Last Breath

By Rafael Lozano-Hemmer

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This short section must be read for proper operation

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General important information

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Last Breath (2012)
By Rafael Lozano-Hemmer

Technique
Motor, bellows, plexiglass, digital display, custom circuitry, arduino processor, respiration tubing, brown paper bags

Dimensions
Apparatus 60 x 27.5 x 23 cm, tube up to 15 m long

Electrical details
The piece needs 150W peak consumption, 60W average, 110 V – 240V.

Edition
Ed. 6 copies + 3AP

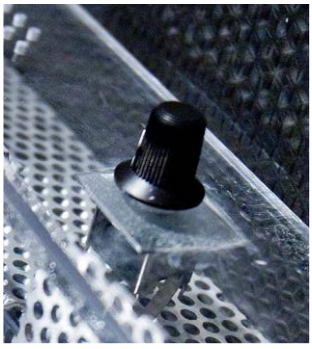
Description
An installation designed to store and circulate the breath of a person forever, between a bellows and a brown paper bag. The apparatus is automatically activated 10,000 times a day, the typical respiratory frequency for an adult at sleep. This is a biometric portrait: when the person who blew into the bag dies, his or her last breath will remain tangible.

Operation

1. Take the piece out of the crate (see appendix III for details). Fix the mechanized bellows to the wall (see Placement Instructions for details).
2. Connect and extend the medical air hoses. Fully extended, a maximum of 7 hoses should be used so as to not overcharge the bellows pressure.

If there is a breath kept already in the bellow a white plastic cap will ensure the bellow is airtight. Then before removing the cap and plugging any air hose in it, ensure all the hose are connected one to the other and that the last one has its paper bag – empty.

3. Install the paper-bag with the rubber bands provided.
4. When everything is in place, connect the piece to electrical power. The piece runs on either 120 Volts or 240 Volts (50-60Hz).
5. Finally insert your breath by turning the switch to “CB” (see Change Breath and Change Bag modes for more details).
6. To start the piece connect it to the electrical supply and turn the ON/OFF switch to ON. At startup the LED counter may show strange characters: it will get back to normal within 3 seconds.



7. To shutdown the piece turn the ON/OFF switch to OFF. The air will be safe inside, but the breathing mechanism will stop and its counter will turn off. The counter remembers the last breath given.

If you disconnect the piece without turning it off previously, you may lose the last breathing iterations.

Change Air **and** ***Change Bag*** **modes**

A 3 position switch on the top of the device allows the collector to change the breath inside the piece or to change the bag (damaged by visitors or by running for many months):

1- *Change Air (CA)*: Turn the knob toward the wall to make all the air go into the bag. The bag filled with the last breath can be removed and a new one filled with brand new air can be connected as soon as you hear the piece beeping. The piece will wait for the new bag to be plugged until the knob is turned back to its RUN position.

2- *RUN*: Middle position of the knob. Normal running behavior of the piece. The piece should always be in this setting.

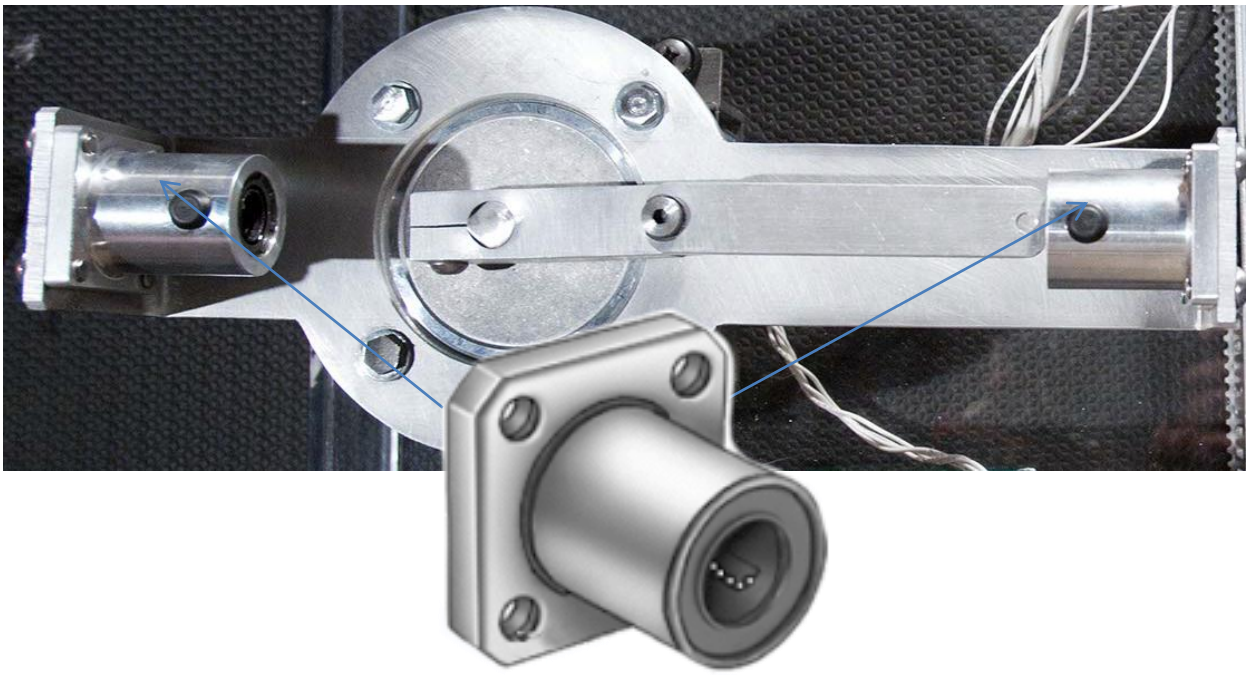
3- *Change Bag (CB)*: Turn the knob toward you to make all the air go into the bellows so that the bag can be replaced by a new empty one without losing the breath inside. Wait for the piece to beep before changing the bag. The piece will wait for the new bag until the knob is turned back to its RUN position. *This position is useful also for shipping the piece so that the breath can travel safely inside the bellows.*

The owner can remove the knob manually by pulling it upwards to ensure the visitors won’t try to play with it.

Cleaning and maintenance

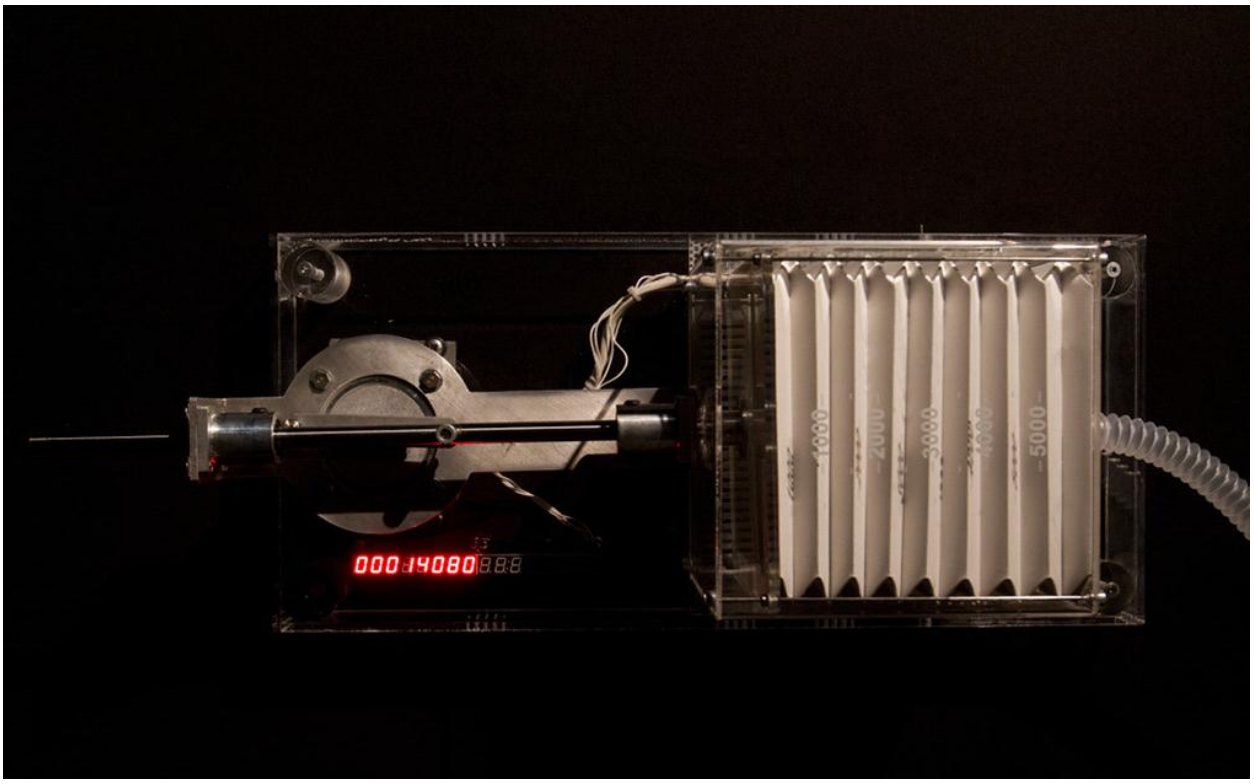
The whole Plexiglas casing has to be cleaned with great care. Standard products for window cleaning are well suited, but only really soft fabrics have to be used.

Once every 2 months a drop of oil has to be put for the linear bearings, through the grease hole if there is one or right on the shaft close to the bearing if there isn't.



Placement instructions

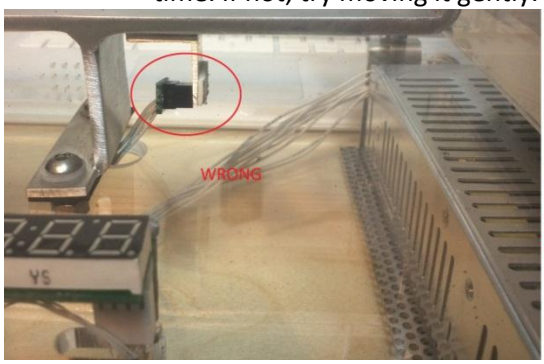
The piece should be hung by the four corner screws vertically centered at 1.6m from the ground (lower edge at 665cm from the floor). The tubing can be coiled and hung from the very same wall so the bag is close to the respirator or it can be hung from thin nylon thread around the room so that the paper bag is in the middle of the room.

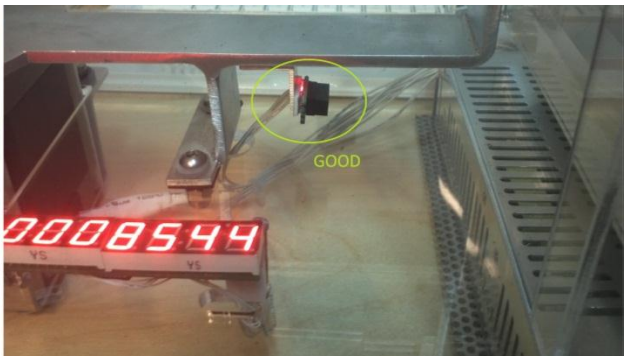


Troubleshooting

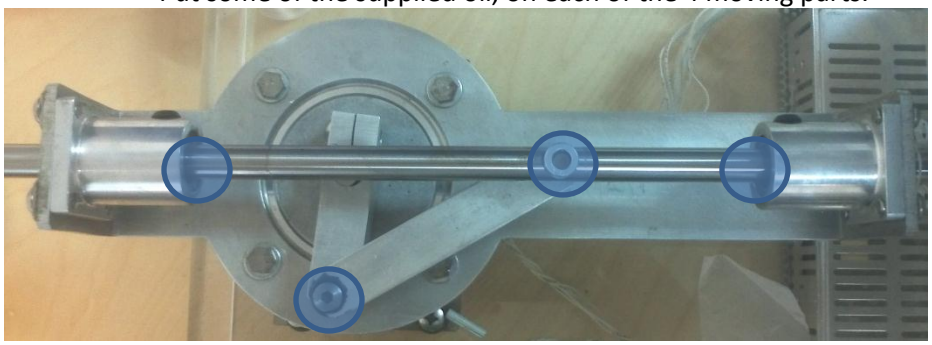
1- When turning on the piece the digits show strange characters before starting the counter.
This is normal, since at startup the motor needs to initialize before the digits.

2- I turned it on/off, back on and the counter never starting counting. It seems to be stuck.
First ensure the rotary switch on the top of the piece is on its middle position (RUN). If yes, this means the bellow never find its startup/reference position. The IR sensor must be misplaced. Check if red LED indicator behind the IR sensor light up when the bellow is fill up (0 Liters as in the bottom picture of the previous page) and only at that time. If not, try moving it gently.



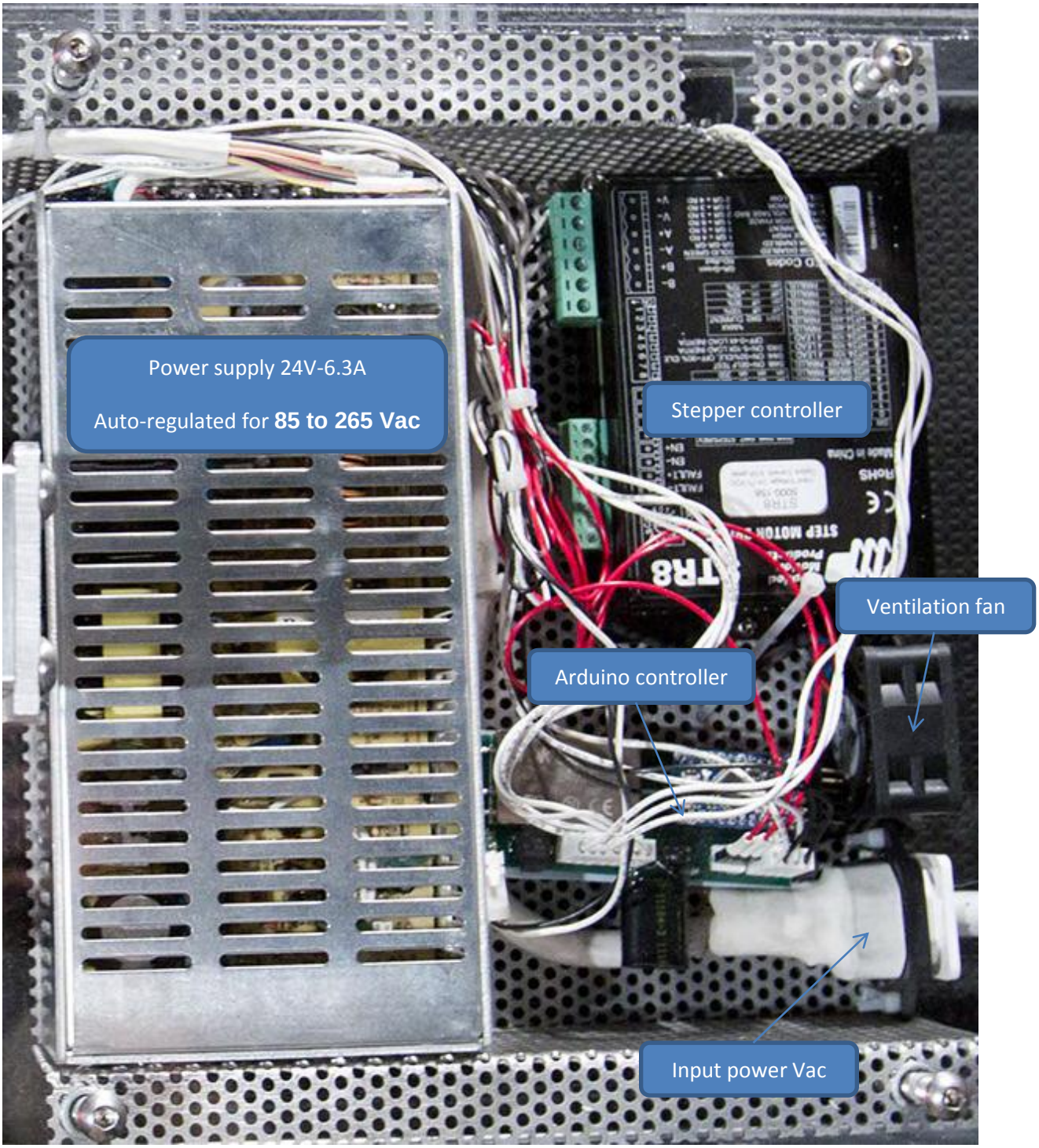


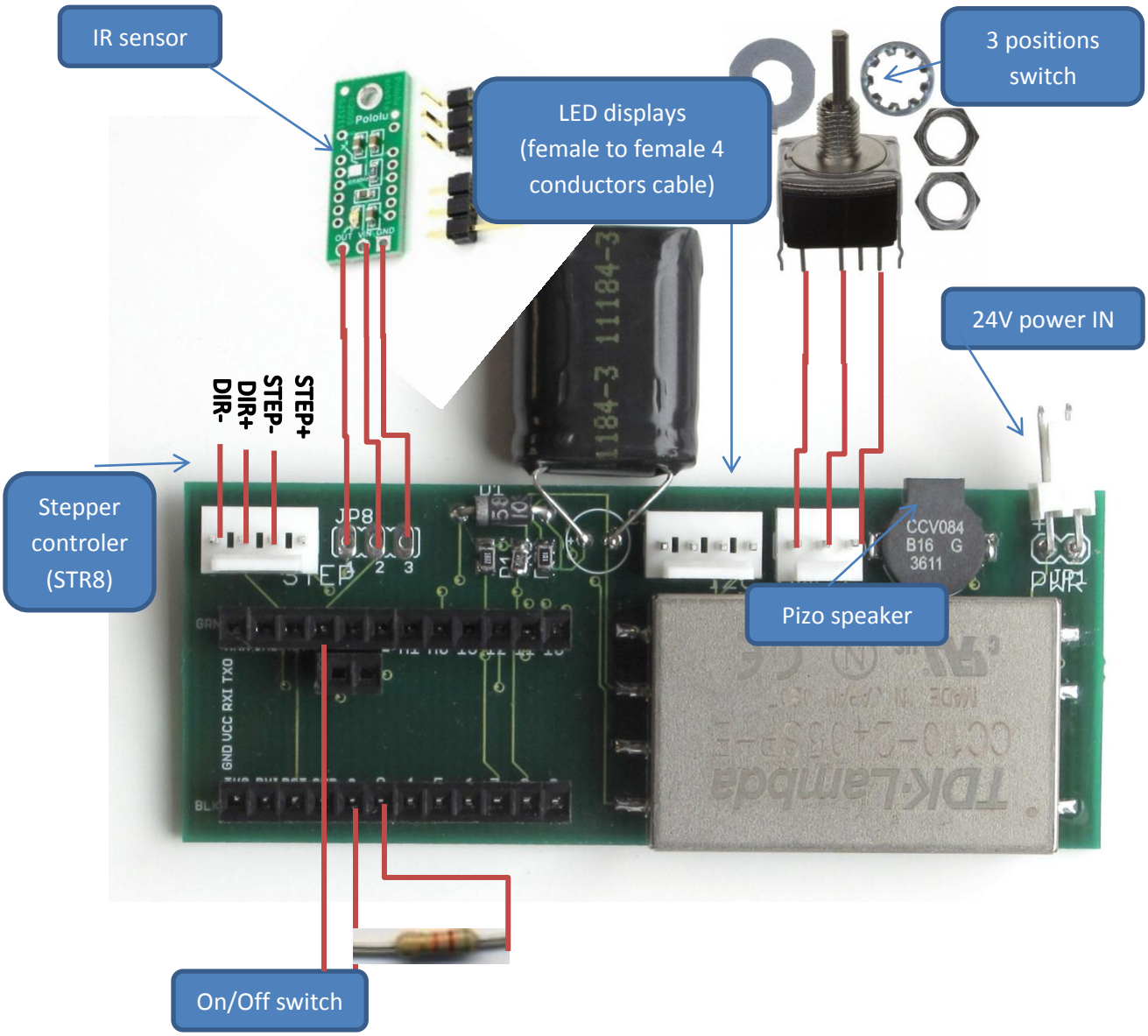
3- The mechanism is squeaking.
Put some of the supplied oil, on each of the 4 moving parts.

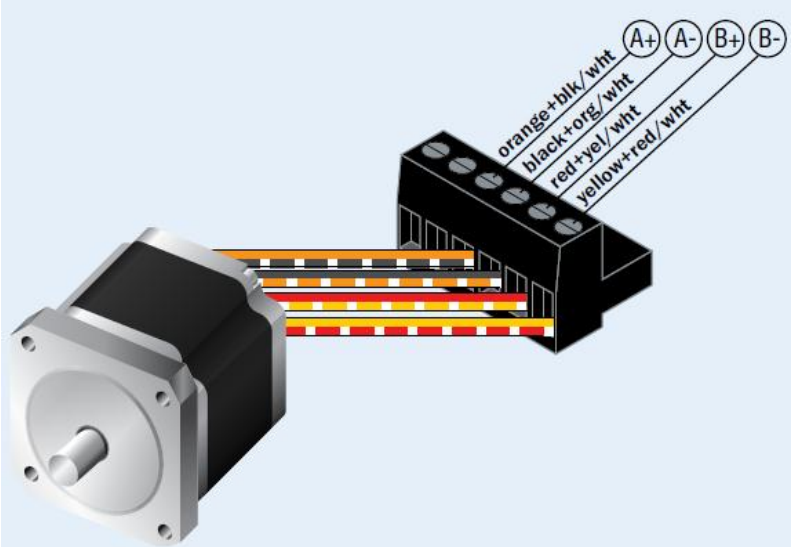


4- One or more of the back plexiglass pilar felt down, while handling or shipping the piece.
Don't worry; these parts are spacer to ensure proper mounting on the wall. We glue them for the piece to be more convenient to handle. You can either hold it while you are screwing the piece to its place or glue it back with Plastic Weld glue from Plastruct (http://www.plastruct.com/Pages/USDealers.html).

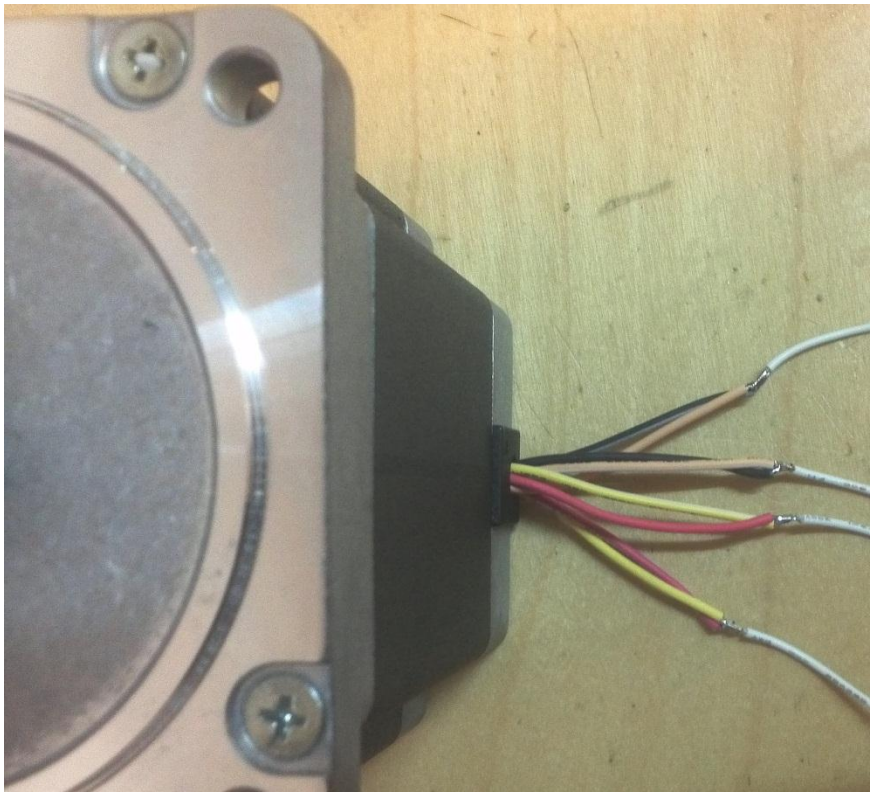
Appendix I – Technical drawings



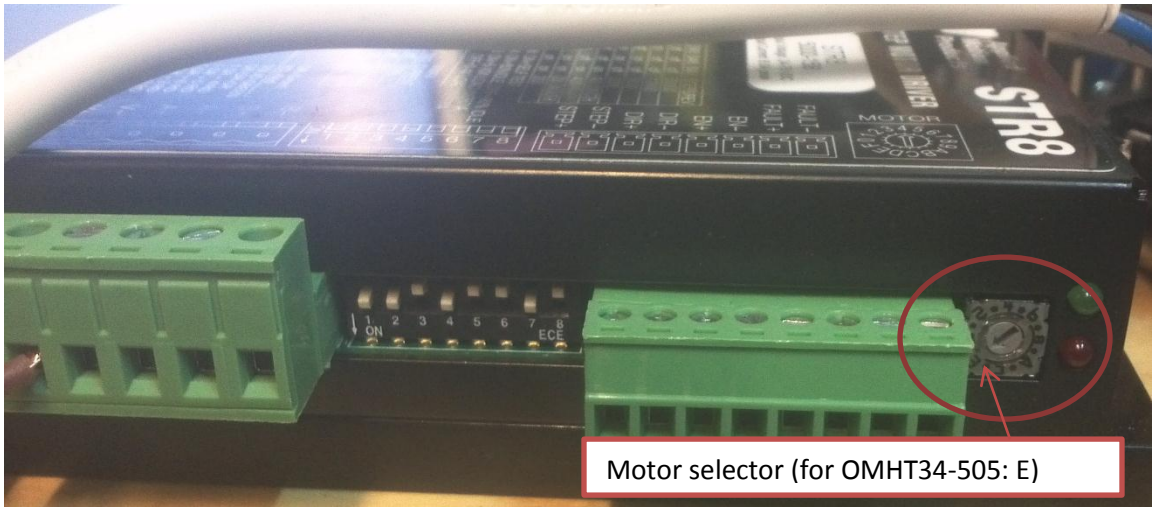

IR sensor
LED displays
(female to female 4
conductors cable)
3 positions
switch
24V power IN
Stepper
controler
(STR8)
STEP+
STEP-
DIR+
DIR-
Pizo speaker
On/Off switch



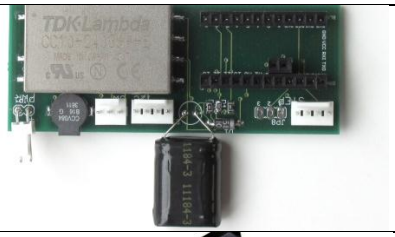
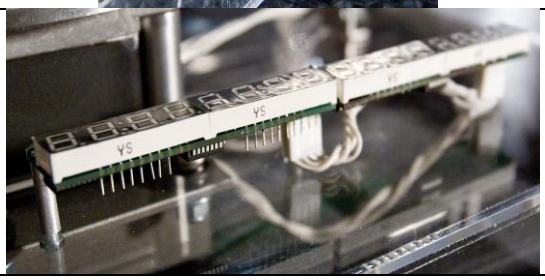
Soldering motor wires (according to the previous diagram)

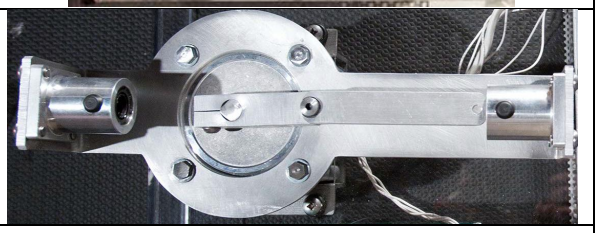
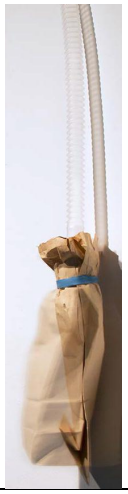


Jumper setup on the STR8 stepper controller



Appendix II – List of components

Component	Description	URLs	Image
Arduino mini Pro	Main controller	http://arduino.cc/it/Main/ArduinoBoardProMini	
Omega STR4	Stepper motor controller	http://www.omega.com/manuals/manualpdf/MSTR4_8_Series.pdf	
Omega OMHT34-505	Stepper Motor	http://www.omega.com/Auto/pdf/OMHT_Series.pdf	
Omega OMPS150A24	Power supply 24V 6.3A	http://www.omega.com/Auto/pdf/PS_Series.pdf	
3 Positions switch	Maintenance button	http://www.nkkswitches.com/pdf/mrb.pdf	
LEDs display	Custom made counter	http://media.digikey.com/pdf/Data%20Sheets/Lite-On%20PDFs/LTC-4627JR.pdf	

White bellows	Custom made white bellow assembled in custom made plexiglass box.	ATMR-PF-032812 - PF ENCLOSED BELLOWS http://www.nabell.com/	
Actuator mechanism	Custom made linear actuator with 2 linear bearing (with oil)	http://www.mcmaster.com/#standard-linear-bearings/=htzpwp	
Breathing bag system	Medical air hoses, white custom made fittings and kraft paper bag	940-F22108INSS02 http://www.dispomed.com/	
White electronic wires	Connecting all the peripherals to the main board	26AWG	- LED : 4 conductors, 75cm - Rotary switch: 3 conductors, 37cm - AC adapter: 3 conductors, 40cm - Board power: 2 conductors, 25cm - STR8 power: 3 conductors, 15cm
Pololu Carrier with Sharp GP2Y0D810Z0F Digital Distance Sensor	Bellow position distance sensor	http://www.pololu.com/file/0J154/GP2Y0D810Z0F.pdf	

Appendix III - Packing Instructions

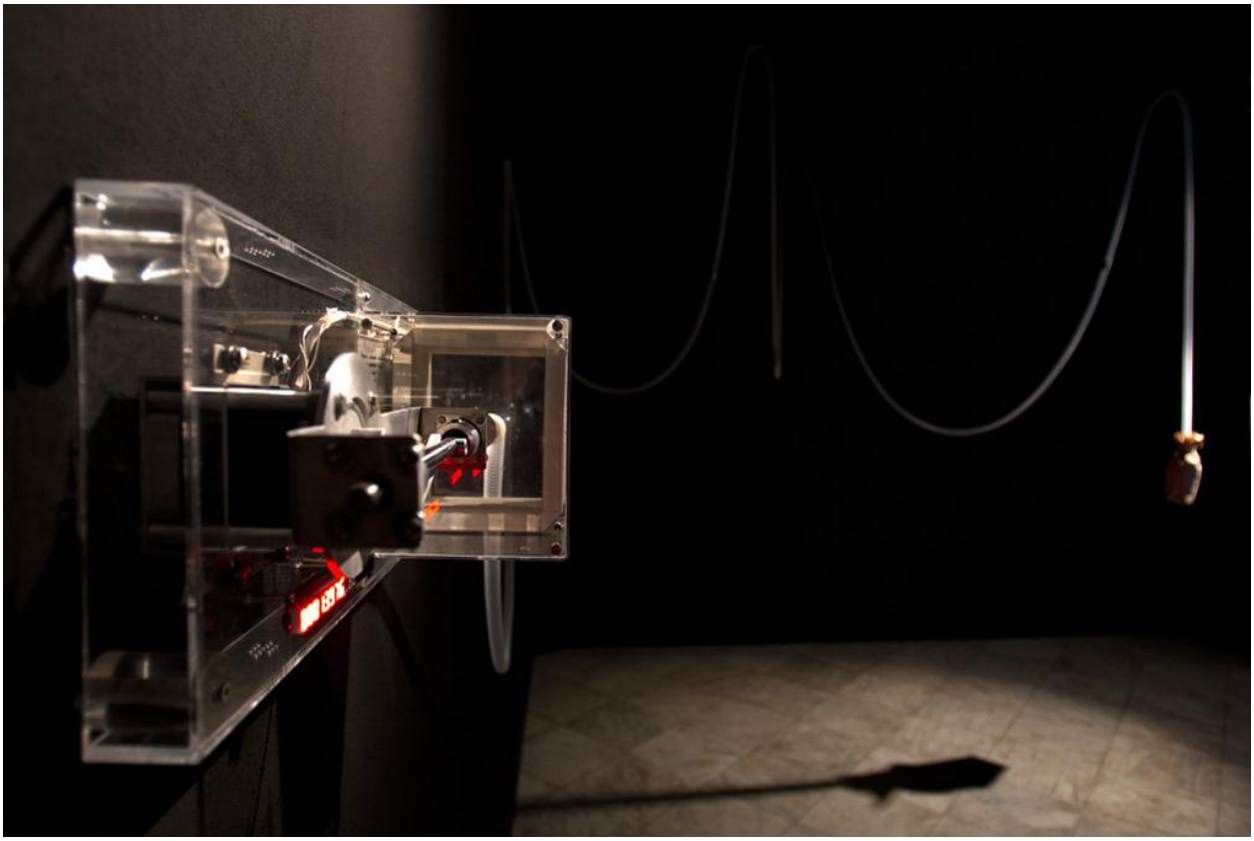
To mount the main unit on the wall only four screw of 3-4” (750mm) are required. One on each corner through the plexiglass pillars. For gypse walls proper wall mount should be used.

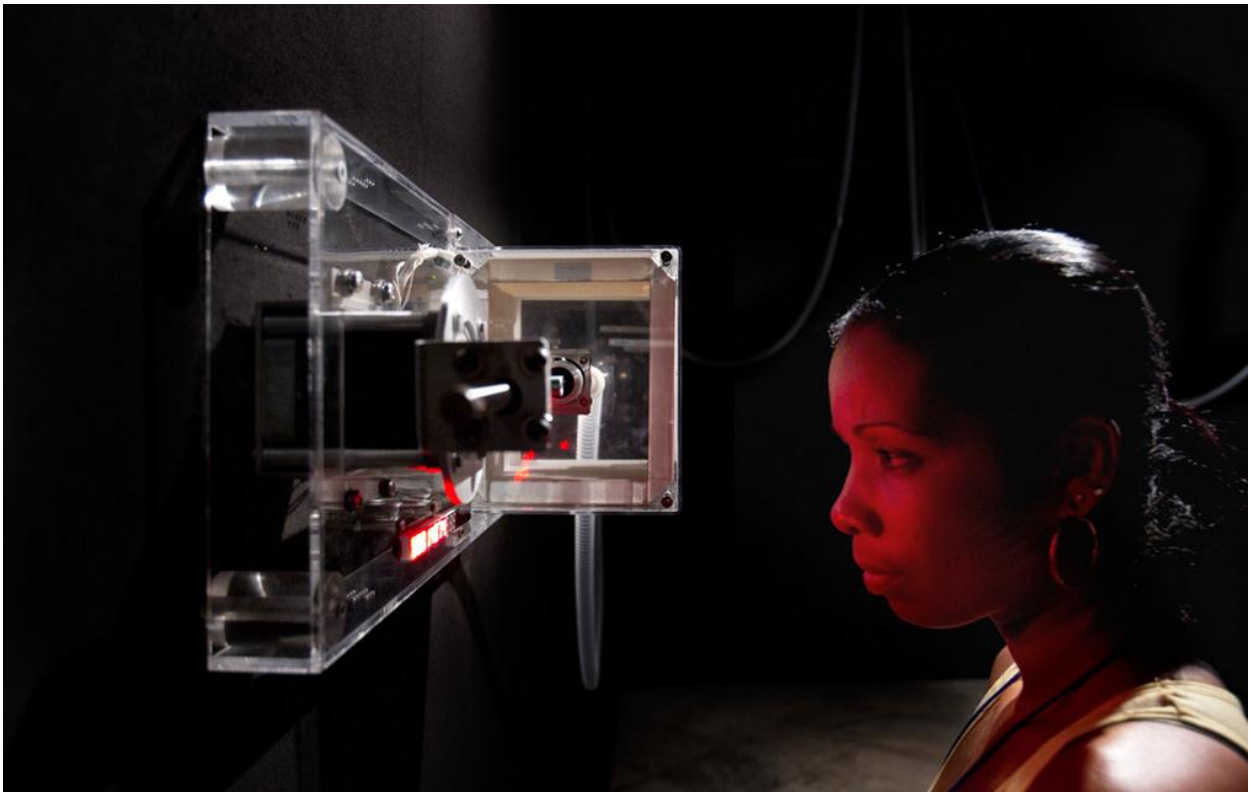
The case is made to fit perfectly the main device. The shaft can to be pull outside so that the breath stays in the bellow for transport. All hoses need to be disconnected. Enough space is available at the right of the device (air output of the bellows) to store the AC cord. The bags should be folded and stored flat with the air hoses in the top envelop.

Two compartments on the left of the device are used to carry oil, plexiglass cleaner, screws and a screwdriver.

Never put directly the plexiglass in contact with the black foam, as it may scratch it in transport. Always use the provided laminated bubble wrap to protect the plexiglass.

Appendix IV – Installation pictures

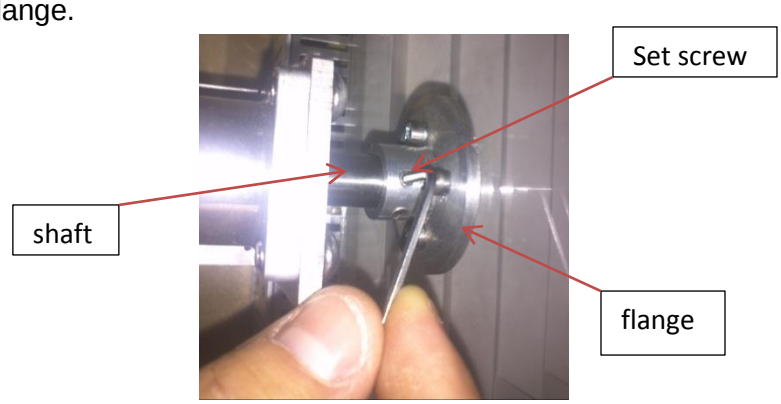




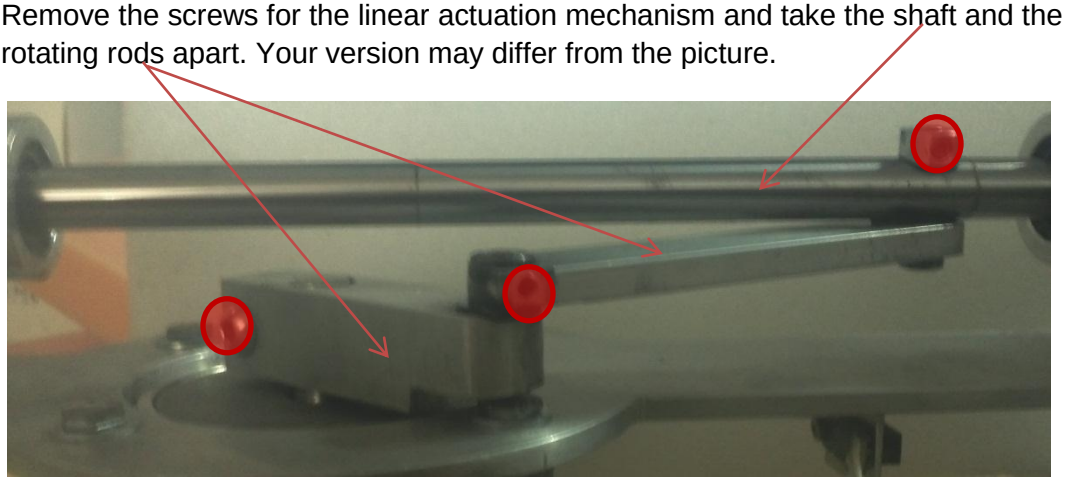
Appendix V – Taking apart the piece

The main parts of the piece are made in fragile plexiglass, if not handle with great care, it may break or scratch. The process to take apart the piece and replace the plexiglass isn't complex but needs to be conducted by a really careful person and should take up to 3 hours. Carefully studying the assembled piece helps understand how to take it apart. We recommend following these steps:

1- If you need to keep the breath inside the piece, turn the mode knob to Change Air, remove the filled paper bag and keep it closed.
2- Turn off the piece, disconnect it and remove it from the wall.
3- Remove the air hoses.
4- Loosen the 2 set screws holding the shaft on the flange of the bellow. Then remove the shaft from its flange.



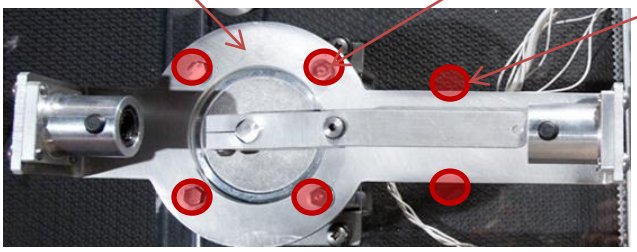
5- Remove the screws for the linear actuation mechanism and take the shaft and the 2 rotating rods apart. Your version may differ from the picture.



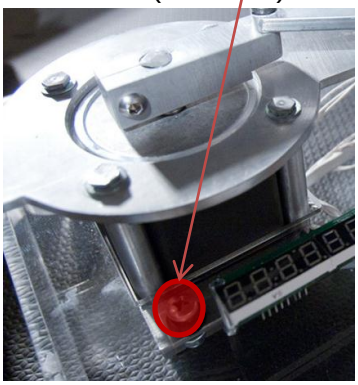
Important: Since the mechanism is vibrating, all the screws supporting the motor, the shaft and the rods have their threads filled with blue LocTite[1]. You may have to force to unscrew them.

[1] http://www.henkelna.com/brands-1556.htm?countryCode=us&BU=industrial&parentredDotUID=brands&redDotUID=brands&brand=0000000389

6- Unscrew the aluminum bearing support from the motor (4 screws) and the base (2 screws), and then remove it.

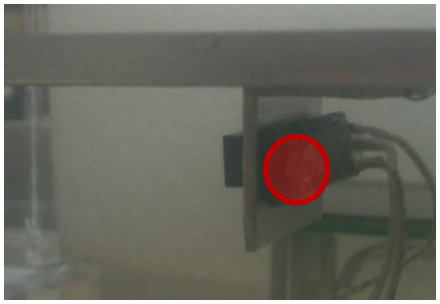


7- Unscrew the motor support from the base (4 screws).

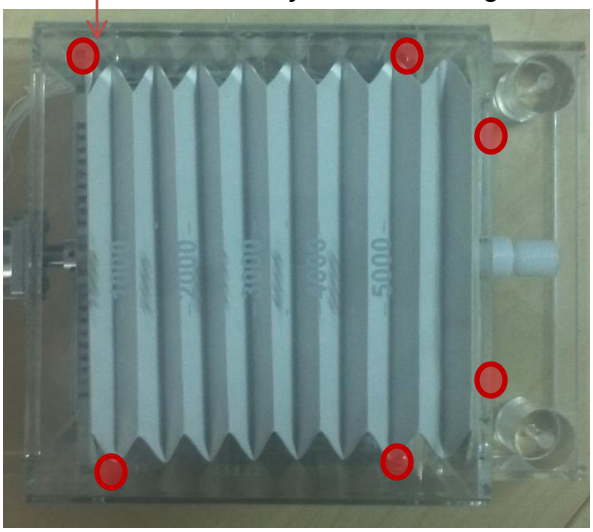


8- Unscrew the LED matrices from the base, disconnect them from the back of the matrices and pull the white wire inside the base.

9- Unscrew the IR sensor and pull it inside the base.



10- Unscrew the bellow box (6 screws) and take it apart. Careful!! The white bellow needs to be supported, otherwise it will fold incorrectly and be damaged.

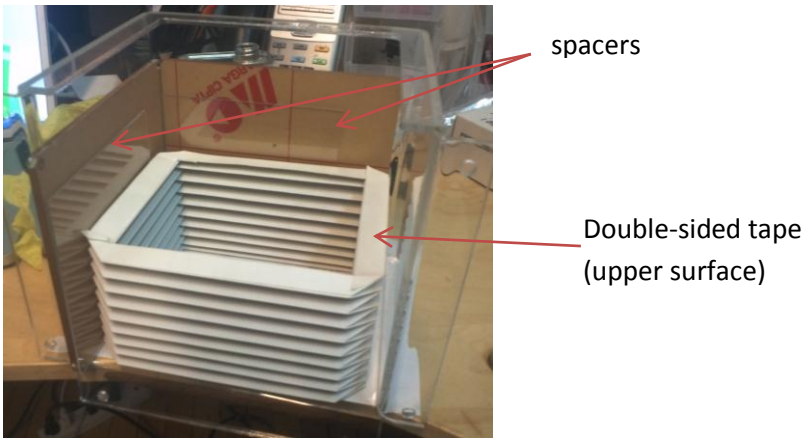


11- Elevate the base from the table enough to have access from the inside to the two switches. Unscrew them from their hole in the plexiglass.

The piece is now completely taken apart. Using the drawings on the DVD provided with the piece you can order new plexiglass parts. The base should always be made of CAST plexiglass as opposed to EXTRUDED plexiglass. In general the 4 plexiglass pillars don't come glued to the base, see the troubleshooting section to learn how to glue them.

Before assembling a new plexiglass bellow box, you will need to glue the white bellow inside it. The recommended steps are:

1- Clean with Novus #1 spray all the internal surfaces of the bellow box.
2- Use 3/8"(~10mm) spacers on two perpendicular surfaces.
3- Remove the glue tape protection on the bellow and carefully place it.
4- Press the bellow to make sure the double-sided tape is well glued. Be careful not to damage the bellow while pressing on it.

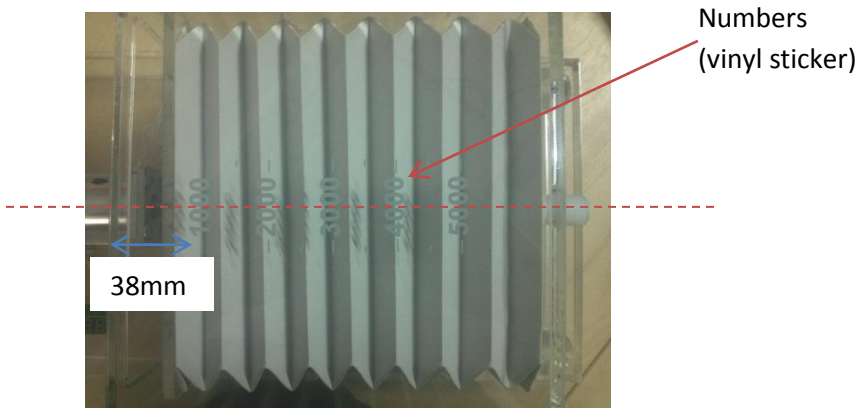


5- Remove the double-sided tape on the upper surface of the bellow.
6- Carefully place the plexiglass plate with its aluminum flange and glue it.

To assemble it back with the new parts, just follow the previous steps in reverse order. Take note that the 2 holes for the switches have to be threaded with a ¼”-20 tap.

When you are finished with assembling back all the parts together, manually push and pull the shaft to make sure the bellow doesn’t rub any internal plexiglass surface.

Finally, the last step consists of gluing the gradation numbers on the top face of the bellow box. It should be 38mm from the right edge and well centered.



Don’t over tighten any screws, otherwise the plexiglass can crack.