

April 2020

To:

Subject: AmboVent Q&A

Disclaimer

This is not a medical grade machine

It was developed rapidly from zero as an engineering concept

**It was not tested for durability, safety or functionality as a
respiratory device**

**Any use of that design and engineering suggestions is on your own
risk**

THIS DEVICE IS NOT APPROVED FOR CLINICAL USE.

1. This doc will elaborate the design decisions and give some answers to common questions.
2. Motor issue's and pully shaft

a. Q: Hello everyone! My name is Estevao, I'm from Brazil. I have a question regarding the motor that you guys used in this project. When I showed this project to a colleague engineer and he pointed out that the motor used, should not be used for continuous rotation (days, weeks) since it is used for a high torque application for a short period of time, have you guys done some stress test and continuous operation using this device? How hot does it get? Is that a relevant point? Thanks in advance

A: Hi Estevao, the motor we used is 8Nm stall and 100 RPM free speed.

the design of the pulling shaft at the middle point of the pressing arm sets the maximum moment to 1.6-2nm when you press on the AMBU at 8 Kg. Most the time the system works on a lower point. (the force to press on the ambu is about 8 KG at high speed and pressure it can rise up to 16 KG but that force for our short experience is rare).

We tried to do almost a full turn of the worm geer at maximum press.

It is not the best motor solution it was the easiest to get and integrat.

You may use a wipper motor instead.

Please adapt the pulling shaft to the motor mid speed so you will pull 50 mm of strap at 0.75 seconds for the inhalation stage.

- b. Q: The team in Alaska is using a motor from Servo City. We don't yet know which gear ratio is best but here are the two we are testing. Also a picture of the work in progress here. We used a CNC to carve a 1.5in aluminum block for the motor side

A: Make sure you get at least 5 nm at the shaft exit at optimum point at 60 RPM.

we chose a worm gear to get a quieter operation

- c. Q: I'm trying to get the andymark snowblower motor and it seems it's out of stock even in the US. any suggestions for a replacement?

A: you can use any strong wiper motor a least 4 NM and 60 RPM at the working !! point. You will have to adapt the pulling shaft to fit the motor exit.

The max pulling force we measured was 16kg and the pulling speed should be 0.75 sec.

You may use versa planetary gear with bag motor, but it will do some noise.

I prefer a worm gear.

- d. Q: I feel like the motor gets quite hot after 20 mins of continuous use?

A: Those window/snowblower/wiper motors efficiency is low, at some working points you can get 20w output supplying 100w input so it gets hot, but after a while they get to stable temperature. Try to find the spec. Maybe your motor is not strong enough.

- e. Q: what is the design considerations for the pulling shaft

A: You have to assure that you get sufficient pull force (we measured up to 16kg pull. at extreme scenarios it can get up to 32kg), our arm is pressing on the ambu at 200 mm from the axis and the motor pull at 100 mm from that axis, if you use different proportion you should do the calculations again.

If you want to check the pulling force yourself : you have to assemble a for respiration tubing including peep valve set to 20 mbar and a lounge simulation balloon.

3. Pressing arm issues:

- a. The pressing arm is pulled down by the motor pully, but it goes up by the elasticity of the AMBU. That's way it should be very light. If you make the arm heavier you have

to compensate the extra weight by a spring or rubber band behind the arm axis just to get a neutral weight do it will be easier for the AMBU to recover from the press.

4. The AMBU type solution BVM

- a. Q: According to a video recently posted by Real engineering, he concluded that mechanically automating the BVM will be not a permanent solution.

A: That's absolutely right. It's only an emergency solution for today's crazy time

5. Power supply:

- a. The motor needs a current in cycles of 1.5 to 5 amperes, perhaps in spikes or malfunctions will reach 7 amps during the ambo pressing. This is a typical cycle:
- i) Pressure cycle is 0.75 seconds (high current required) pressing.
 - ii) 0.7 seconds the arms is halt (no current needed).
 - iii) Rapid arm lift (0.5 seconds) Low current required
 - iv) Wait for end of cycle without current (in this 24 BPM 1 second standby, in 12 PBM this is 3.5 seconds standby).
- b. Therefore, I estimated that the average current will not exceed 2-2.5A at full load (when everything is properly calibrated) so we are talking about 2AH 12V consumption.
- c. So to get 2 hours working time on battery a 7AH gel lead-acid is completely enough.
- d. To get continues sufficient power supply when connected to the wall 220/110 V you will need a power supply output of 13.8V-14.2V at 8-10A minimum to run the machine and charge the battery.

6. Arm shaft potentiometer or encoder

- a. Q: We need to know what encoder you are using to track the position of the arm. We are using a 10k potentiometer, but the voltage variation is very small and the code can't handle the small changes.

A: You should use 270° potentiometer. Maybe you used 10 turns one ? With that type you can't get good accuracy. You may also use a free turn encoder (hall effect) that is more reliable but you will need to adapt the code for it.

7. Will be continued