

Application Note

Micropumps for Cell Culturing and Tissue Engineering

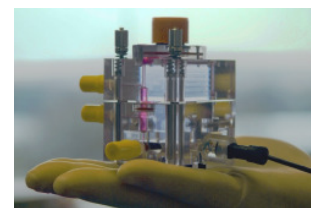
As the field of cell culturing develops further towards more complex culturing systems and tissue engineering, the demand for flexible and active supply of cell culturing media increases. While cell culturing is often carried out under static conditions, nowadays advanced procedures like active perfusion of cells improves results. Since the cells are continuously supplied with culturing media more realistic culturing conditions are provided enabling variations in the culture media over time and also limiting the risk of contamination. In addition, due to the more natural so called "organotypic" culturing, 3D structures for tissue engineering can be achieved.

The need for continuous fluid supply brings the mp6 micropump into play. Being a miniaturized membrane pump with a footprint of only 15 x 30 x 3.8 mm³ it offers several advantages over conventional pumps. Providing a virtually pulseless flow due to the low displacement volumes of maximum one microliter, optimum culturing conditions are assured. Having only a single material certified according to USP class VI / ISO 10993 in contact with the medium minimizes the risk of incompatibilities or long term contaminations. Dependent on the target procedure both flow rates of a few ml/min or in the µl/min range can be addressed with a single product. Due to the continuously adjustable flow rate, the pump can be easily tailored to the individual needs. In comparison to other products in the field, because of the simple design and optimized flow path, the pumps are very robust and reliable which has been proven by numerous customers from both the academic and industrial sector. Using active perfusion on HepG2 cells, positive effects on the hepatic differentiation and low proliferation rates were observed using the mp6 micropump for fluid supply.

While perfusion culturing also enables long term experiments, in most cases the system is inspected and maintained one to two times a week. As the lifetime of the pumps is verified with more than 8000 hours this is not a limiting factor. Being manufactured in quantity the mp6 micropump allows a weekly replacement of the pumps as this is less costly than a re-sterilization procedure of both pump and tubing. Stable operation of the pump has been demonstrated with standard culturing media including Fetal Bovine Serum (FBS) at temperatures of 37 °C and 5% CO₂ atmosphere



Micropump mp6



Bioreactor with integrated micropump
Picture: University of Ilmenau



inside an incubator. Prior to use, the pumps can be sterilized to avoid cross contamination. Both autoclaving (20min at 121°C according to DIN 554) and EtO sterilization (10% EtO, 50°C, >60% humidity) have been demonstrated without major effects on pump performance. As the pumps are used as a weekly disposable in most cases, they are sterilized only once prior to operation.

For small scale applications in a laboratory environment, standard evaluation kits including fully adjustable driving electronics are available. With its USB interface it allows use in a LabVIEW or other software environment. For more customized applications, miniaturized driving modules are available, which can be easily implemented into an existing system electronics. As the low power consumption allows battery use, all components can be placed inside the incubator chamber.

In summary, combining a smooth flow profile and widely adjustable flow rates together with robustness and compatibility with cell culturing media, the mp6 micropump provides a well proven unique solution for active cell culturing devices.

In case the standard micropumps are not able to fully cover the applications need, Bartels microComponents offers to develop tailor-made micropumps, system integration and the development of application specific controllers.



Evaluation kit mp6-go!

General Specifications	mp6*
Type	Piezoelectric diaphragm pump
Pump medium	Liquids, gases and mixtures
Outer Dimensions (without fluidic connectors)	30 x 15 x 3,8 mm ³
Fluidic connectors	Tube clips, 1,6 mm outer diameter
Operating temperature	0 - 70 °C
Life time	> 8000 h ²
Material in contact with media	PPSU
Power consumption	< 200mW (at 3 V including driving electronics)
Max. flow, water ¹	6 ml/min +/- 15% (100 Hz)
Max. pressure, water ¹	550 mbar +/- 15% (100 Hz)

* Typical values. Values can vary under application conditions. Content is subject to change without notice.

¹ Values taken with electronic controller mp-x set to 250V amplitude, SRS Signal

² Conditions: DI water, room temperature, settings mp-x: 100Hz, 250V, SRS

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