

MAGMA™

KEEPS YOUR FLOW MOVING

Advanced Pumping System - Gen2

LOW SHEAR SANITARY DIAPHRAGM PUMP AND CONTROLLER

For Control of Your Alternating Tangential Flow (ATF) Filtration Process



- Key applications include:
 - Bioreactor perfusion with a hollow fiber filter (compatible with all brands of filters)
 - N-1 perfusion process intensification
 - Viral Vector Production
- Low shear operation in its pumping action that makes it ideal for use in shear-sensitive applications such as pumping mammalian cells
- A wide range of pump head sizes that for perfusion, enable scalability from 100mL to >100L
- Single-use pump heads that eliminate the need for cleaning and can be integrated smoothly into other single-use process components including single use bioreactors
- Perfect for both research and production
- Plug-and-play design creates an integrated system for advanced applications

CP biotools

www.cpbiotools.com

Product Highlights

Magma™ Advanced Pumping System-Gen2

Control Your Alternating Tangential Flow (ATF) Process - The combination of the diaphragm pump head with the pump controller, facilitate the pumping process to fill and empty the pump when connected to a hollow fiber filter which is in turn connected to a bioreactor. The valves on the controller are set to control the filter cross flow rate to match the filter size and characteristics.

Low Shear Liquid Handling - Diaphragm pumps are low shear in the manner in which they handle fluid and fluid components. Certain pumps such as peristaltic pumps and rotary lobe pumps create pressure gradients and pinch points as the liquid flow is moved through narrow mechanical devices or pinch points. The Magma Advanced Pumping System (APS) diaphragm pump creates only enough pressure to push the liquid against back-pressure and eliminates pinch points. This can be important in applications where the liquid and/or liquid components are shear sensitive.

Scalable - Six pump sizes available to meet a range of process requirements.

Smart-Stop™ - After pressing the button, the pump empties the liquid and momentarily vents the air from the pump head to relieve pressure. This minimizes liquid hold-up in the pump while safely removing excess air pressure.

Quick-Stop™ - Pressing the QUICK-STOP button immediately stops the pump in its current position. It can be useful in certain applications when you do not want the liquid hold-up to be purged.

Safety Alarms - Process conditions are monitored to detect if the pump is not operating properly and if an alarm condition occurs, a QUICK-STOP is initiated and the alarm visual and audible indicators occur.

Data Output - The data server enables data to be captured by an external computerized system via the controller Ethernet Port.

Monitoring of Process Fluid Path Pressures - Three PendoTECH Single-Use Pressure Sensors™ can be connected to the controller. There are user definable minimum and maximum notification settings and the control system will compare the settings to the minimum and maximum pressures since the last time the RUN button was pressed. There is a notification on the display if the running minimum drops below its setting or the maximum exceeds its setting. This is particularly useful for monitoring of the pressure in the permeate tubing in a perfusion process which will start to drop as the filter fouls indicating action must be taken.

Permeate Pump Integration - A permeate pump can be interfaced to the control system to be turned on/off when the controller switches between the run/stop modes either manually or by an alarm condition.

Vessel Weight Control System - A scale and a feed pump can be connected to the control system and a set-point weight entered into the control system. In the run mode, the feed pump will turn on when the scale reading drops below the set-point value.

Liquid Detector - In case of improper installation of the diaphragm or a failure condition, liquid entry through the air line to the pump controller will trigger a Quick-Stop and close a valve in the controller to minimize liquid entry to the controller and prevent liquid flowing through the controller.



**Magma APS Pump Controller:
Controller Box with Touch-Screen Interface and Pneumatic Box**



**Magma APS Diaphragms
Five Sizes**



Magma APS Plastic Pump Heads - Five Sizes



Magma APS Pump Controller Rear View



**Magma APS Plastic Pump Head - 4L
Coming Soon**

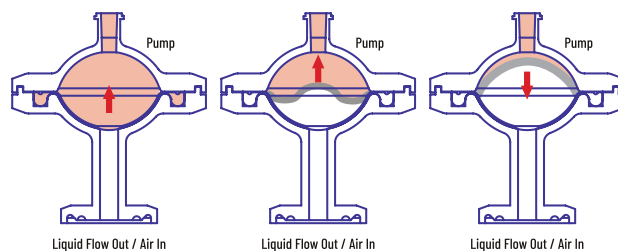
Pump and Diaphragm

Designed for Low Shear and Sterile Processing

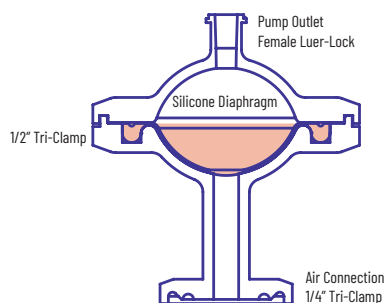
Low Shear - Through the air inlet/exhaust sanitary fitting, air from the control system enters to push liquid from the pump and through the fitting that is connected to the process fluid. The only pressure generated is from process back-pressure. After the pump has discharged the liquid, liquid is then drawn into the pump by vacuum connected to the control system unless there is enough liquid pressure to drive liquid into the pump at the desired flow rate, then vacuum is not needed.

Sanitary - The specially designed silicone diaphragm is sealed with an industry standard sanitary clamp into the pump. It is designed for quick assembly and disassembly and the pump and diaphragm are made of materials that meet industry guidelines. All pump head materials are either stainless steel or plastic and are compatible with autoclaving, and for the plastic pump heads, with gamma irradiation.

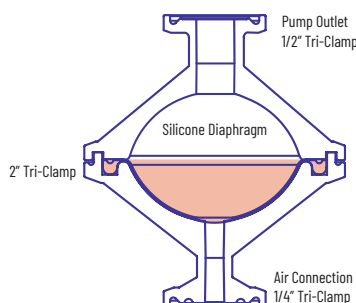
Proven Performance - Silicone Diaphragm material is USP Class VI and all sizes tested to run > 1 million cycles (~60 days continuous use). The pump heads are proven for sterile operations with years of customer use.



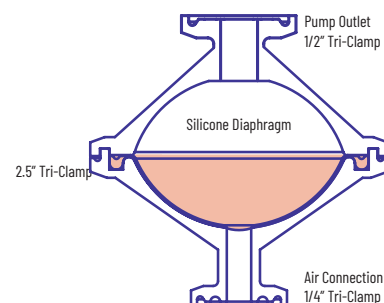
Available Pump Sizes



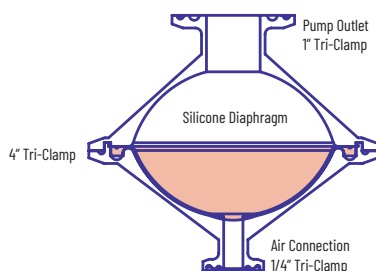
Pump Volume = 6mL



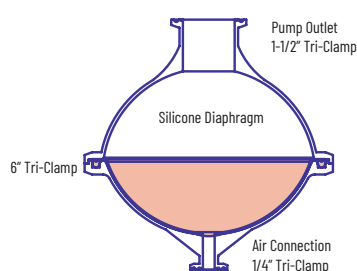
Pump Volume = 20mL



Pump Volume = 50mL



Pump Volume = 180mL



Pump Volume = 860mL

Product Features

Magma™ Advanced Pumping System-Gen2

Pump Controller

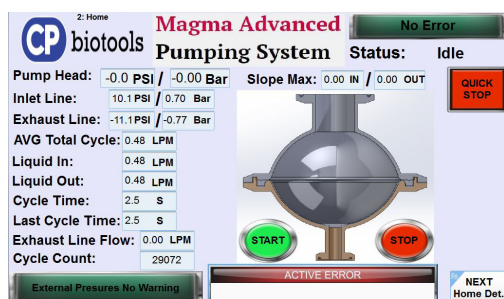
Designed for Easy Use and Plug'n'Play Integration

The controller comes with all the cords and hoses to be up and running in a matter of minutes. Industry standard connectors are used to assist with specific integration situations. The control box connects via a single cable to the pneumatic box which modulates the air flow in/out of the diaphragm pump. When power is initiated, the graphical touch-screen interface turns on and a screen appears to set the incoming pressure via a regulator mounted on the front panel of the pneumatic box. Once that is acknowledged the Home Screen appears. At the Home Screen you can enter the Run mode or navigate to the Set-up menus. In the Run mode there are several views that can be selected to view process conditions. The Set-up menus are easy to navigate and allows the user to set pump parameters and configure an custom advanced pumping system with the interfaced components.

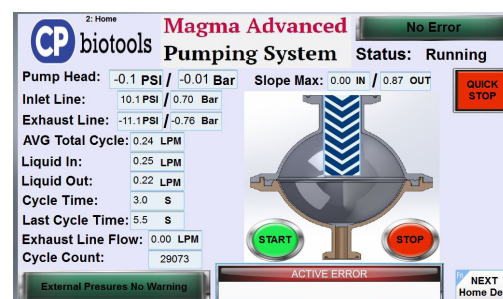


Graphical Touch-screen Interface

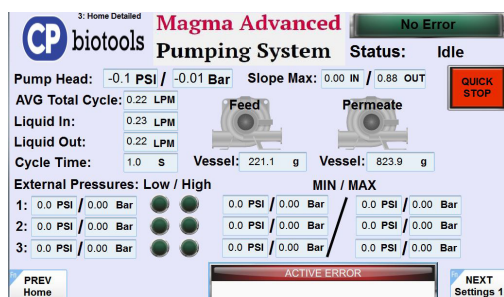
Examples of Touch-Screen Interface



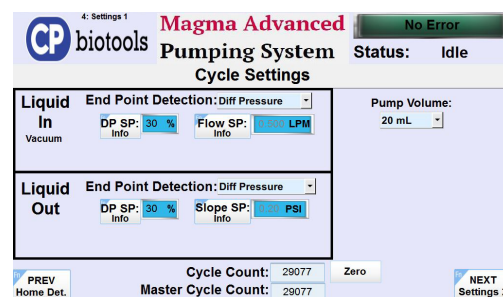
Home Screen



Home Screen with pump graphic in/out flow indicator when in Run mode



Home Detail screen- status of Pumps (highlight green when on), Scale readings, Single Use Pressure Sensor status and Min/Max since run started



Settings Screen

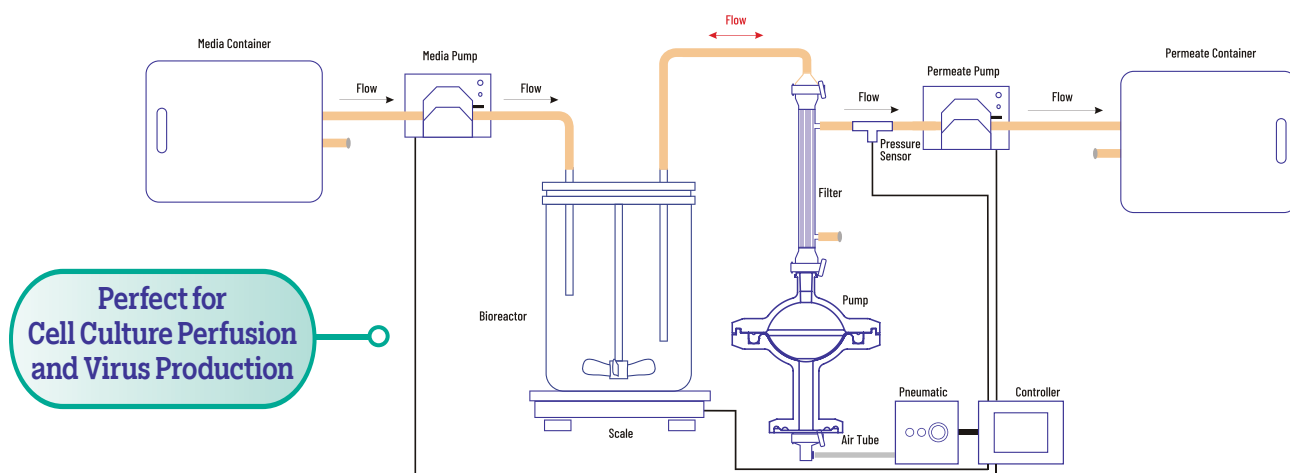
Choose pump cycle endpoint settings and pump volume

Solid Performance and Robust Design

The pump control system is engineered with robust industrial components to ensure solid performance. The software written by experienced engineers in the biopharm industry with full documentation and testing ensuring a path to validation. Additionally, components were selected with the highest level of assurance of supply chain availability.

Alternating Tangential Flow (ATF) Filtration

The Magma APS in conjunction with a hollow fiber filter can create a bioreactor perfusion system. The hollow fiber filter retains the cells in the bioreactor and the alternating tangential flow (ATF) through the hollow fiber inhibits debris from fouling the membrane filter surface. With the ATF action, also known as reverse cross flow or RXF, the low shear pump minimizes cell damage and eliminates the use of tubing in a pump that can rupture and spill vessel contents during an extended process such as perfusion. The Magma APS offers a sanitary design that maintains sterility and creates a low shear perfusion system with disposable processing options with plastic pump heads. The weight control system can be used to maintain the vessel level as permeate leaves the bioreactor during a perfusion run. The run interlock can shut off the permeate pump when the system stops to preserve filter capacity, and up to three single use pressure sensors can be used to monitor filter performance by placement in the fluid path.



Sanitary and low shear perfusion with disposable processing options.

What is Tangential Flow Filtration (TFF) Filtration?

A traditional tangential flow filtration process using a hollow fiber filter module (versus a plate and frame flat sheet device) is shown in **Figure 1**.

Liquid is fed from a product vessel (or bioreactor) by a recirculation pump (frequently a peristaltic pump) to a filter module containing numerous hollow fibers and the liquid flows into the inner cross section of the individual fibers. The wall of the hollow fiber is the filter membrane.

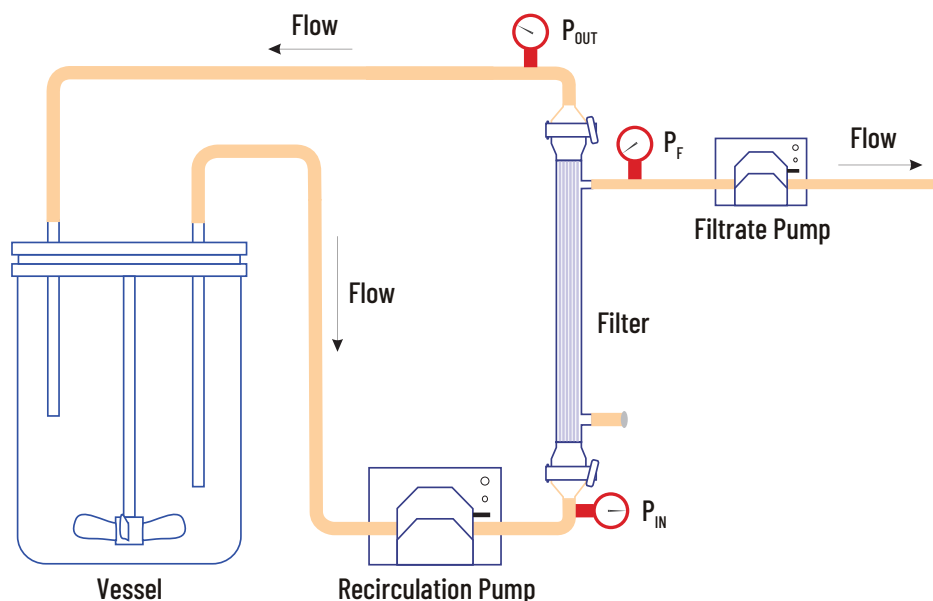


Figure 1. Typical Tangential Flow Filtration Process

As is shown in **Figure 2**, a certain amount of liquid and liquid components smaller than the pore size of the fiber wall “permeates” through the wall (the filtrate). The filtrate collects in the module shell and the shell has ports for removal of filtrate from the shell (the void area between the fibers is closed at both ends to prevent the liquid that is entering the filter module from going directly into the shell). The feed pressure (P_{IN}) is higher than the return pressure (P_{OUT}) because of the pressure drop as liquid flows through the narrow fibers and returns to the vessel. There is also a pressure drop across the fiber wall and the filtrate pressure is measured at P_F . The circulation flow rate is orders of magnitude above the filtrate flow rate and it is this phenomena that prevents a membrane filter from clogging from material that would rapidly clog a membrane filter operating in “normal flow” filtration. Tangential flow filtration is very effective process selection in many areas of biopharmaceutical processing.

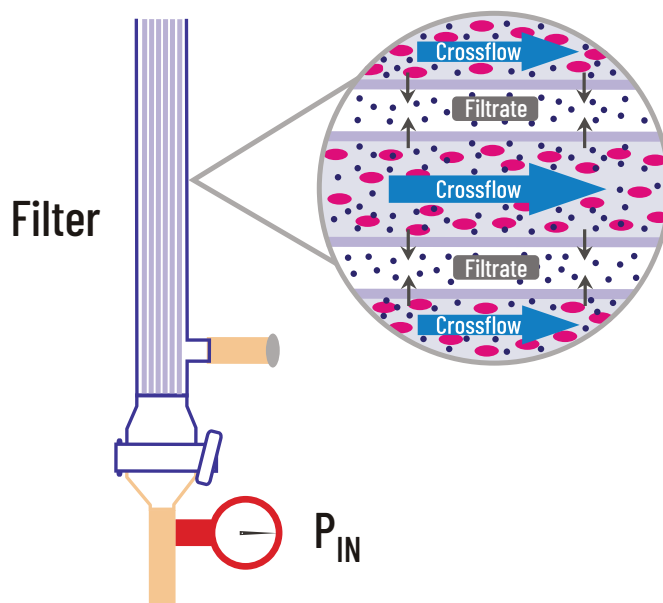


Figure 2. Illustration of Filtrate Passing Through Fiber Wall

Using Magma APS for Alternating Tangential Flow (ATF) Filtration

Using the Magma APS pump with a hollow fiber filter can improve performance in certain applications that require extended, low shear, and aseptic operation (such as cell culture perfusion). The process schematic for use in a cell culture perfusion process is shown in **Figure 3** below. A diaphragm pump is used to create the ATF mode of action and the pump can be configured to deliver around the same flow rate as in a system with a recirculation pump. The filter module and vessel connection liquid working volume, in general, determine the diaphragm pump volume option that is best for the application. The pump volume should be an adequate percentage based on the process dynamics, of the combined filter module and vessel connection liquid working volume to ensure sufficient turnover of liquid back to the vessel.

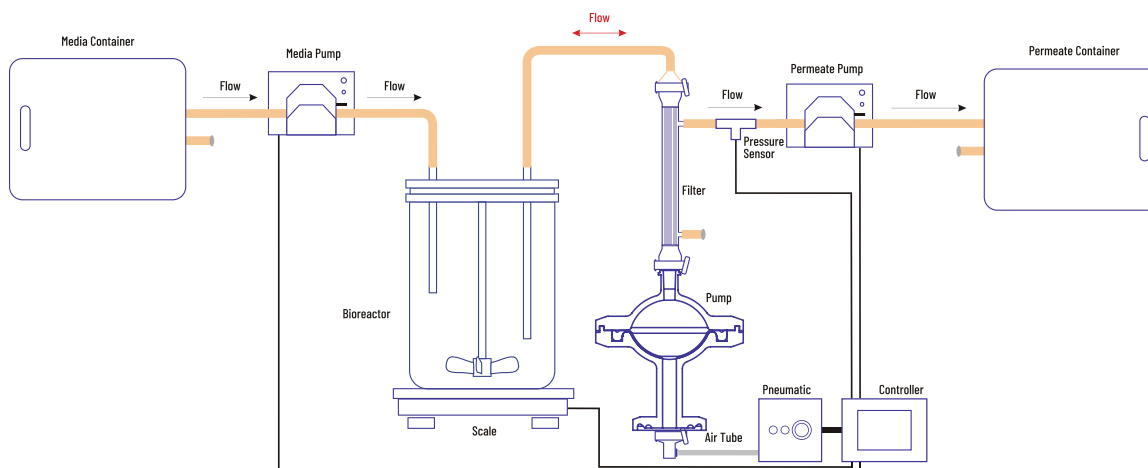


Figure 3. Schematic of Bioreactor Process in ATF Mode

The Magma Pump Controller is shown in **Figure 4**. As depicted in **Figure 5**, through the air inlet/exhaust sanitary fitting, air from the Magma pneumatic box enters to push liquid from the pump and through the sanitary fitting that is connected to the hollow fiber filter module. The only pressure generated is from filter backpressure. After the pump has discharged the liquid, liquid is then drawn into the pump by vacuum connected to the pneumatic box (unless vessel can provide pressure to fill the pump then vacuum may not be required). This creates the ATF action. The pump and diaphragm are steam compatible and can be steam sterilized in an autoclave with the filter and bioreactor. Single use plastic polysulfone pump heads that eliminate the need for cleaning and can be integrated smoothly into other single-use process components including single use bioreactors. Improved performance versus using a recirculation pump is possible based on several differences in set-up and operation.



Figure 4. Magma APS Pump Controller



Figure 5. Magma APS Pump system with Hollow Fiber Filter connected to the pump head in the stand with permeate peristaltic pump shown which integrates to the system

Pump Tubing Elimination

For extended processing, when using a peristaltic pump and tubing to provide the flow to the filter, the tubing is at risk to rupture and lead to leaking/ pumping of bioreactor contents and termination of the process. In a continuous process this is a concern because it could happen at any time, without notice with unexpected results. With the Magma APS design and operation this risk is eliminated.

Low Shear

Certain pumps such as peristaltic pumps, quaternary diaphragm pumps, and rotary lobe pumps can create pressure gradients and pinch points as the liquid flow moves through narrow mechanical devices or pinch points. The Magma APS diaphragm pump creates only enough pressure to push the liquid through the filter and eliminates pinch points. This can be important in shear sensitive applications such as pumping mammalian cells that lack a cell wall.

Dynamic Transmembrane Pressure (TMP)

If using a recirculation pump to create cross flow, there is a relatively static, steady state P_{IN} , P_{OUT} , and P_F (see Figure 1). TMP is typically represented as an average ($TMP = [(P_{IN} + P_{OUT})/2] - P_F$), however, the actual TMP is higher at inlet end of the filter than at the outlet. Because flow is proportional to pressure, there is a higher flow through the membrane into the permeate, at the inlet end and therefore more filtration demands on that end. Therefore, even with the sweeping action, this ends start to foul more quickly putting steadily more demand on the other sections of the filter (particularly if a constant permeate is required as in cell culture perfusion) which effectively starts to reduce the “effective filtration area”. By the reversal of flow in the ATF process with the Magma APS, a dynamic TMP situation is created. The pressure along the filter length changes and so neither end of the membrane will be exposed to a constantly higher pressure and spreads the demand more equally across the entire filter surface area. This is represented in the figure to the right.

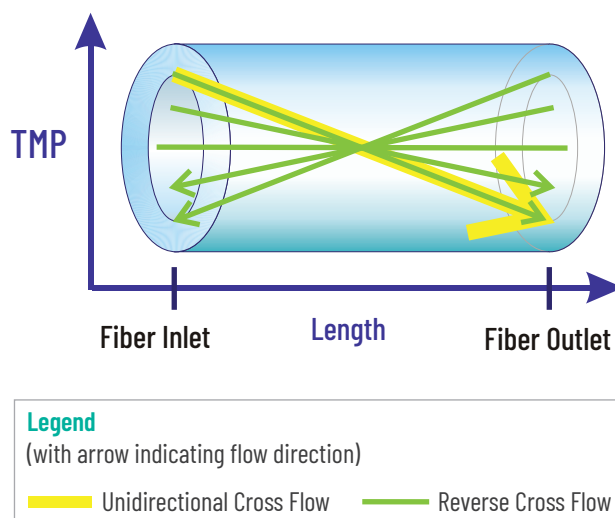


Figure 6. Representation of TMP versus location on Fiber for an Alternating Tangential Flow (ATF) Flow Filtration Processes

Scale-Up and Scale-Down

One of the advantages of hollow fiber filtration is that the process flux is very linearly scalable. For instance, for cell culture perfusion, if it was determined that a process flux of in the range of 100 LMD (100 Liters/m²/day) was optimal, the square meters of filter area for a larger volume process could easily be calculated then achieved by adding either larger modules with more fibers or multiple modules in parallel. The hydrodynamics of scaling up a typical recirculation pump may prove to be more difficult because at the lab scale a peristaltic tubing pump may be used but may not be an option for a large scale process. Changing the pump may have an impact on the cell culture conditions (e.g., cell viability). The Magma APS Pump behaves very similar at a wide range of process scales therefore helps resolve issues with scale up of a recirculation pump. The range of products are shown in **Figure 7** and they offer the ability to operate at the small scale of 100mL up to >500L bioreactors for cell culture perfusion.

Based on filter hold-up volumes for typical industry standard filters, and using a process flux of 100 LMD, a table of approximate liters per day for each pump size is shown in **Table 1**. The actual rate can be higher or lower depending on process length, cell-line, media, and other factors.

Flow per day based on 100 liters per m² per day and cross flow rate ranges for each pump size.

Magma APS Model Number	Pump Volume	Approx. Liters Per Day	Min. Flow (30 Second Cycles) in LPM	~Max Flow (4 Second Cycles) in LPM
MAPS-6	6mL	1	0.012	0.090
MAPS-20	20mL	5	0.040	0.300
MAPS-50	50mL	15	0.100	0.750
MAPS-180	180mL	50	0.36	2.7
MAPS-860	860mL	200	1.72	12.9

** these are representative and actual rate can be higher or lower depending on process length, cell-line, media, filter length and other factors*

Table 1. Example of Magma APS Flux Rate Estimates and Cross Flow Rate Ranges For Each Pump Size



Five Sizes



4L Size - Coming Soon

Figure 7. Magma APS Lab Series Diaphragm Pumps with the Respective Filters

Options for Extended Processing with a Hollow Fiber Filter

There are advantages of using a filtration process versus centrifugal devices and settling devices in certain extended bioprocessing operations such as cell culture perfusion, however, one disadvantage with a membrane filter (even when operating an ATF Process) is that eventually the membrane surface can foul. And before actually blocking fluid flow, the membrane can experience a reduction in effective pore size leading to high retention of constituents that are desired to go through the membrane into the filtrate.

To optimize the filtration process, as shown in **Figure 8**, a “Y” can be connected to the vessel connection and off the two branches of the “Y” can be two filters and diaphragm pumps. The filters and pumps could be steam sterilized with the bioreactor or gamma irradiated with an aseptic connector and connected as required. Initially the primary filter branch, would handle the filtration and at some point in the process, the flow to the primary filter could be terminated and the flow to the secondary filter commenced by opening the valve in the secondary filter branch. A pressure sensor connected to the permeate line (and monitored by the Magma APS Controller for an out of range value) could determine the optimal time to switch filters.

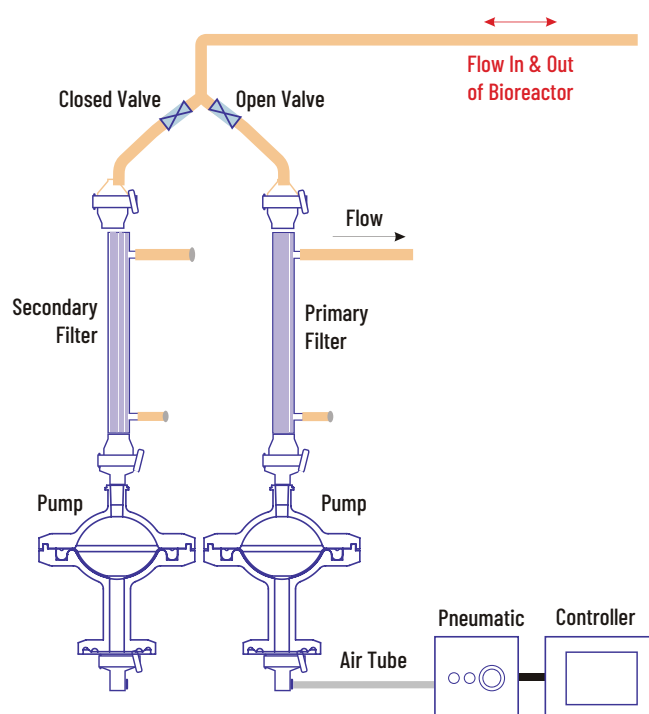


Figure 8. Connection of Two Filters to a Bioreactor

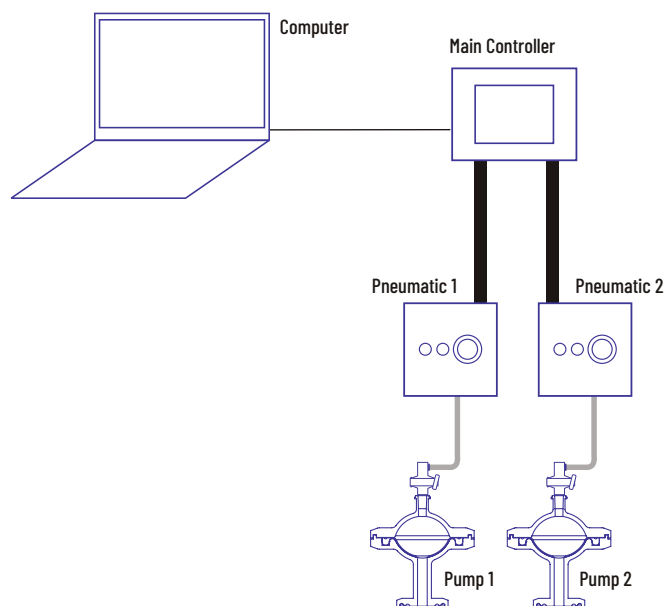


Figure 9. Schematic of Custom Magma Multiplex System

Small Scale Multiplex Options

The Magma APS in conjunction with industry standard hollow fiber filter modules can create a scalable system ranging from lab scale / bench top R&D, to process development, pilot scale to production. Using a duplex pump controller as shown in **Figure 9**, process development and optimization can be conducted on a small scale where costs are minimized including hardware costs, (minimize valuable process components as cell culture media and minimize the use of bench space). Small scale systems offer the opportunity to optimize a process which would facilitate the successful implementation of a optimized perfusion process to the pilot plant and then to production.

Pump

Material: 316L stainless steel or Udel® Polysulfone

Tri-Clamp: 304 stainless steel or nylon

Dimensions: See Page 3

Diaphragm

Material: Molded from platinum cured silicone that meets USP Class VI Medical Grade Specifications

Control System

Control System Enclosure Dimensions (DxWxH):

Base: 13.25in x 12.25in x 11.25in Top: 7.25in x 12.25in x 11.25in

Control System Weight: 23.5 pounds

Enclosure Material: Stainless Steel

Enclosure Material: Stainless Steel

Power Requirements: 100-240 Volts, 50-60 Hertz, 2.5 amp

Pumps Remote Signals : Dry Contact Relay

Scale Inputs: RS232 communication protocol configurable in software

External Pressure Inputs: PendoTECH Single Use Pressure Sensors

Data Output: Ethernet with MODBUS protocol

Pneumatic Box

Enclosure Dimensions (DxWxH):

Base: 13.25in x 6.5in x 11.25in

Top: 7.25in x 6.5in x 11.25in

Pneumatic Box Weight: 17.0 pounds

Air Pressure Regulator

Input: 125 psi max (8.6 bar)

Output: 2-25 psi (0.14 - 1.7 bar)

Magma Pump Connection

Female 1/8 for Quick-Disconnect Coupling, 1/8 Coupling Size, for 1/4" Tube OD

[reducers for use with 5/32in tubing and 1/8in tubing]

Air Connection

Male 1/8 for Quick-Disconnect Coupling, Socket with Shut-Off, 1/8 Coupling Size, for 1/4" Tube OD

Exhaust Connection

Female 1/4 for Quick-Disconnect Coupling for Air, 1/4 Coupling Size, for 3/8" Tube OD

Pump Head Stand

304 Stainless Steel with Delrin Pump Cradle

Dimensions (DxWxH): 6in x 8in x 3in with pole height of 12.5in

Ordering Information

Diaphragms

Part #	Description
APSP-DIA6D	Magma APS-6 Dome Diaphragm, Silicone
APSP-DIA20D	Magma APS-20 Dome Diaphragm, Silicone
APSP-DIA50D	Magma APS-50 Dome Diaphragm, Silicone
APSP-DIA180D	Magma APS-180 Dome Diaphragm, Silicone
APSP-DIA860D	Magma APS-860 Dome Diaphragm, Silicone

Stainless Steel Pump Heads

Part #	Description
APSP-PH20D	Magma APS-20D Dome Pump Head in 316L stainless steel
APSP-PH50D	Magma APS-50D Dome Pump Head in 316L stainless steel
APSP-PH180D	Magma APS-180D Dome Pump Head in 316L stainless steel
APSP-PH860D	Magma APS-860D Dome Pump Head in 316L stainless steel

Plastic Pump Heads

Part #	Description
APSP-PH6-SU	Magma APS-6D Dome Pump Head, Polysulfone
APSP-PH20-SU	Magma APS-20D Dome Pump Head, Polysulfone
APSP-PH50-SU	Magma APS-50D Dome Pump Head, Polysulfone
APSP-PH180-SU	Magma APS-180D Dome Pump Head, Polysulfone
APSP-PH860-SU	Magma APS-860D Dome Pump Head, Polysulfone*

Pumping System

Part #	Description
MAPS-BA1-S	Magma Advanced Pumping System- Small (for Pump Sizes 6, 20 and 50)
MAPS-BA1-M	Magma Advanced Pumping System- Medium (for Pump Size 180)
MAPS-BA1-L	Magma Advanced Pumping System- Large (for Pump Size 860)

*Available late 2025

Subject to the limitations contained in LIMITATION OF REMEDY AND LIABILITY and except as otherwise expressly provided herein, CP Biotools LLC ("Seller") warrants that the Software will execute the programming instructions provided by Seller, and that the products, systems and goods ("Goods") manufactured by Seller will be free from defects in materials or workmanship under normal use and service until the expiration of twenty-four (24) months from the date of shipment by Seller. Expendable items are warranted to be free from defects in material and workmanship under normal use and service for a period of ninety (90) days from the date of shipment by Seller. Products purchased by Seller from a third party for resale to Buyer ("Resale Products") shall carry only the warranty extended by the original manufacturer. Buyer agrees that Seller has no liability for Resale Products beyond making a reasonable commercial effort to arrange for procurement and shipping of the Resale Products. If, within thirty (30) days after Buyer's discovery of any warranty defects during the applicable warranty period, Buyer notifies Seller thereof in writing, Seller shall, at its option and as Buyer's sole and exclusive remedy hereunder, promptly correct any errors that are found by Seller to exist in the Software, or repair or replace F.O.B. point of manufacture, that portion of the Goods or Software found by Seller to be defective. All replacements or repairs necessitated by inadequate preventive maintenance, or by normal wear and usage, or by fault of Buyer, or by unsuitable power sources or by attack or deterioration under unsuitable environmental conditions, or by abuse, accident, alteration, misuse, improper installation, modification, repair, storage or handling, or any other cause not the fault of Seller are not covered by this limited warranty, and shall be at Buyer's expense. Seller shall not be obligated to pay any costs or charges incurred by Buyer or any other party except as may be agreed upon in writing in advance by an authorized Seller representative. All costs of dismantling, reinstallation and freight and the time and expenses of Seller's personnel for site travel and diagnosis under this warranty clause shall be borne by Buyer unless accepted in writing by Seller. Failure by Buyer to give such written notice of defects within the applicable time period shall be deemed an absolute and unconditional waiver of Buyer's claim for such defects. Goods repaired and parts replaced during the warranty period shall be in warranty for the remainder of the original warranty period or ninety (90) days, whichever is longer. All warranties, either express or implied, extend to BUYER only. All descriptions, representations and/or other information concerning Goods on the CP Biotools LLC website and/or contained in CP Biotools LLC's advertisements, brochures, promotional material, or statements made by employees or sales representatives of CP Biotools LLC are solely for general informational purposes only and are not binding upon CP Biotools LLC. No employee or sales representative of CP Biotools LLC shall have any authority to establish, expand or otherwise modify CP Biotools LLC's warranty associated with the sale of Goods. SELLER shall not be liable to BUYER in any manner with respect to Goods sold. SELLER MAKES NO REPRESENTATIONS OR WARRANTIES OF ANY TYPE, EXPRESS OR IMPLIED, AND EXPRESSLY DISCLAIMS AND EXCLUDES ANY REPRESENTATION OR WARRANTY OF MERCHANTABILITY, FITNESS FOR A PARTICULAR PURPOSE OR USE, NON-INFRINGEMENT OR WARRANTY ARISING FROM USAGE OF TRADE, COURSE OF DEALING OR PERFORMANCE. CP BIOTOOLS LLC, LLC MAKES NO WARRANTY OR REPRESENTATION REGARDING WHETHER OR NOT A CUSTOMER'S END USE OF ANY CP BIOTOOLS LLC PRODUCT, SYSTEM OR GOOD INFRINGES THE VALID INTELLECTUAL PROPERTY RIGHTS OF OTHERS.

LIMITATION OF REMEDY AND LIABILITY

SELLER SHALL NOT BE LIABLE FOR DAMAGES CAUSED BY DELAY IN PERFORMANCE. THE SOLE AND EXCLUSIVE REMEDY FOR BREACH OF WARRANTY HEREUNDER SHALL BE LIMITED TO REPAIR, CORRECTION OR REPLACEMENT UNDER THE LIMITED WARRANTY. IN NO EVENT, REGARDLESS OF THE FORM OF THE CLAIM OR CAUSE OF ACTION (WHETHER BASED IN CONTRACT, INFRINGEMENT, NEGLIGENCE, STRICT LIABILITY, OTHER TORT OR OTHERWISE), SHALL SELLER'S LIABILITY TO BUYER AND/OR ITS CUSTOMERS EXCEED THE PRICE TO BUYER OF THE SPECIFIC GOODS MANUFACTURED BY SELLER GIVING RISE TO THE CLAIM OR CAUSE OF ACTION. BUYER AGREES THAT IN NO EVENT SHALL SELLER'S LIABILITY TO BUYER AND/OR ITS CUSTOMERS EXTEND TO INCLUDE INCIDENTAL, CONSEQUENTIAL OR PUNITIVE DAMAGES. THE TERM "CONSEQUENTIAL DAMAGES" SHALL INCLUDE, BUT NOT BE LIMITED TO, LOSS OF ANTICIPATED PROFITS, LOSS OF USE, LOSS OF REVENUE AND COST OF CAPITAL.

Rev. 0

Warranty

For warranty information see our website at www.cpbiotools.com/about