Use your Elveflow Equipment

Working at high flow rate with significantly high flow resistance.

It is always recommended to read the appropriate Instrument User Guides in the Elveflow Documentation before starting to install anything. The Elveflow Documentation is provided in a USB key to each customer following an order or a loan, and can also be found in the Elveflow Knowledge Base, that you can access from https://support.elveflow.com/support/solutions.
These guides and application notes have been specially designed for the final users, and you will find most of the answers to your questions about the use of Elveflow products. The information provided will also give you critical details about user safety, operation conditions, and warranty conditions.
A dedicated installation support webpage (Elveflow.com/unboxing-OB1) already displays a series of videos created specifically to provide our customers with the best experience. Step by step, we guide you to install your OB1 pressure controller, install and connect reservoirs and flow sensors. A dedicated part shows the ESI software installation and the calibration needed as you use it for the first time.
THIS DOCUMENT IS A PRACTICAL QUICKSTART WHICH COVERS THE MAIN STAGES YOU WILL GO THROUGH INSTALLATION, BUT IT DOES NOT REPLACE THE EXISTING USER GUIDES INSTRUCTIONS.
PLEASE READ EACH USER GUIDE BEFORE STARTING INSTALLATION.

1. Generalities of working with high flow resistance

Many users expect their liquid sample to flow into their circuit, whatever the conditions.
But in practice many parameters can adversely affect flow speed and impact flow rate performance. This may raise the feeling that the equipment is not working while in fact the low flow performances may be due to the fact that the key parameters are not enough taken into account.

When a user needs to work at a high flow rate, he would need to facilitate the flow of liquid in his system.

Several solutions are generally applied, mainly:

1. pushing the liquids into the system with more force.
2. reducing the fluidic resistance of the circuit.

2. Possible workarounds to overcome this situation

2.1 Pushing the liquids into the system with more force.

If an Elveflow OB1 is used, it is possible to change or install a new, more powerful regulator.
For example :

- Switch from a 200mbar regulator to 2000 mbar
- Switch from a 2000 mbar regulator to 8000 mbar

Having a more powerful regulator installed on an OB1 channel allows users to apply a greater pressure in the reservoir containing the liquid, and thus to propel the latter with a greater force [1]. Note that this should imply using reservoirs rated for higher pressure, for safety reasons.

[1] This setup modification is free of charge within a 1 month period following the delivery of your OB1 (if returned regulators are not damaged).

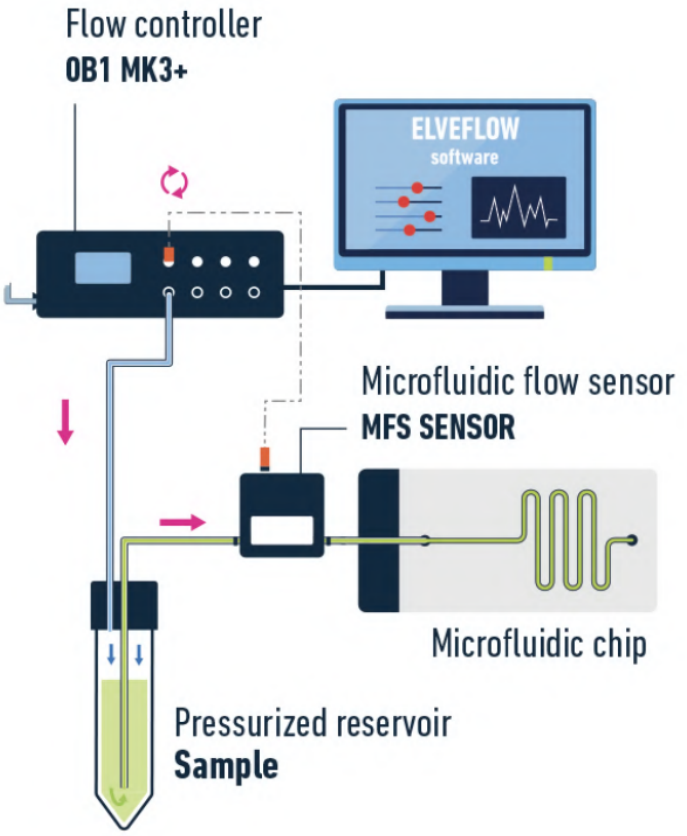

Fig 1. *Principle of pressure control and flow control feedback loop.*

2.2. Reducing the fluidic resistance of the circuit.

In a microfluidic channel, and in the case of a Poiseuille laminar flow, the resistance $\mathbf{R_h}$ will depend on the channel diameter **R** , the length of the channel **L** , and the viscosity of the liquid **μ** .

$$R_h = \frac{8\,\mu\,L}{\pi\,R^4}$$

The viscosity of the liquid is generally set by the user's experiment, and therefore can not be modified but it can be noted the preponderance of the channel diameter (in $\mathbf{R^4}$) and the tube length **L** .

These are the two main options to decrease the resistance.
In practice, reducing the influence of the diameter **R** of the channel implies the use of fluidic tubes of larger section, to promote an easier flow of liquid. This is the parameter with the most critical impact.
The reduction of the length of the channel (or tubing) **L** is another important parameter on which the user can have an impact. In practice this means having the shortest possible connections, i.e. not using too long tube sections if it is not useful.

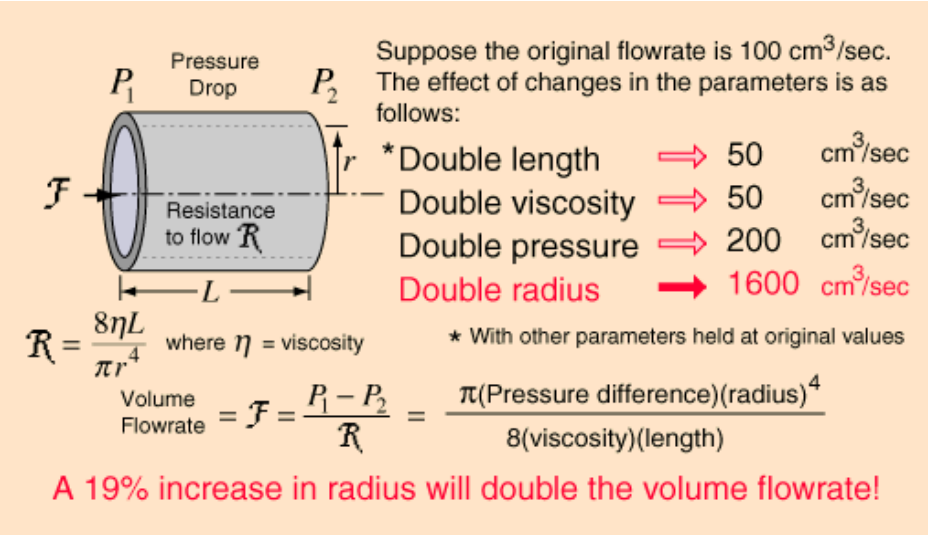

Fig 2 *Application of the Poiseuille law to fluids flow, and the impact of various parameters.*
Source: http://hyperphysics.phy-astr.gsu.edu/hbase/ppois2.html

2.3. Practical adjustments to overcome a high flow resistance

1. We advise users to **use a larger diameter tube,** and to go from standard 1/16 OD tube (inner diameter of 0.8 mm) to a tube of 2.5 mm internal diameter (4mm external) that you will receive soon. This tube, whose **diameter is more than 3 times higher than the 1/16 OD** should allow the user to reach higher flow rate values. Note that some Elveflow devices, such as the MUX only accept 1/16 OD tubing (0.8 mm) and that the implementation of this principle assumes an adapted connection scheme.

2. We advise users to **limit as much as possible the 1/16 OD tube length that they would use,** as this does not promote the best possible flow. Tubing and fittings can be sent at not charge to elveflow users in need. Please send your request to customer@elveflow.com for details.

3. **Using an OB1 4 x 8000 mbar** enables any user to set higher pressures and move fluids more efficiently and quickly. This option requires additional purchase to install new, more powerful OB1 pressure channels. Please send your request to customer@elveflow.com for details.

3. Additional information (to learn more about flow resistance)

You may read the following documents:

MFS Sensor resources page: you will find there the user guide, along with the documentation that explains the principle of Elveflow Flow Control Tuning. Please read these documents to get a general insight about the principle of flow resistance, and learn about the Do's and Don'ts of flow control tuning.