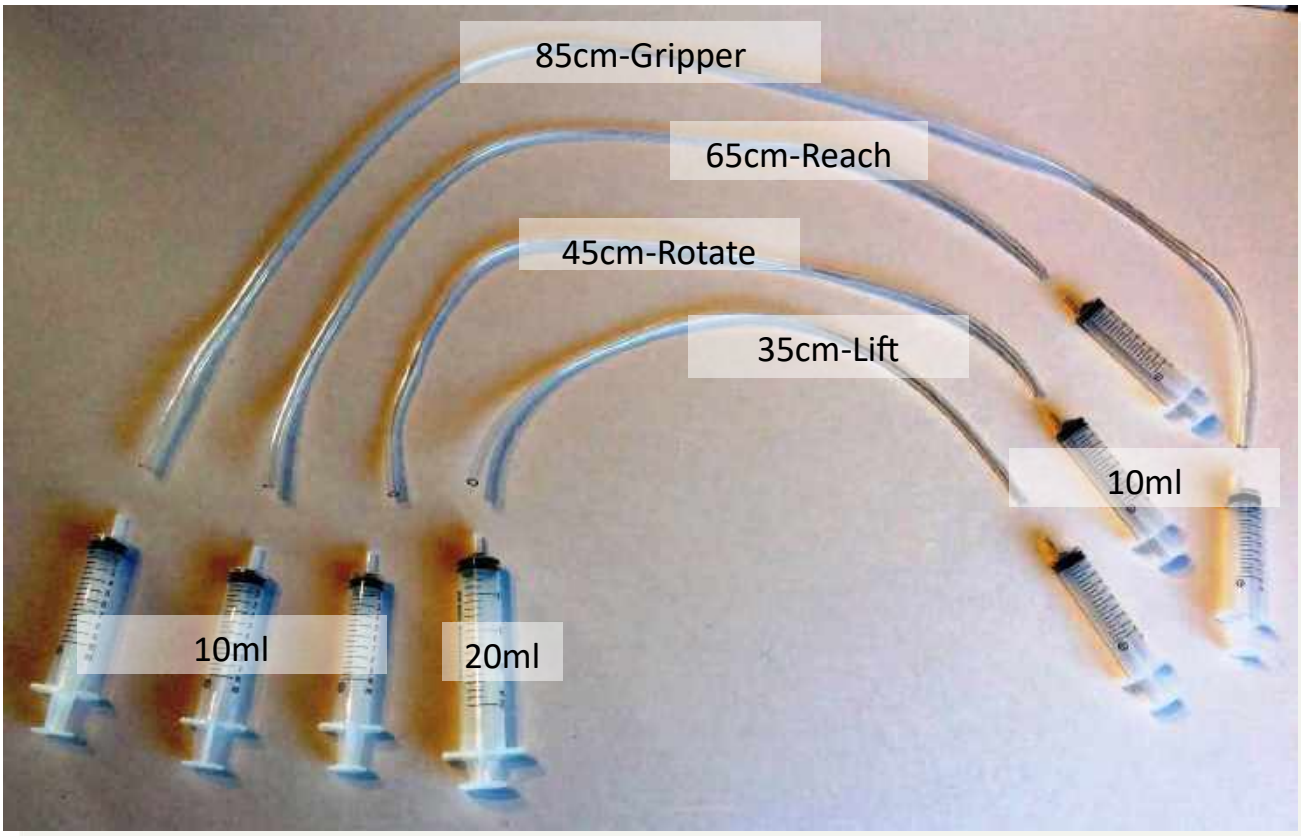
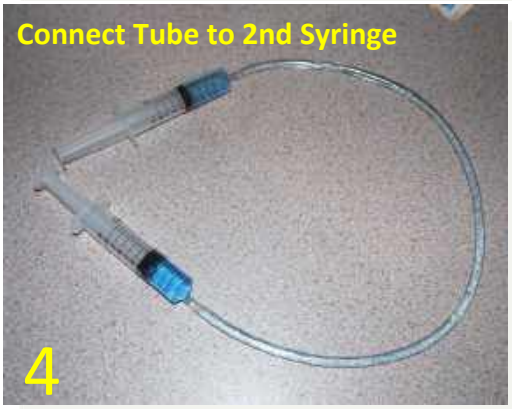
TUBE CUTTING & SYRINGES



FILLING OF SYRINGES AND TUBES

Hydraulic systems do not work efficiently if there is air in the lines. To eliminate air bubbles, fill, empty and refill syringes and tubes repeatedly in Steps 1, 2 and 3. Before fitting tube to second syringe, fill both syringes to 5ml mark – see Step 4. See following page for detail on filling syringes and tubes. Use distilled water if possible. (Coloured water illustrated for reference only)



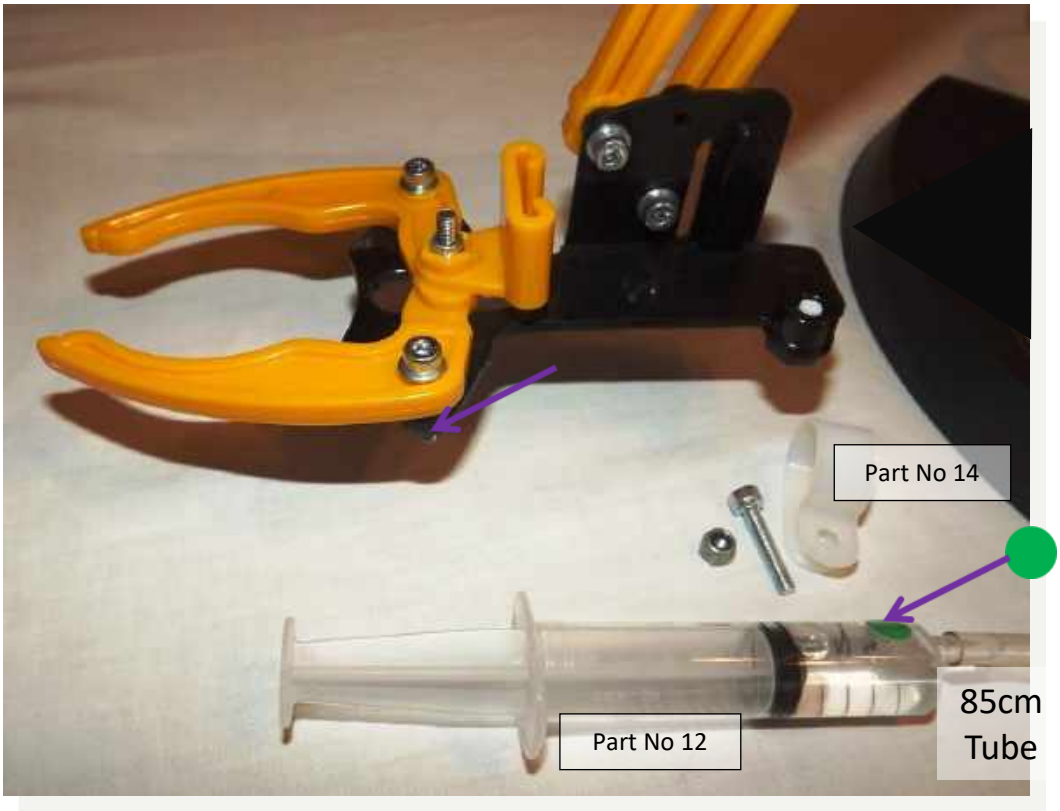
SOME TIPS ON SYRINGE FILLING

The filling procedure for all four control axes of the Hydraulic Arm is similar:

- **Prepare a bowl of cold water, distilled preferably.**
- **Prepare lengths of tube.**
- **Take a syringe—flush out the air**
  - *** Dip its spout into the water.**
  - *** Push the plunger down fully, expelling the air.**
  - *** Pull the plunger out to draw in water.**
  - *** With the spout still in the water, push the plunger down again (usually more air bubbles).**
  - *** Pull the plunger out to refill with water.**
- **Push one end of the tube hard down onto the spout.**
- **With the other end of the tube under the water, push the plunger down to expel the air in the tube. Repeat this until you are sure all the air has been expelled.**
- **Pull the plunger out so that the tube is full of water and is up to the 5ml mark on the syringe.**
- **Flush out the other syringe as above and fill to the 5ml mark.**
- **Connect the tube by pushing onto the spout of the second syringe.**

- **Water containers must be very clean to prevent any contamination.**
- **Do not store the syringes or tubes with water in them for any length of time.**

GRIPPER SYRINGE ASSEMBLY



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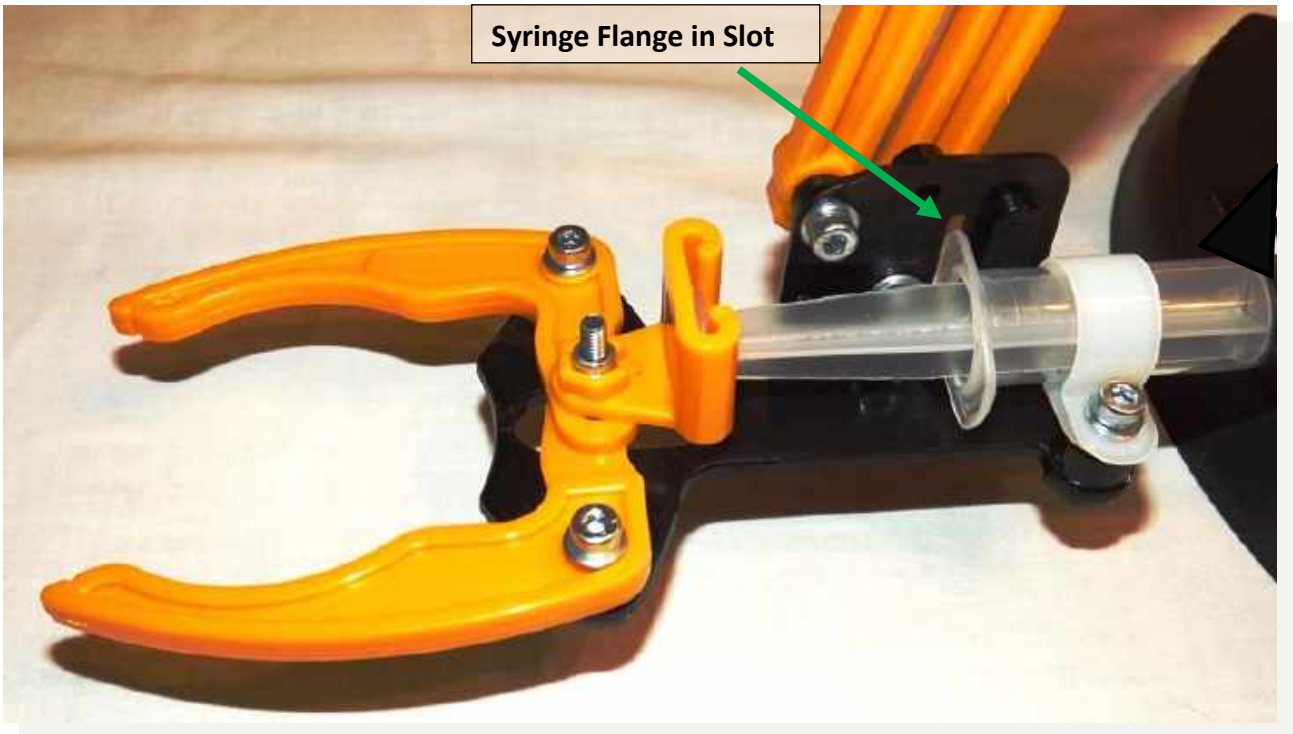
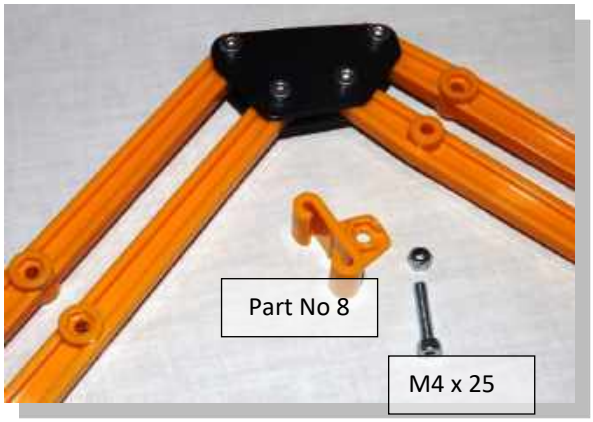


REACH SYRINGE ASSEMBLY



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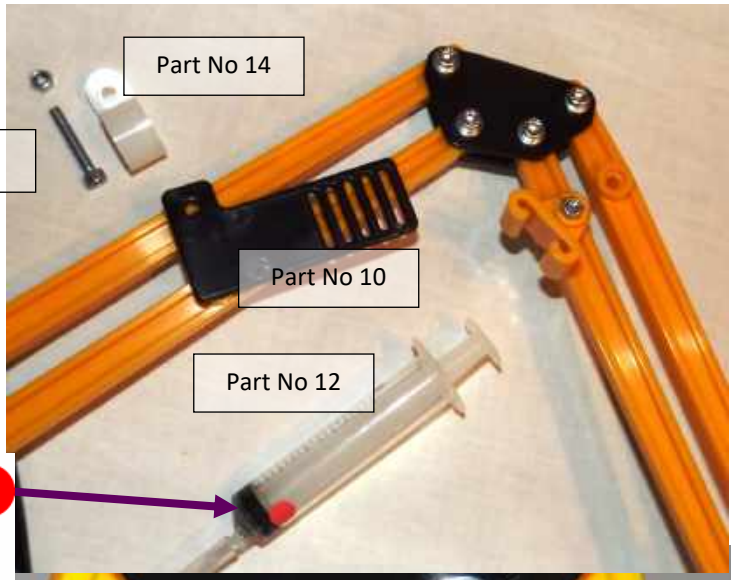
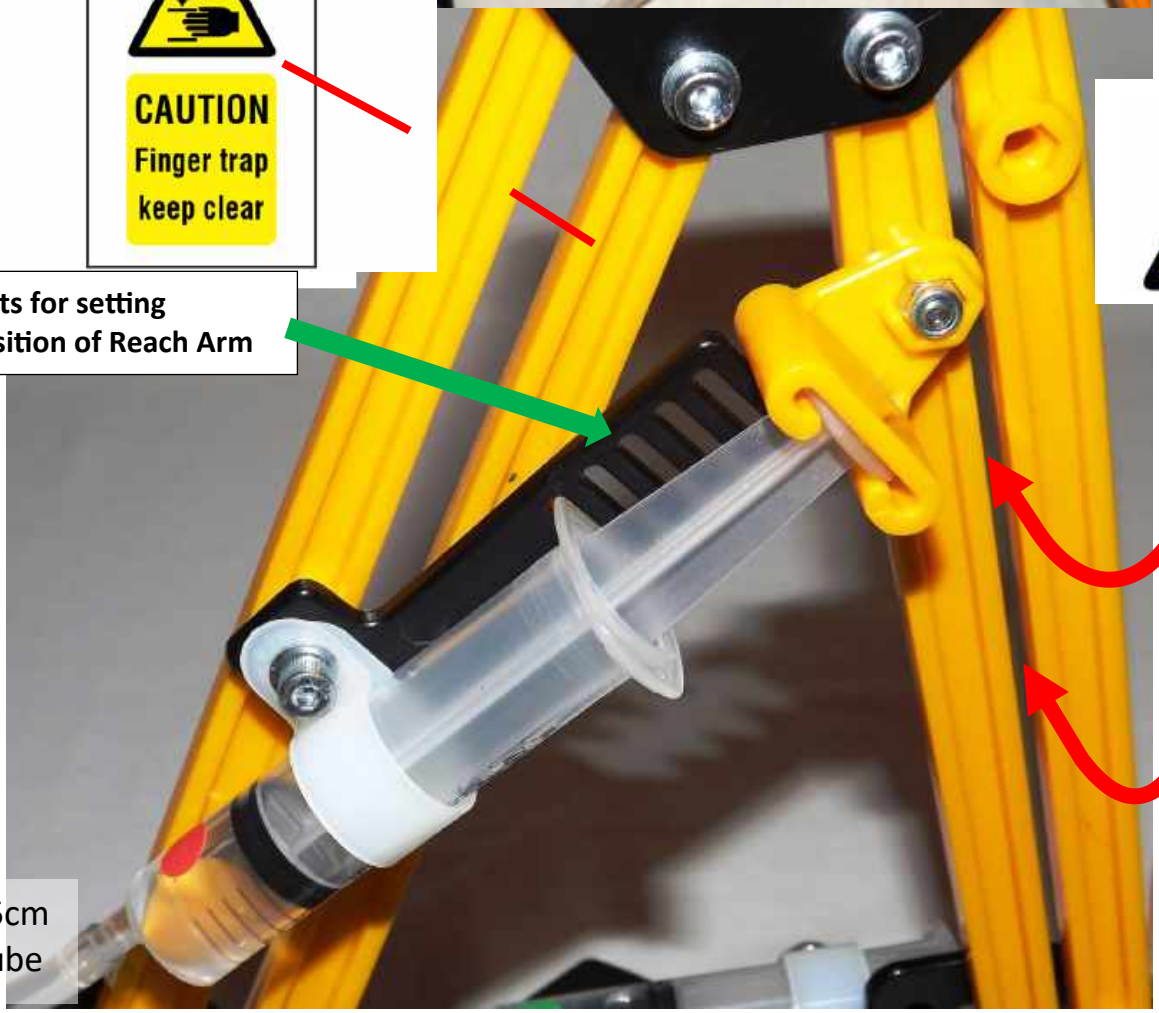
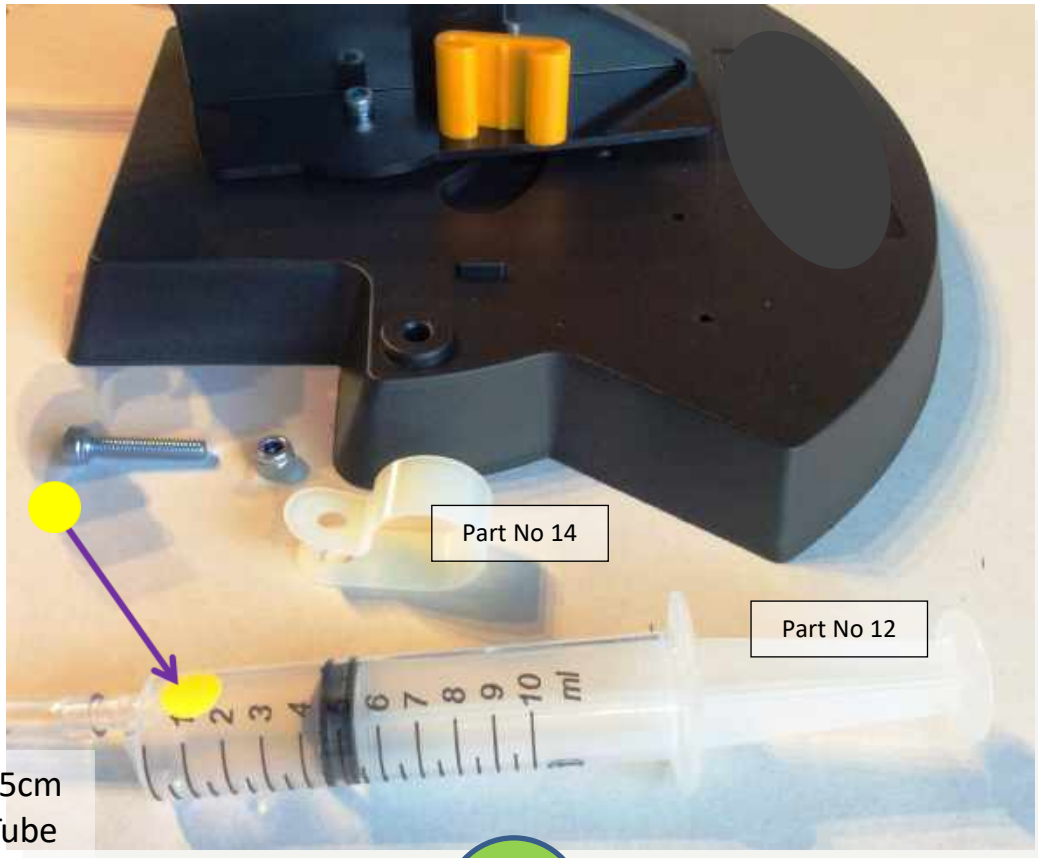


Slots for setting position of Reach Arm



ROTATION SYRINGE ASSEMBLY



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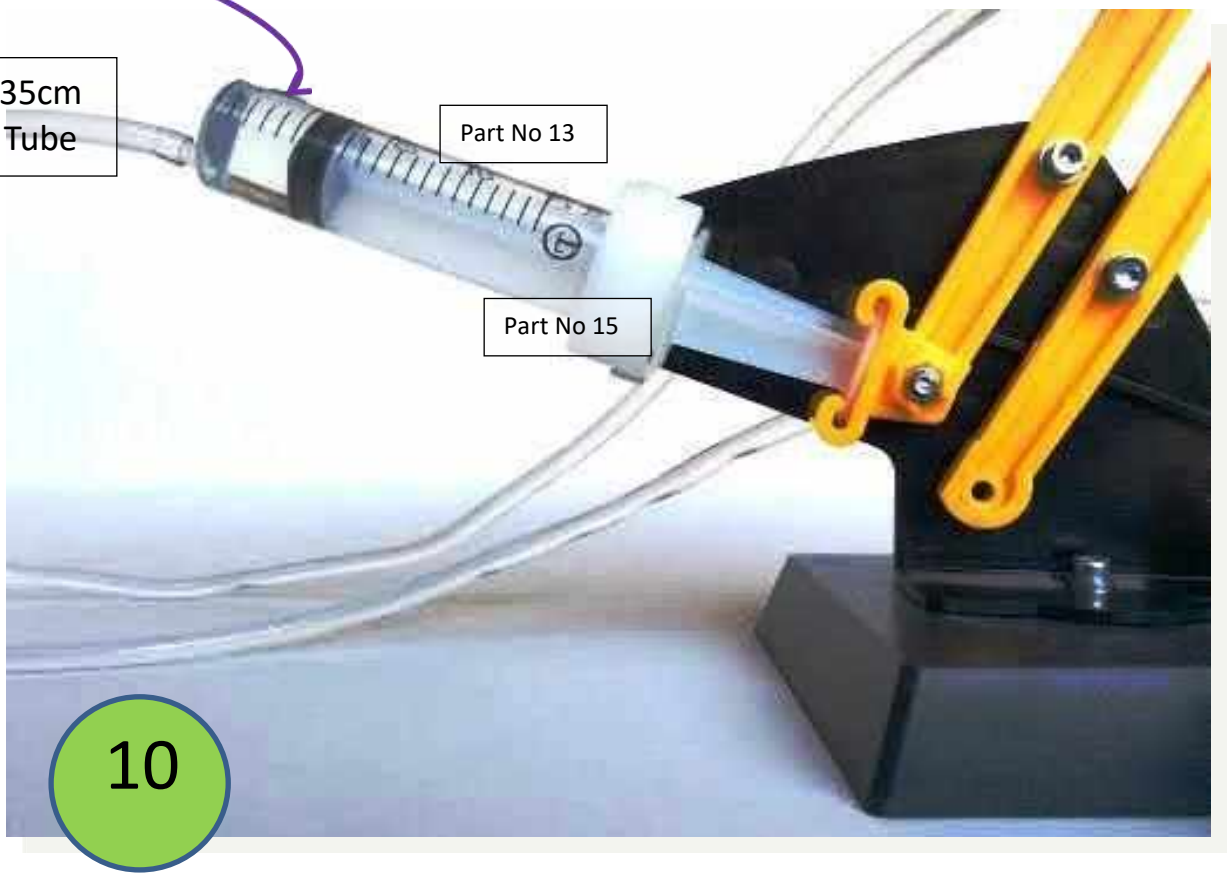
LIFT SYRINGE ASSEMBLY



HAND UNIT ASSEMBLY