

Revolutionizing Single-Use-Pump



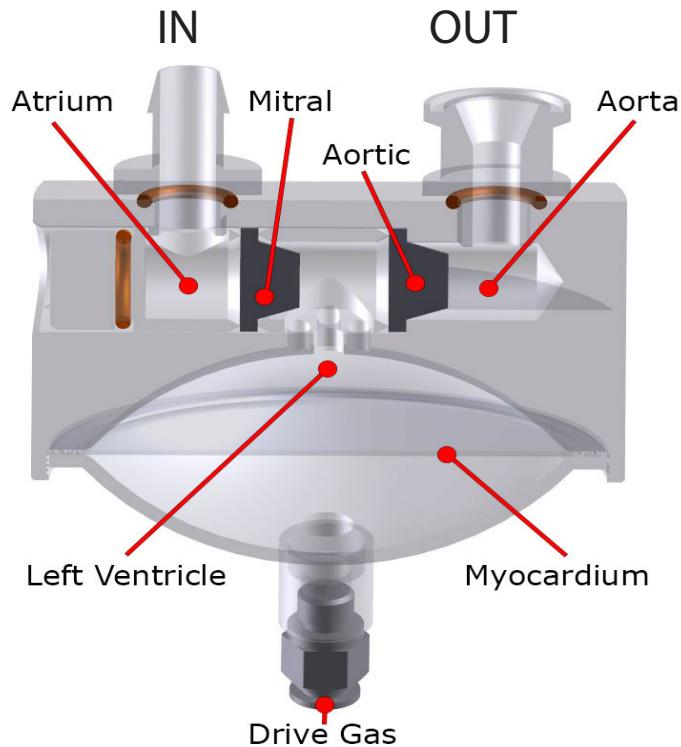
Allow me to explain
the techniques behind



Per Stobbe

Check out "Intellectual Property Rights" on www.PumpCell.com

Single-Use-Pump copying the mammalian heart



Unmatched weight, unbelievable small and compact with massive opportunities for programming of any performance requirements



Ready to use
"right out of
the box"

The dynamic, untiring human heart has 4 valves, 2 inlet chambers and 2 power chambers. The two Ventricle muscle walls Myocardium contracts and force fluid through the 2 one-way valves Pulmonary, Aortic out of the heart and into the body. PumpCell copy with some limitations the human heart!

The unique Single-Use-Pump - Clio functionality

The mammalian heart max variation in Cardiac Output (CO)
= 1:10 (CO = BpM x SV)

- Beats-per-Minute (BpM) variation: 1:3
- Stroke Volume (SV) variation: 1:3

Clio pump cell integrates only three moving parts:

- one Pericardium membrane as found on the outside of the Myocardium muscle
- two one-way cross-slit valves like Tricuspid and Pulmonary valves

Atropos drive unit integrates the Apollon PLC brain, which collects electrical signals from the Laser sensor, pressure, vacuum, and temperature sensor's. Hereby the Apollon brain calculate on-line and in real-time:

- the actual position of the Pericardium membrane with 1/10th of a millimetre precision

Apollon corrects the membrane position continuously according to changes in real-time:

- use vacuum to contract (Systole) Pericardium
- use pressure to expand (Diastole) Pericardium

In Clio one side of the Pericardium medical grade silicone membrane is in contact with sterile fluid and the other side in contact with the non-sterile drive gas pressure.

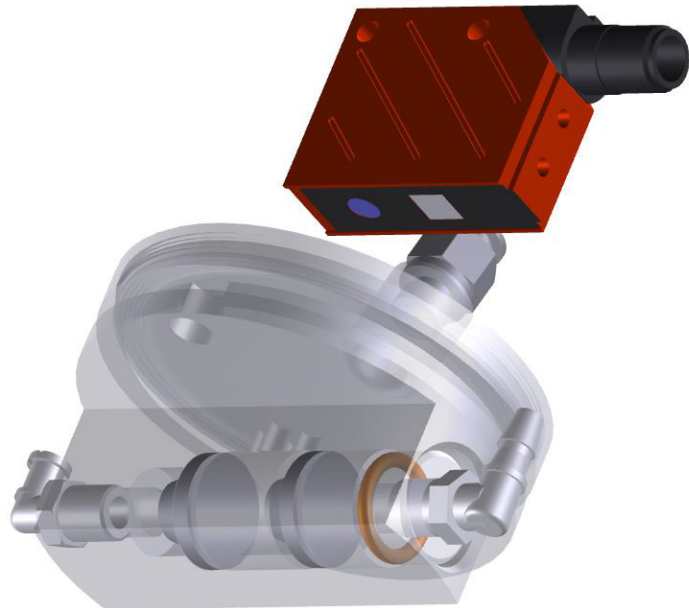


The unique **Single-Use-Pump** - Clio performance

Mammalian heart comparison

	Beats-per-Minute	Stroke Volume	Cardiac Output	Blood volume	Max pressure	Heart weight	Body weight	Beat life time
Abbreviation	BpM	SV	CO		mm Hg x 1,3			
Measures		Liter	L/minute	Liter	mBar	Kilo	Ton	$\times 10^{12}$
Adult human	60 - 150	0,060 - 0,090	4 - 14	4 - 6	160	0,25 - 0,35	0,08	1-2
Horse	30 - 100	1 - 3	30 - 300	40 - 60	150	3 - 6	0,4 - 0,8	>1,1
Elephant	25 - 50	12	300 - 600	300 - 450	200	12 - 21	5 - 6	>1,1
Blue whale	6 - 30	>350	>2100	<6500		400 - 700	100 - 180	>1,1

Clio SUP



The total volume of blood pumped by the average animal mammalian heart in a lifetime is approximately 200 million Liter/kg heart. The obtainable / realistic number of human heart beats is ranging 1-2.5 billion ($1-2.5 \times 10^{12}$) per lifetime - yes, all depending on how lucky we are!

Clio Single-Use-Pump is designed for 1 mio cycles.

The stand-alone **Single-Use-Pump** - Clio sizes

Stand-alone product, model	Euterpe-30	Euterpe-100	Euterpe-300	Euterpe-500	Euterpe-1000
Layout, number of diaphragms	single	single	single	single	single
Cardiac Output, CO range, mL / min	0 - 750	0 - 2.000	0 - 3.500	0 - 6.000	0-10.000
SUP cell weight, grams	100	200	300	400	800



Super compact Air-Operated-Diaphragm-Positive-Displacement (AODPD) Single-Use-Pump (SUP) offer a range of unique features unheard of in the industry. For even more compact installation the stand-alone pump cell and the Atropos Drive Unit are separated. Off course the pump cell's are all single-use, durable and of low cost.

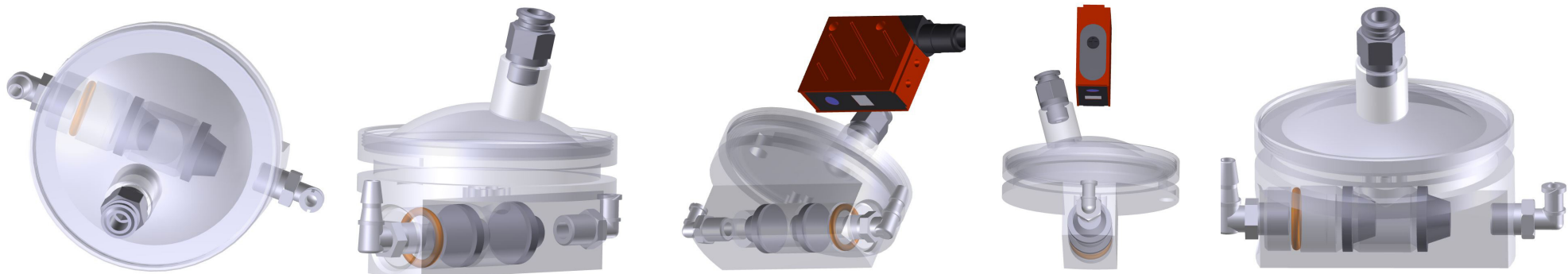


The unique **Single-Use-Pump** - features of Clio

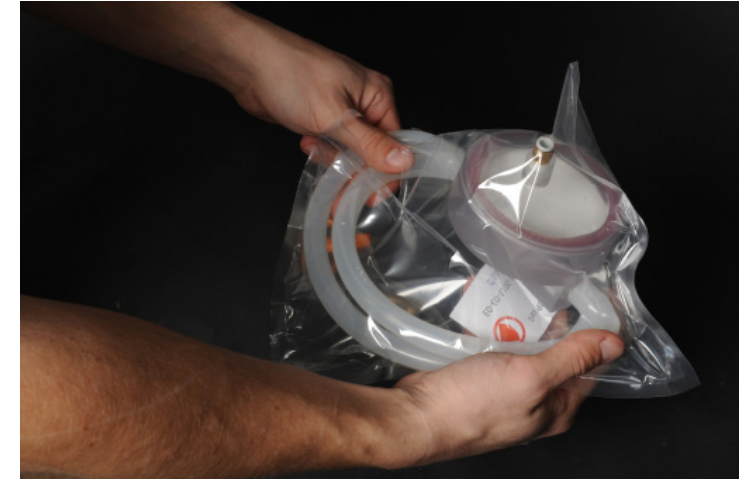
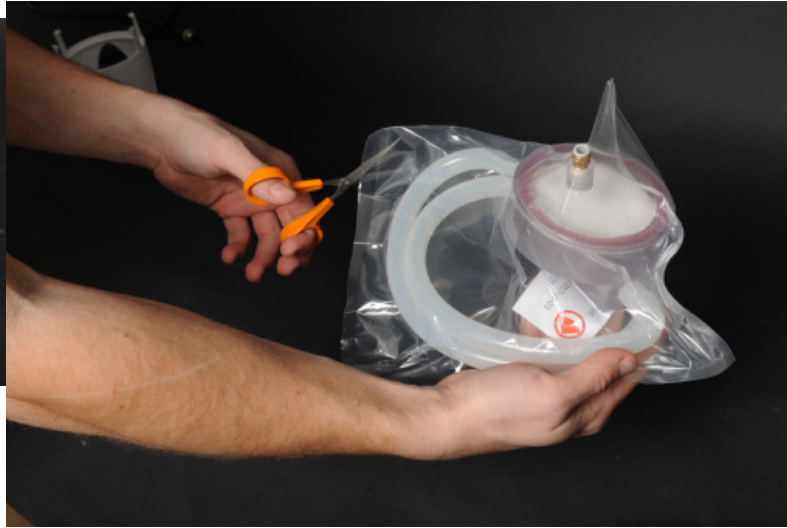
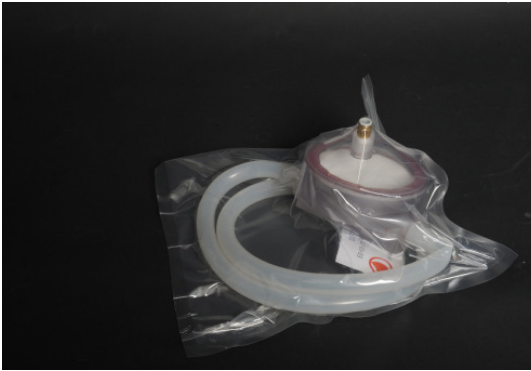
- Clio (AODPD) SUP show on the Atropos Drive Unit display the conveyed mass-flow in real-time with 1% accuracy
- No extra mass-flow sensor is needed
- Several fully programmable individual operating Single-Use-Pump cell's from Atropos Drive Unit
- Clio is self-priming and pump any mix of gas and liquid
- No tools required for exchange of pump cell
- Clio SUP do NOT require calibration
- Lifetime exceeds 1 million cycles at 75% CO
- Communication with Atropos equipped with both Wi-Fi and LAN

The here shown SUPs
are all machined parts

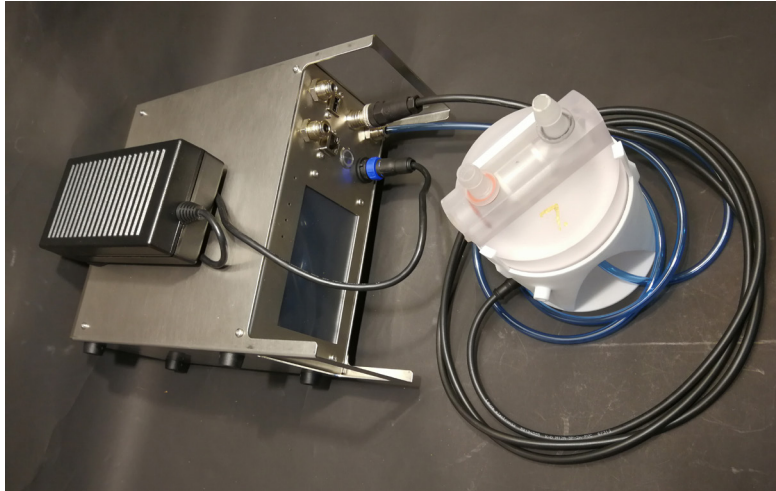
In the process of being
injection moulded parts



The unique **Single-Use-Pump** - how to unpack Clio

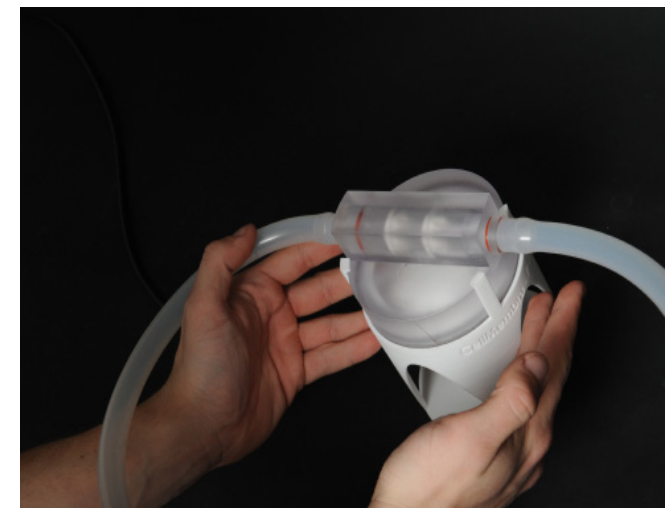


The unique **Single-Use-Pump** - how to install Clio

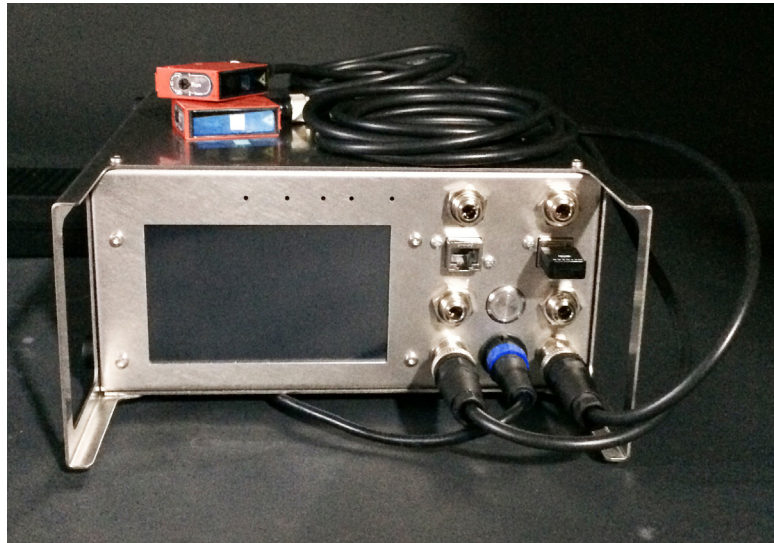


Clio preferable is part of a customized kit. Clio-100 shown on all photos. The shown white Laser-Foot is just one example of installation. Clio operates in any position. Only requirement is red Laser sensor positioned correct relative to the transparent dome. Future plan is Laser foot is integrated with the injection moulded dome.

The ultra compact Clio-100 has the weight of only 200 grams.



The unique Single-Use-Pump hardware - the drive unit



The portfolio of the Single-Use-Pump cell's are technically driven by the Apollon PLC and CODESYS software. Apollon is integrated into the very compact Atropos Drive Unit housed in the Hephaestus cabinets. One Atropos is able to drive remotely one or two stand-alone pump cell's over distances up to 2 meter.

The re-useable red Laser sensor is a unique way of online measuring the position of the elastic diaphragm.



The shown stack of 4 x Atropos-2 can drive as much as 8 x Clio in different size individually.

One ultra compact Atropos drive unit is only 5 liter in physical volume.

The unique Single-Use-Pump - Atropos software

The most important principles behind the Atropos Drive Unit software

- Cardiac Output (CO) = total pumped volume, SUP capacity, ml/min (CO = BpM x SV) = depending on the specific Euterpe SUP specification
- Beats-per-Minute (BpM) = determined by the diaphragm diameter, ranging 0-25 BpM
- Stroke Volume (SV) = programmable from 10 - 100% in 10% steps

Version A.63 Atropos-1

Year Month Day Hour Min. Sec.
Time: 2017 6 29 9 36 9

Stroke length Percentage:	Cardiac Output:	Velocity calc: ID Tube:	Configuration:
Percentage	0 ml/min	1.0 mm	Close

Automatic Pump control		Manual Pump control	
Run	Stop	Vacuimize	Pressurise

Configuration Time:
Wanted: 2017 Y 6 M 29 D 9 h 30 m 45 s
Set Time

Pump selection:
Disabled
Euterpe-30
Euterpe-100
Euterpe-300
Euterpe-500

30s 1m 1m.

Pump Pressure:	Realtime-flow (filter 0.5s):	Repetitions per min:	
0.018 Bar	0.0 ml/min	0	
Sup. Pressure:	Average-flow:		
0.018 Bar	0.0 ml/min		
Vac. Pressure:	Total volume conveyed:	Total repetitions:	Total run time:
0.016 Bar	0.0 ml	0	0.0 min

Version A.64 Atropos-2

Year Month Day Hour Min. Sec.
Time: 2017 7 27 9 36 19

Stroke length Percentage:	SP flow:	Velocity calc: ID Tube:	Configuration:
Percentage	0 ml/min	1.0 mm	Close

Automatic Pump control		Manual Pump control	
Run	Stop	Vacuimize	Pressurise

Adjust Time:
Wanted: 2017 Y 7 M 27 D 9 h 35 m 39 s
Set Time

Pump selection:
Disabled

7m30s 8m 8m3

Pump Pressure:	Realtime-flow (filter 0.5s):	Repetitions per min:	Last Harvest avg. velocity:
-0.009 Bar	0.0 ml/min	0	0.0 m/s
Sup. Pressure:	Average-flow:	Repetitions before cleaning:	Last Cleaning avg. velocity:
-0.016 Bar	0.0 ml/min	999	0.0 m/s
Vac. Pressure:	Total volume moved:	Total repetitions:	Total run time:
0.009 Bar	0.0 ml	0	0.0 min

Version A.64 Atropos-2

Year Month Day Hour Min. Sec.
Time: 2017 7 27 9 36 44

Stroke length Percentage:	SP flow:	Velocity calc: ID Tube:	Configuration:
Percentage	0 ml/min	1.0 mm	Open

Automatic Pump control		Manual Pump control	
Run	Stop	Vacuimize	Pressurise

8m 8m30s

Pump Pressure:	Realtime-flow (filter 0.5s):	Repetitions per min:	Last Harvest avg. velocity:
-0.010 Bar	0.0 ml/min	0	0.0 m/s
Sup. Pressure:	Average-flow:	Repetitions before cleaning:	Last Cleaning avg. velocity:
-0.016 Bar	0.0 ml/min	999	0.0 m/s
Vac. Pressure:	Total volume moved:	Total repetitions:	Total run time:
0.010 Bar	0.0 ml	0	0.0 min

Version A.64 Atropos-2

Year Month Day Hour Min. Sec.
Time: 2017 7 27 10 19 45

Go to left side

51m40s 52m

Pump Pressure:	Total run time:
-0.002 Bar	0.0 min
Sup. Pressure:	Total repetitions:
-0.001 Bar	0
Vac. Pressure:	Total volume moved:
0.016 Bar	0.0 ml

Go to right side

51m40s 52m

Pump Pressure:	Total run time:
-0.003 Bar	0.0 min
Sup. Pressure:	Total repetitions:
-0.001 Bar	0
Vac. Pressure:	Total volume moved:
0.016 Bar	0.0 ml

Example of use

Perfusion SUB integrating the Single-Use-Pump

Miniature SUB for cell retention through perfusion cultivation setup in a fully single-use setup. The CellMembra-mini integrates a customized CellVessel Single-Use-Bioreactor (SUB) with the Clio Single-Use-Bioreactor (SUB) with the Clio Single-Use-Pump (SUP), the CFF (Cross-Flow-Filter), and Single-Use-Sensor's.

General features of CellMembra-mini:

- CellVessel SUB designed for operation in various applications and setup.
- Supplied with Single-Use-Sensor (SUS).
- Pumped volume and obtained velocity accurately measured – no guessing.
- The complete and pre-assembled unit packed in dual film bags and precision irradiated – forget the autoclave.
- Working Volume (WV) range from 100 ml to 300 ml.
- From www.perfusecell.com



World
smallest
P-SUB



Single-Use-Pump for perfusion offer accurate measurement of both volume and velocity

The SUP is arranged inside a Polycarbonate housing mounted either on desk top or integrated with the SUB.

The 1,0 mm thick silicone Pericardium membrane separates the drive gas pressure and / or vacuum from the broth.

The red tri-angular laser sensor read the membrane position with 0.1 mm accuracy at any time. Pressure sensors inside Atropos control unit measure online the actual drive gas pressure. The Atropos microprocessor control via PWM signals proportional drive gas valves and hereby in PID loop the wanted membrane position.

Clio can easily be programmed to convey fluid in 1:1000 range over time or by conveyed amount of fluid. Clio is a true Positive Displacement (PD) pump where every stroke is measured accurately independent of the ever dynamic stroke volume. Each stroke duration can vary between seconds and multiple minutes.

Clio-80 SUP



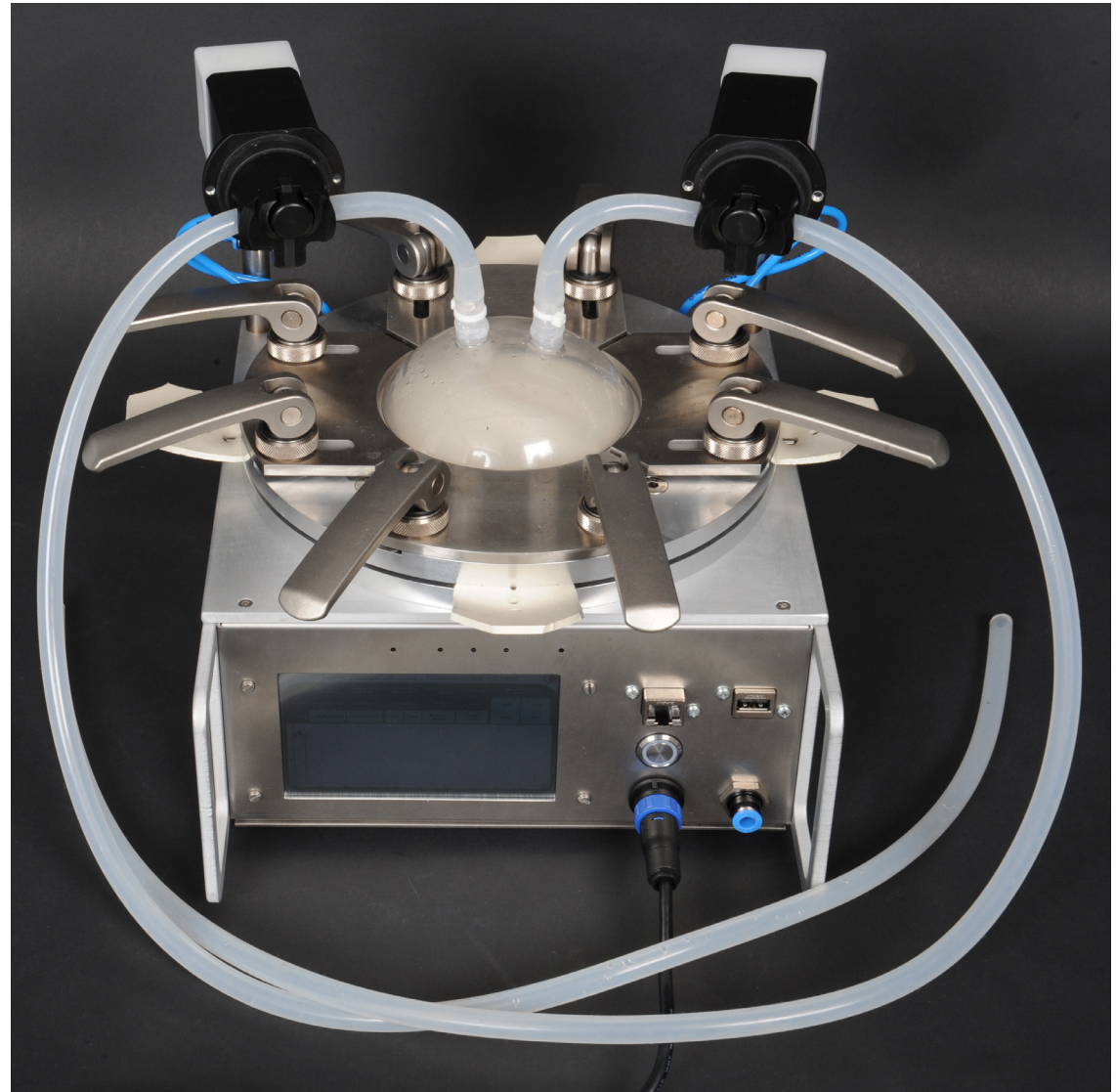
All around the stand-alone
Euterpe SUP

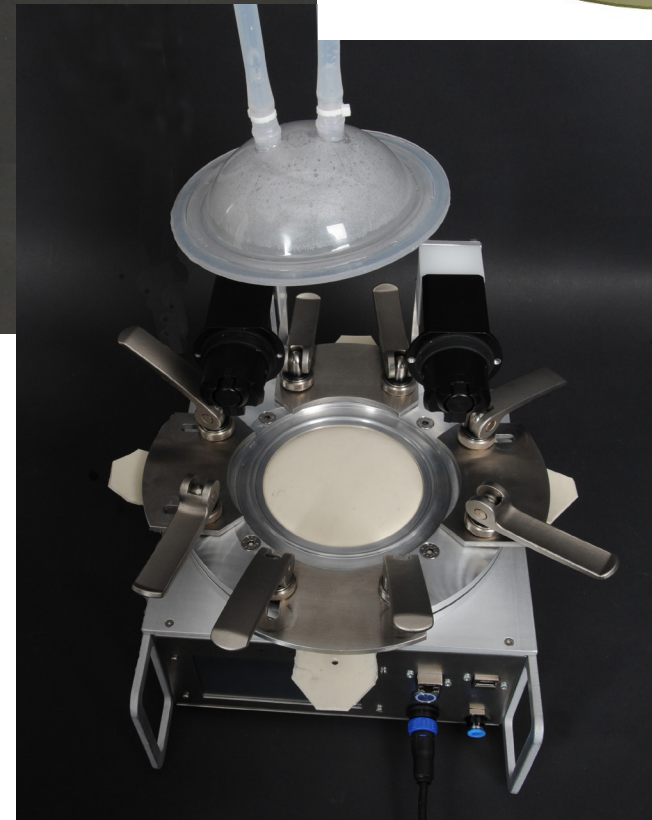
Now to the integrated
Erato SUP

Integrated Single-Use-Pump - Erato

Erato integrates both the SUP cell(s) and the control unit in the same cabinet. This setup offer durable SUP cell's of very low cost.

- One or two or even four individual operating SUP cell's in the same housing
- Select freely volume, select stroke length, individual pump cell operation
- Up to 5 bar fluid pressure via controlled pinch valves
- True fluid metering design, display in real-time the conveyed mass-flow with 1% accuracy
- NO calibration needed
- 100% programmable via build-in touch sensitive 5" display or Pad, Smartphone, PC
- Each SUP cell (Thorax dome + Pericardium membrane + hoses) is inserted into an encapsulating housing in the cabinet
- NO tools required to exchange pump cell'





Erato SUP cells is the cheapest
and only high precision
pump on the market!

Required pressurized air for operation.

Erato pump 3.000 ml/min.

Our Vision is



To give licenses to the patented membrane pump

Disposable part eliminate contamination

Re-usable Drive-Unit which measure conveyed volume and pressure at any time

Further use for cosmetics, chemicals, colour,

No cleaning required

Various sizes as to need



Worlds most accurate membrane pump

Thank you
for your attention

Much more info to be found on
www.pumpcell.com