ELVEFLOW an ELVESYS brand

Elveflow User Guide

OB1 MK3+

Pressure and vacuum controller

DOCUMENT REF: UG_OB1_MK3+_20240125

SYMBOLS USED IN THIS DOCUMENT

IMPORTANT INFORMATION. Disregarding this information could increase the risk of damage to the equipment, the risk of personal injuries, and influence your user experience.

HELPFUL INFORMATION. This information facilitates the use of the instrument and contributes to its optimal performance.

ADDITIONAL INFORMATION is available on the internet or from your Elveflow representative.

PLEASE READ THE ENTIRE DOCUMENT CAREFULLY BEFORE STARTING ANY EXPERIMENT.

By disregarding the document, the user might be exposed to dangerous situations and the instrument can undergo permanent damage.

Elveflow cannot be held responsible for any damage related to the incorrect use of the instruments.

Table of contents

1. Introduction

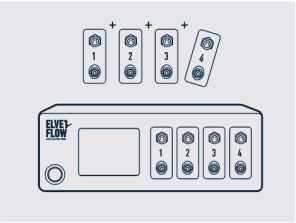
The **OB1 pressure controller** allows controlling output pressure from -900 mbar to 8000 mbar (5 different pressure ranges available) in up to 4 independent channels. It uses a gas input pressure (positive or negative) to precisely control the output delivered pressure. Up to 4 sensor connections are available. A feedback loop can be implemented between a sensor and the controller.

General recommendations:
The OB1 must be used in a clean and dry environment with up to 80% relative humidity and in a ventilated room. Do not use the instrument in connection with substances that may emit toxic or corrosive fumes, such as acids or alkalis. The OB1 can't be used with pure oxygen or in any other fire-risk situation. It must be used exclusively with non-explosive, neutral, dry, dust- and oil-free, and particle-filtered gases.

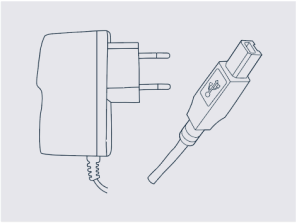
2. Design and package content

Package content

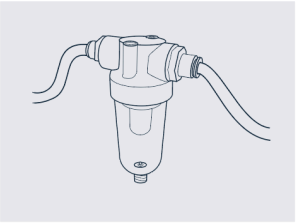
Before setting up your OB1, please check the package contents to ensure you received all the items below.
Each package includes the following:



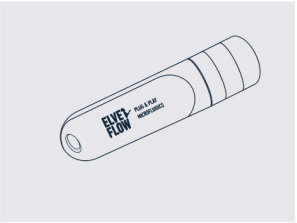
OB1 Mk3+
+ number of chosen channels



Power supply unit adapted to your country and USB cable



Particle/humidity filter



Elveflow Smart Interface software
ESI in the USB key

In addition to the above items, you may have received a starter kit. If it is the case, please refer to Section 9 for details.

Defects or missing items:
Please report any defects or missing items **within one month** of your order receipt.

Create a ticket

Design

Front panel information

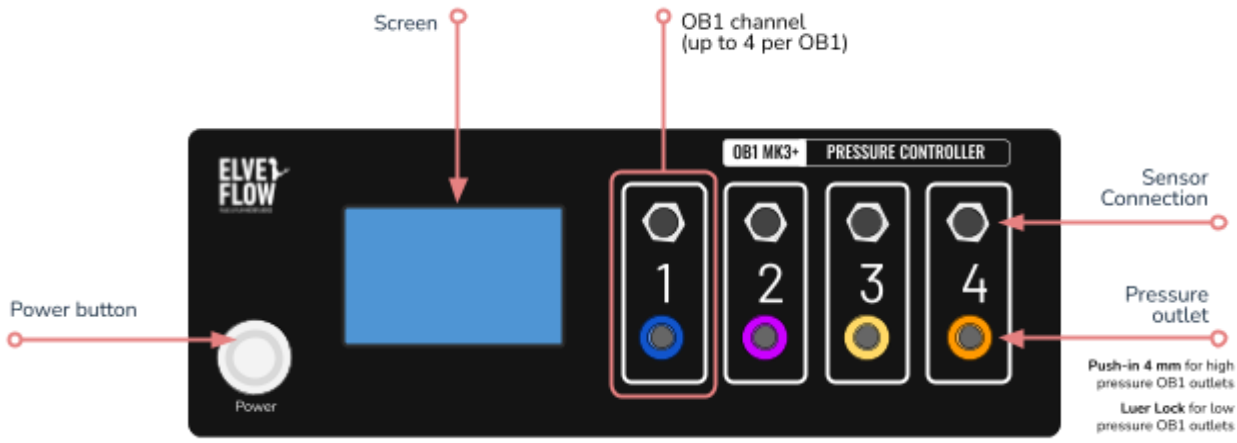


Fig 1. *Front view of the OB1 Mark 3+ pressure controller.*

You find the following elements at the front of the OB1 (Fig 1):
- The Power button
- The LCD screen that displays basic information
- One to four pressure channels

The OB1 can accommodate 1 to 4 independent pressure channels. Each channel consists of a sensor connection slot and a pressure outlet. Each pressure range, i.e each output of the OB1, are color coded and marked differently to facilitate their identification (Fig 2).
Note that the type of connectors for high and low pressure channels are different. For high-pressure channels, the OB1 is fitted with push-in 4 mm connectors, unlike low-pressure channels which are fitted with Luer Lock connectors.

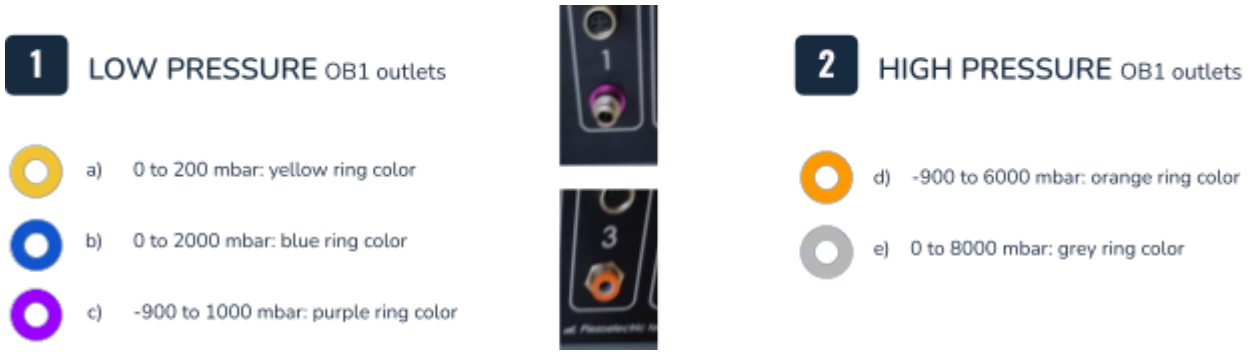


Fig 2. *The OB1 channel outlets and recommended connections. Channels type* ***a****,* ***b****, and* ***e*** *are "Positive channels", while channels type* ***c*** *and* ***d****, work both with positive and negative pressures and are called "Dual channels".*

Back panel information

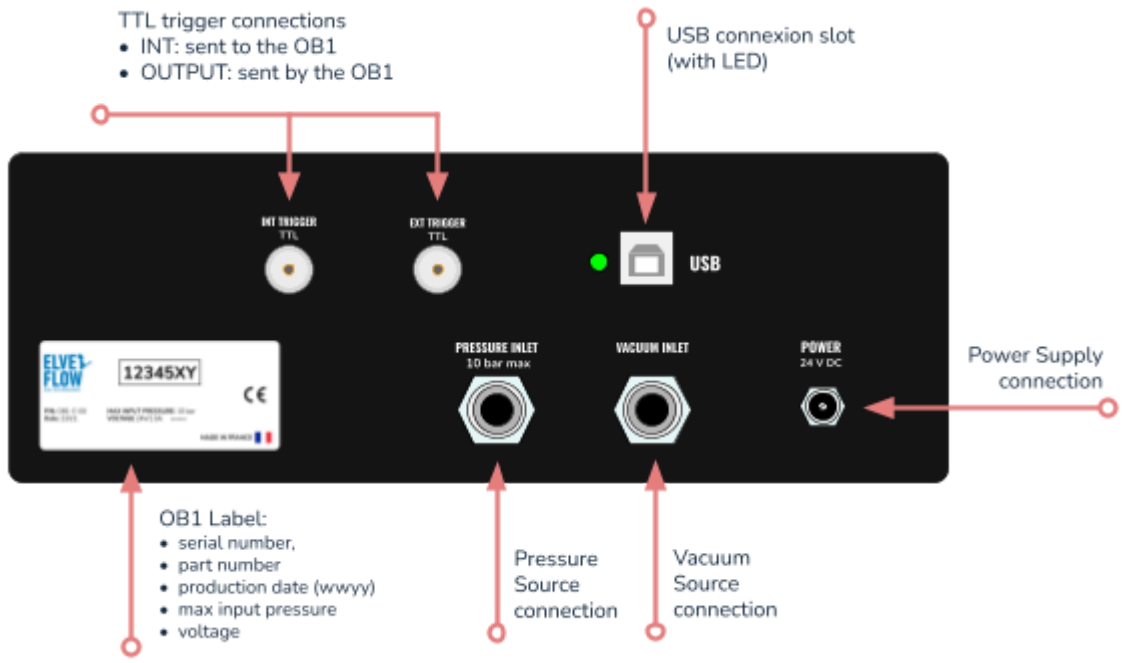


Fig 3. *Rear view of the OB1 Mark 3+ pressure controller.*

You will find the following elements on the back of the OB1 (Fig 3):

- The label that provides essential information, such as the device's serial number. This reference is required when contacting technical support.
- 2 TTL connections (triggers):
  - Input trigger: for signals sent to the OB1 from other devices.
  - Output trigger: for signals sent by the OB1 to other devices.
    - These two functions can be reached and used in the ESI sequencer. For more information, refer to the ESI User Guide.
- Inlets for connecting the pressure and vacuum sources.
    - Please note that these inlets use secure push-in connections.
- The USB connection with a green LED light
- Power supply connection: the OB1 requires a 24 DC input voltage, 1,5 A. The instrument will only work correctly with the correct voltage.

3. Set-up of the equipment

OB1 surroundings checking

For pressure source and vacuum source (if applicable), you may have some Elveflow's equipment. In that case, please refer to the dedicated user guides. You can find them on the Elveflow support center.
If you are using different pump equipment, please refer to the manufacturer's instructions.
Alternatively, you can connect your OB1 to a gas cylinder (e.g. CO2, Nitrogen) or a local compressed air network.

For a general overview of all these cases, please refer to Fig 8.

To ensure safety conditions are taken and maintained anytime using gas cylinders (e.g. CO2, Nitrogen), **close the OB1 outlets when not in use and ventilate the room where the OB1 is.** We also advise to **close the gas bottle after each experiment** to avoid excess gas consumption or gas concentration built-up in the experiment room, as a small intrinsic leak occurs within the normal operation of the OB1, even when switched off.

Pressure requirements

The OB1 positive pressure channels require having a pressure source that meets and maintains the following specifications:

- dry and non-corrosive (use an air drier, please refer to ISO 8573-1, cl. 3 for detailed information)
- no risk of fire and explosion (no oxygen)
- dust, oil-free and particle-filtered gases. We recommend filtering particles of 5 µm and larger.
- output pressure between 1.5 and 10 bar. Do not connect the instrument to a pressure source greater than 10 bar.

The pressure source should be ON at a pressure value at least 0.5 bar above the OB1 channel top range anytime the OB1 is used. For example, for a 2000 mbar pressure channel, the pressure source should deliver at least 2.5 bar, with a sufficient air flow rate depending on your application.

Vacuum requirements

Dual OB1 channels can be used with positive and negative (vacuum) pressure (i.e. -900 to 1000 mbar and -900 to 6000 mbar channels).

- Regarding the positive pressure range (i.e. 0 to 1000 mbar, 0 to 6000 mbar), follow the recommendations for positive channels found in the “Pressure requirements” section above.
- Regarding negative (vacuum) pressure, using a vacuum pump with the lowest possible vacuum value is recommended since the vacuum pump defines the vacuum pressure range of the OB1. For instance, if the ultimate vacuum value delivered by the vacuum pump is -600 mbar, the OB1 dual channel (-900 to 1000 mbar) would be limited by this value, i.e., the possible reachable values would be -600 to 1000 mbar.

- There is no minimum recommended vacuum value.
- In the case of dual channel OB1, both pressure and vacuum sources are needed for good operation.

OB1 Installation

Close the channel outlets

Before starting the proper installation of the OB1 and its connection to the pressure and vacuum sources, we advise to place the dedicated plugs, either luer plugs (Fig 4.a) or push-in plugs (Fig 4.b) to the luer lock or push-in channel outlets of the OB1 (Fig 4).

Fig 4. *Type of outlets and the corresponding fittings.*

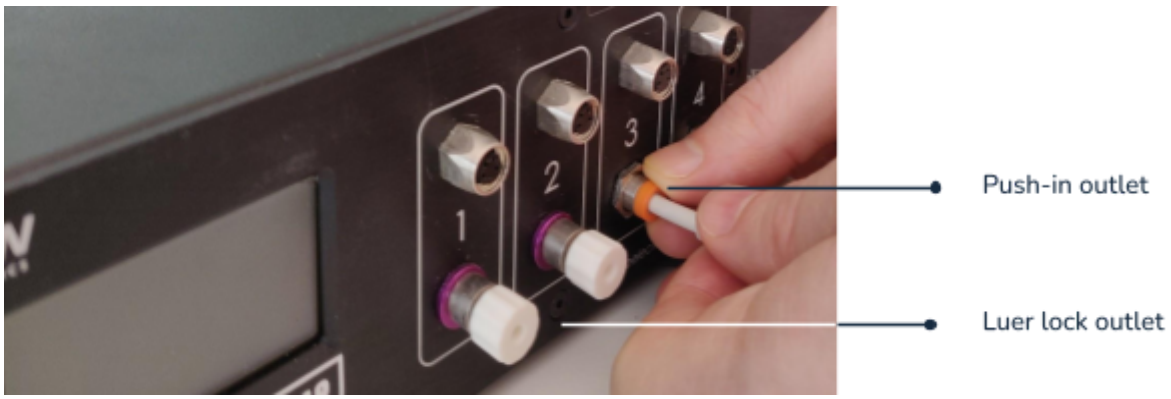


Fig 5. *OB1 MK3+ and its dedicated plugs*

Keep the compressed air lines dry and clean

Condensed water and particles shorten the life of the OB1 pressure controller, cause significant maintenance costs, and may result in loss of accuracy. The most effective way to eliminate condensed water and particles is to install an air dryer and filter in between the pressure source and the OB1 pressure controller. **The air dryer should be mounted vertically, with the drain plug at the bottom and the side arrow of the cap towards the OB1. Check the arrow on the dryer to orient it correctly** (Fig 6).

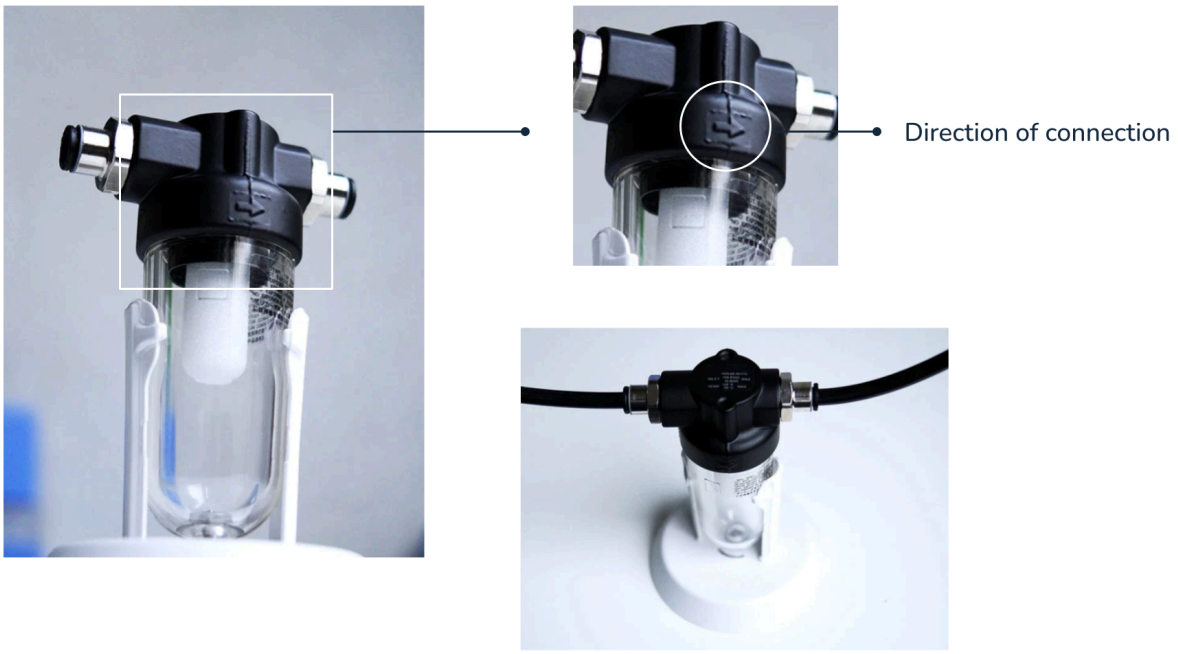


Fig 6. *Install an air dryer to keep water and particles out of the pneumatic circuit.*

Connecting pressure and vacuum sources to the OB1

Using 6 mm OD pneumatic tubing, connect the pressure and vacuum pump to the push-in pressure and vacuum inlets indicated by “pressure inlet” and “vacuum inlet” at the rear of the OB1 device (Fig 3).

Strictly follow the information for each inlet and do not interchange the two inlets, otherwise the instrument might be damaged.

Push-in connection use:

- To connect the tubing to the push-in connection, simply insert the tube.
- To disconnect the tubing, ensure that the pressure and vacuum sources are turned off, and the tubing is purged to the atmospheric pressure, then press the gray ring and pull the tubing (Fig 7).

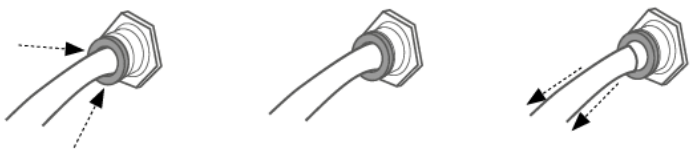


Fig 7. How to disconnect OB1 push-in fittings

On the compressed air line, remember to connect the air dryer as explained in the above section (Fig 6). The connections of your OB1 to the pressure and vacuum (if applicable) sources should look as illustrated on Fig 8.

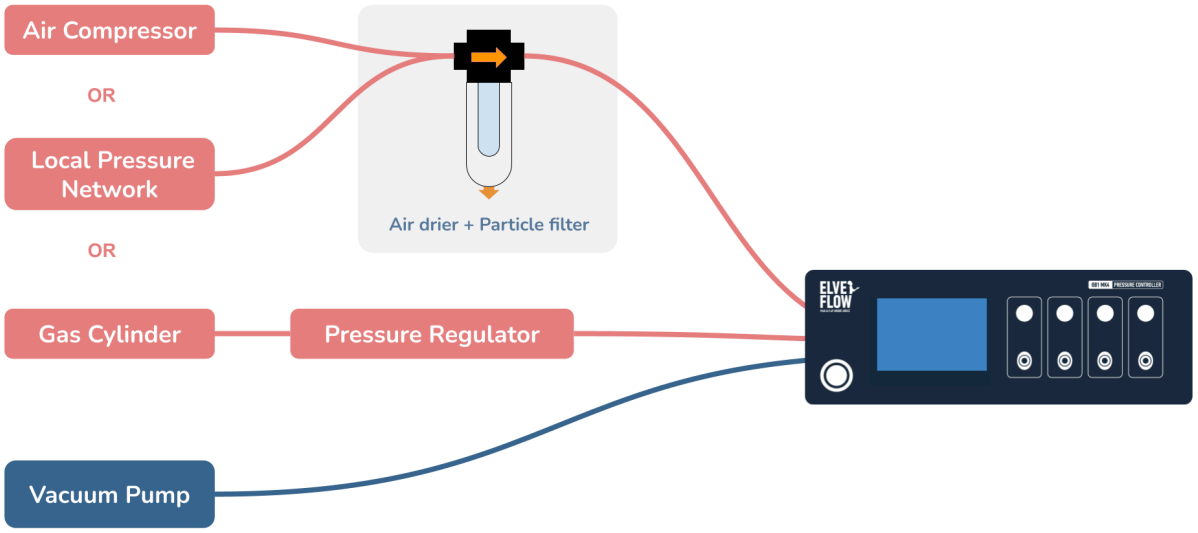
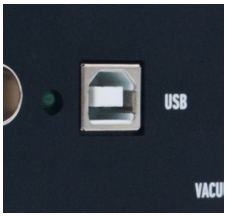


Fig 8. Pressure (red) and vacuum (blue) sources connection possibilities to an OB1

Connect your OB1 to your computer and the power supply

Connect the instrument to the computer using the USB cable.
The USB connection is located on the back of the device.



Next, plug the power adapter into the instrument (“24 V DC” marking), and connect the adapter to an electric socket (country-specific plug adapters provided).

Your OB1 is now ready to be switched on.

Add your OB1 to the ESI software

To install the software on your computer, you can either use the provided USB key or download the ESI software through the Elveflow Website.

You will find the software description and operation details in the ESI guide under the .zip archive downloaded with the software or on the support portal.

To add an OB1 to the software, click on ADD INSTRUMENT (Fig 9.a).

In the New Instrument window, select the Instrument type and name it. You can use letters from A to Z (upper or lower cases), numbers from 0 to 9, and underscores. The instrument name should not contain any space.

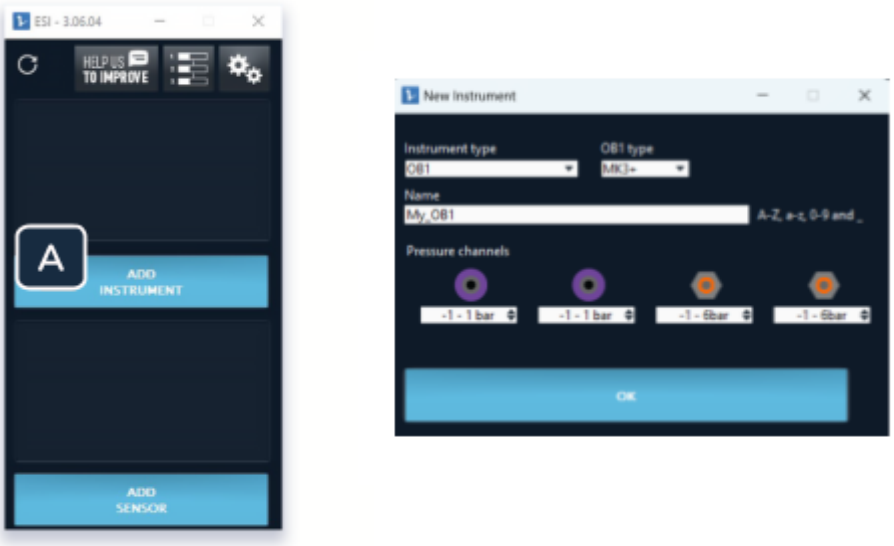


Fig 9. *Adding an OB1 to the ESI software.*

The configuration of your OB1 Mk3+ will be automatically detected.
Click OK, and your new instrument will appear in the main window (Fig 10.a).

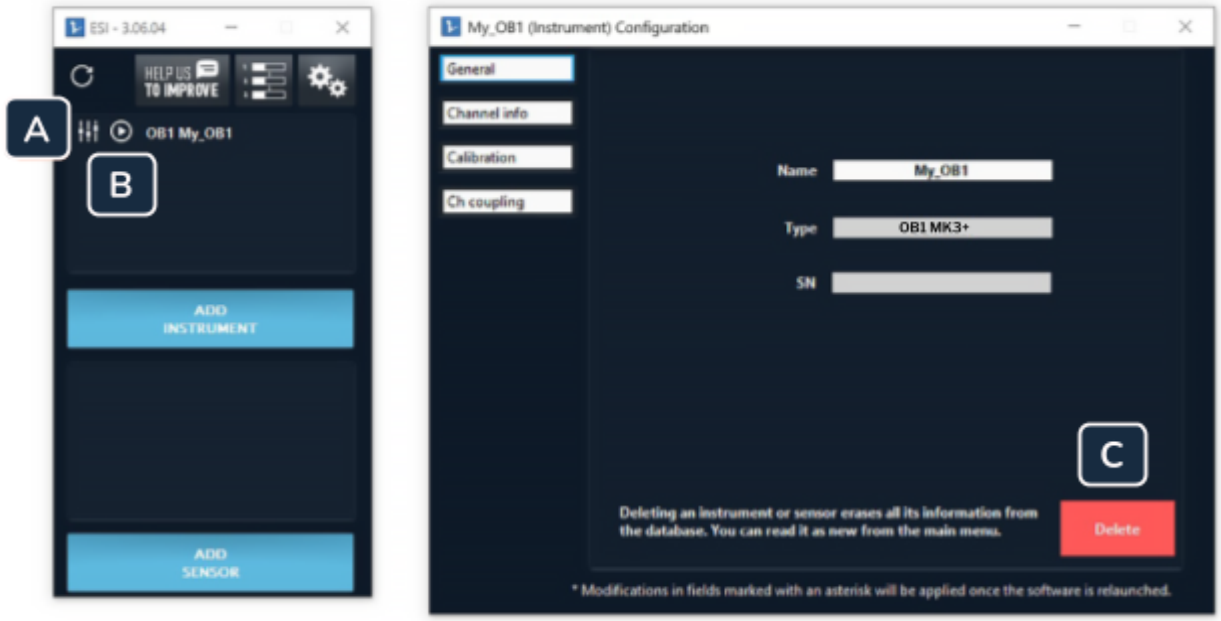


Fig 10. *Removing a device from the list.*

To access the OB1 settings tab, click on the button on the left of the OB1 name (Fig 10.a). To open the OB1 control panel, click on the button with the arrow (Fig 10.b).
If you want to remove your OB1 from the devices list, click the “delete” red button in the ESI OB1 settings tab (Fig 10.c).

OB1 calibration in the ESI software

Now that the OB1 pressure controller is added to the software, turn on the pressure and vacuum sources.
For best performance, **allow the OB1 to warm up and stabilize for at least 30 minutes** before starting an experiment.

- Positive OB1 channels should be calibrated with the pressure pump open and switched ON.
- Dual OB1 channels are designed to work with vacuum and pressure and, therefore, require both the pressure pump AND the vacuum pump to be open and turned ON during calibration and at all times.
- To calibrate the instrument, all pressure outlets must be closed with the appropriate push-in plugs.

Open the instrument settings window from the main window (Fig 11.a) and select the calibration tab (see Fig 11.b). Adjust the pressure range used in the calibration if a specific configuration is required (Fig 11.c). Press “Start Calibration” (Fig 11.d). This process takes a few minutes and begins with the calibration of channels 1 and 2, then proceeds to the calibration of channels 3 and 4.

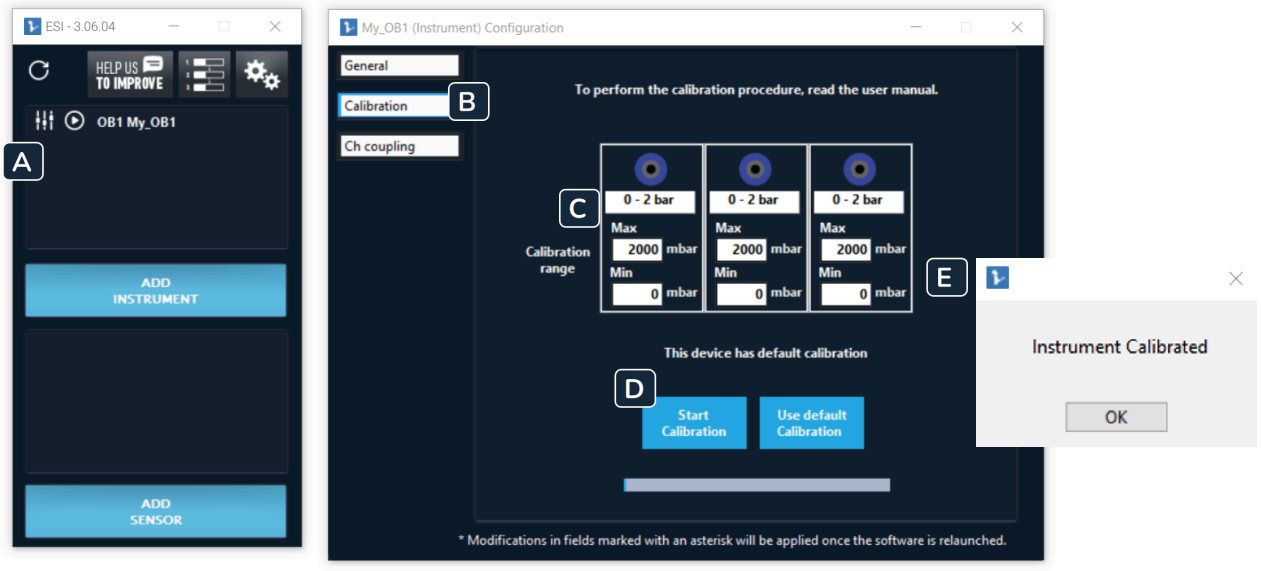


***Fig 11**. Quick and easy calibration of the OB1 is essential before use.*

Once the calibration is completed and successful, a window pops up (Fig 11.e). The plugs can now be removed. To remove the luer lock plug, simply unscrew it from the connector. To remove the push-in plugs, press on the fitting ring as you pull the plug in the opposite direction (Fig 12). If you simply try to remove the plug without pressing the fitting ring, the teeth will engage, and you will not be able to extract the plug.

We recommend keeping the plugs on the OB1 channels when the OB1 controller is not in use to protect the device from dust and particles.

***Fig 12**. How to disconnect push-in plugs from high-pressure outlets.*

When using a dual OB1 (pressure and vacuum):

- Start the ESI software before the vacuum pump and stop the vacuum pump before closing the software. When the software does not run, dual regulators are fully open to the vacuum side, which may result in backflow.
- A slight vacuum pressure around 0 mbar is intrinsic to dual regulators.

OB1 pressure control in the ESI software

Open the OB1 interface from the main window (Fig 13.a). You can set a pressure by writing the pressure directly on the interface (Fig 13.b).

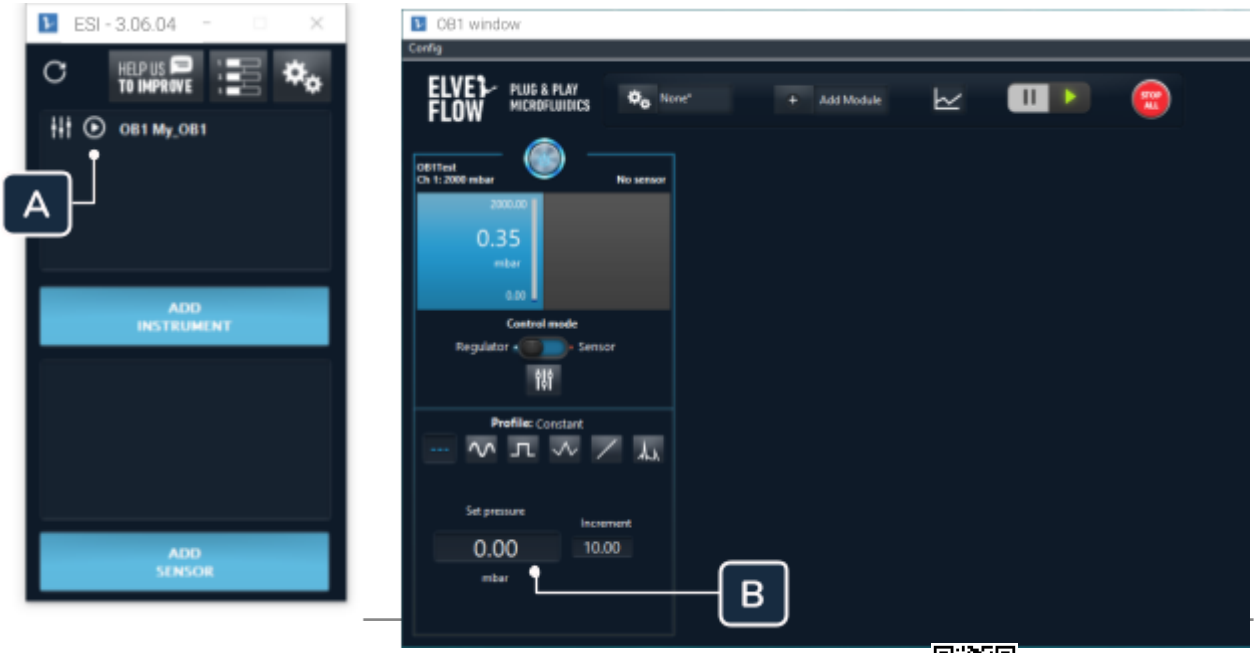


Fig 13. How to open the OB1 interface (A). Set a pressure (B)

For more information, please refer to the ESI User Guide which provides a detailed description of all the OB1 software settings.

4. Use case

Your OB1 is now ready. We advise starting with a simple and easy microfluidic setup to master the installation steps. The setup can be incrementally complexified and adapted to your own application.

The pressure controller pressurizes a reservoir containing the liquid to flow (Fig 14). This action generates a pressure differential between the inlet and the outlet, so the liquid is moved smoothly and quasi-instantly into the fluidic path. Thus, controlling the input gas pressure of the tank allows controlling the liquid that flows out of the tank.

For more information, check our YouTube video:

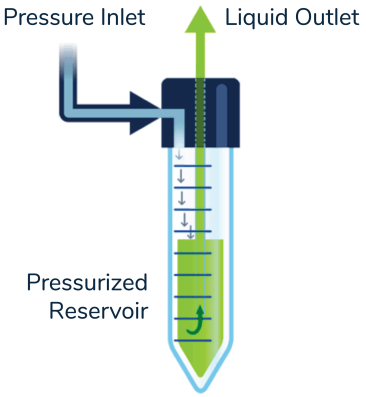


***Fig 14.** Principle of pressure-driven fluid motion.*

An experimental use case scenario is presented in this section. The experimental setup comprises an OB1, a reservoir, a MFS flow sensor and a waste tank. This flow experiment is only an example to give you installation advice.

For this experiment, you will need the following elements:

- 1 OB1
- 1 MFS flow sensor
- 1 reservoir filled with water
- Tubings (4 mm OD - 2.7 mm ID tubing for air pressure connections, and 1/16” OD tubing for liquids)
- Some additional accessories included in the starter pack (see Section 9)
- A waste reservoir
- A computer equipped with the Elveflow Smart Interface (ESI).

We will guide you through the different steps for the connections of the different elements.

Install the anti-backflow filters to the OB1 outlets

Each OB1 pressure/vacuum outlet should be equipped at all times with a filter to prevent the accidental flow of liquids in the instruments (backflows).

Figure 15 illustrates our recommended filter installation. Depending on the type of connector, either luer lock for low-pressure channels or push-in for high-pressure channels, the installation of the filter differs. The filter can be connected directly to the luer lock connector, whereas a push-in connector requires the addition of 4 mm pneumatic tubing. The filter can be connected in either direction - its orientation is not important.

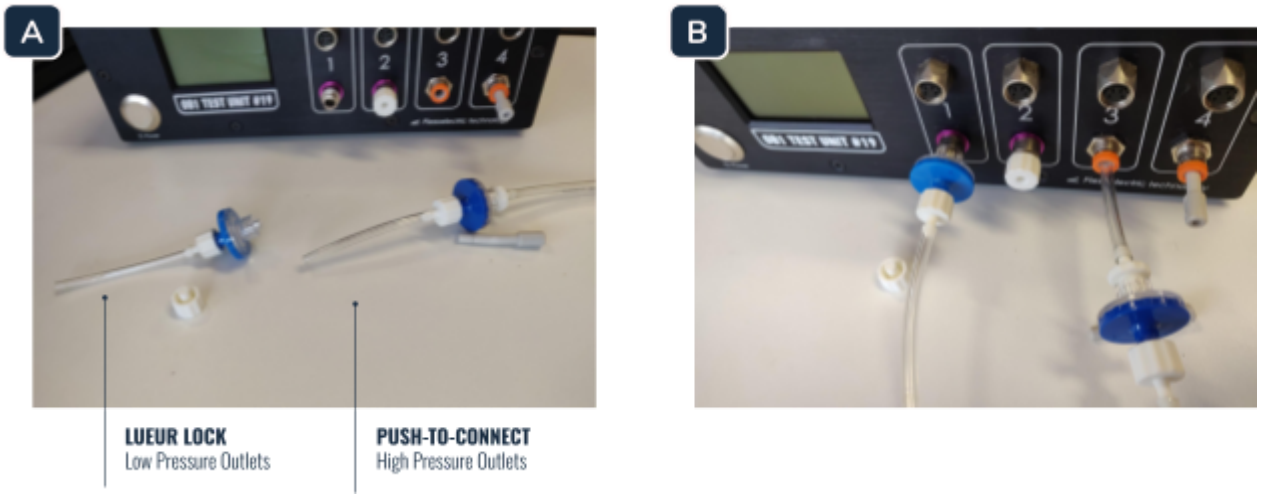


Fig 15. *How to install the anti-backflow filters to the OB1 outlets*

To install the tubing to a push-in fitting, simply insert the 4 mm OD pneumatic tubing into the mouth of the fitting.

Connect the reservoirs

Use the following fittings to connect the reservoirs to your microfluidic setup:

- 1/4-28 fitting + ferrule for 1/16" OD tubing.
- 1/4-28 fitting to Barb 3/32".

Figure 16 illustrates our recommended reservoir installation. Please refer to the user guide for pressurized reservoirs for the specific instructions on connecting the Elveflow reservoirs.

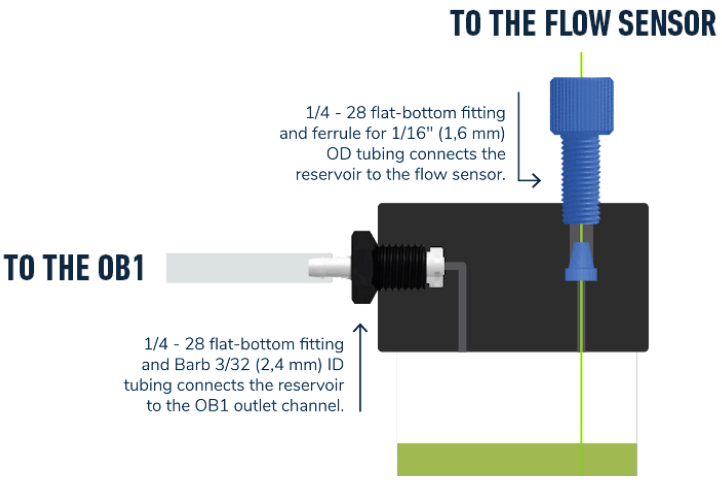


***Fig 16**. Cross-section of a reservoir with the fittings and tubings required to connect it to the pressure generator and flow sensor.*

To avoid any pressure leak:

- check the connections of the different fittings and tight them correctly.
- feel free to adjust the fitting's tightness using Teflon thread seal tape to avoid pressure or liquid leaks.

We recommend placing the OB1 above the reservoirs as illustrated in Fig 17. This way, it will prevent liquids flowing to the OB1 controller and be a second safety measure (on top of the back flow filter).

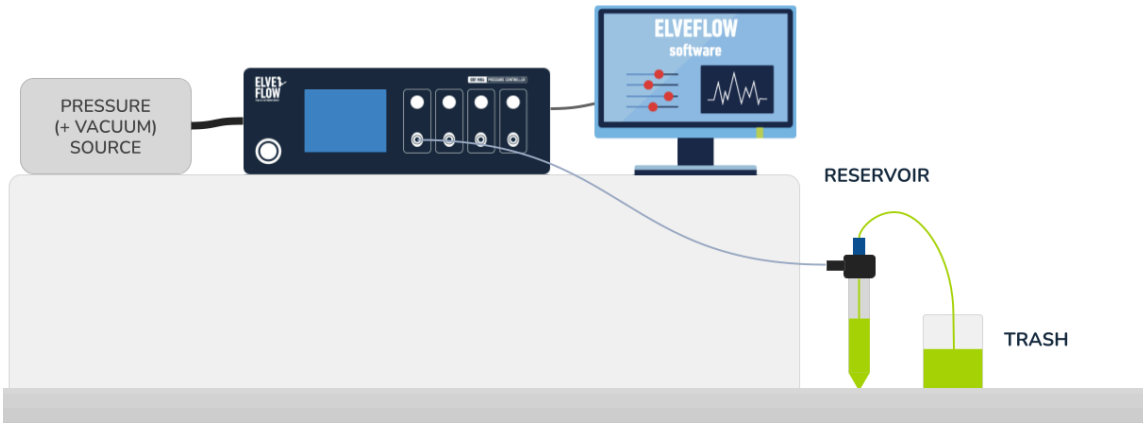


***Fig 17**. OB1 pressure controller connected to the pressure (and vacuum) sources and to the liquid reservoir.*

Connect the sensors

To connect an MFS flow sensor to the OB1, use the supplied sensor cable and plug it into the sensor receiver port above an OB1 pressure outlet on one side and to the flow sensor on the other side. Check the orientation of the port compared to the pins of the cable to ease the connection.

To add a sensor to the ESI software, it has to be physically connected to the OB1 pressure controller. Click on Add Sensor (Fig 18.a). Choose the type of sensor (Fig 18.b), a flow sensor in this case, and choose the communication type, either digital or analog (Fig 18.c).
If connecting a digital sensor, the model of the sensor will be automatically recognized by the software.
However, if connecting an analog sensor, a selector will appear at the top right corner for you to choose the model of sensor you are using (Fig 18.d).
Then give it a name, choose the instrument and the channel your sensor is connected to (Fig 18.e) and click on OK.

Check the type of sensor you are working with and strictly follow the information displayed on the sensor's sticker. Do not add a digital sensor as an analog one and vice-versa.

Refer to the MFS user guide for more information.

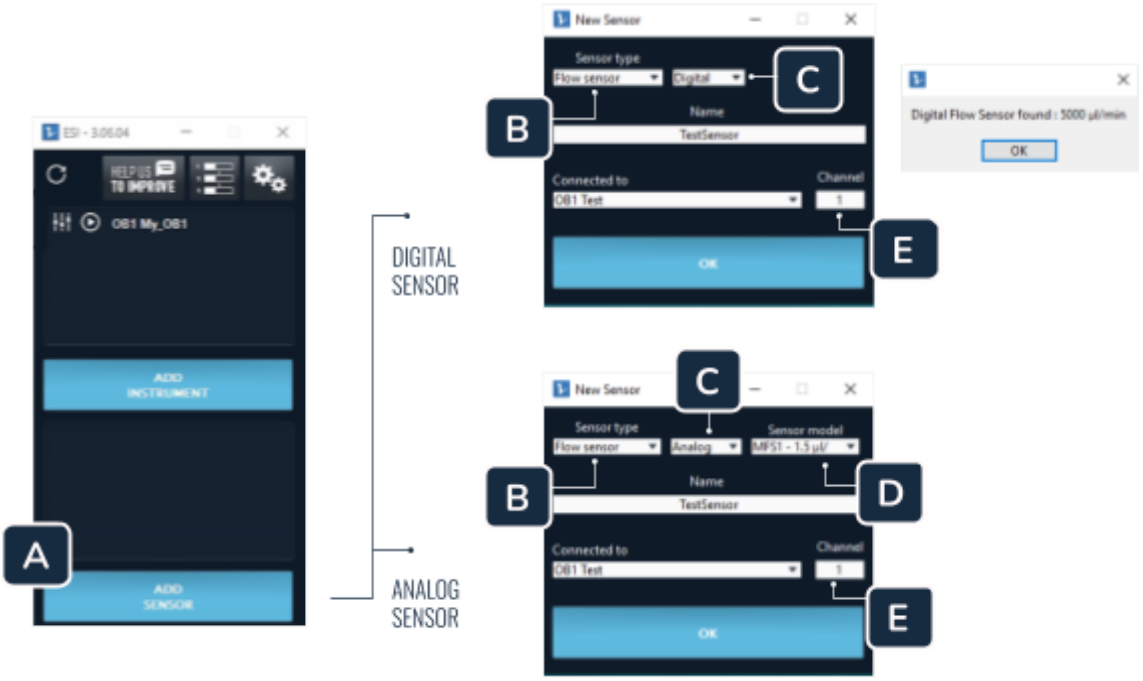


***Fig 18**. Adding a sensor connected to the OB1 on the ESI software.*

Connect the inlet and outlet of the flow sensor to the 1/16" OD tubing. It is connected on the inlet side to the liquid reservoir. On the outlet side, place the tubing in a waste reservoir (Fig 19).

Your set-up is now ready (Fig 19). You can practice your skills in pressure and flow control. You may need to add some microfluidic resistance tubing to your system. We advise you to master and understand this experiment before switching to your own experiment.

Tip:

- The tubing in the inlet reservoir must be immersed.
- The tubing in the outlet reservoir should be immersed in the liquid to avoid drops dripping into the trash, as this may cause flow instability.

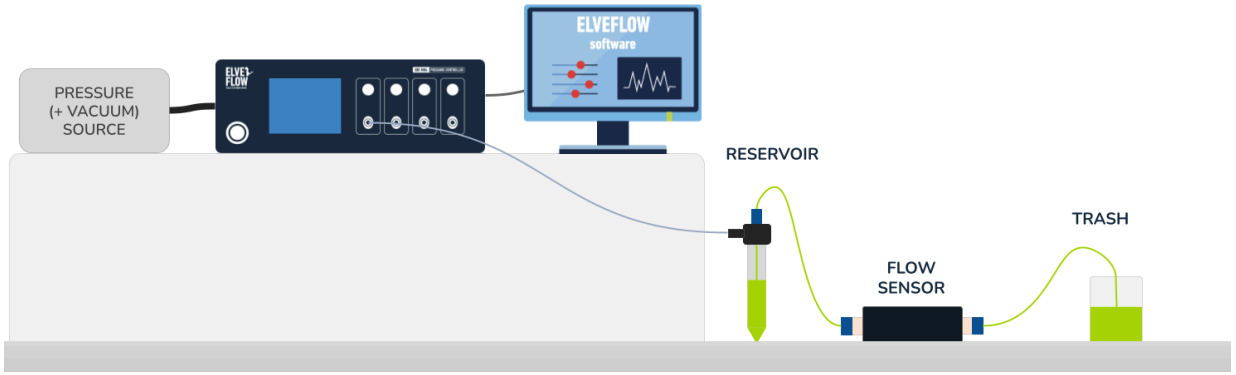


Fig 19. *Example of a simple setup to master flow control.*

Browse through our Knowledge Base to find more information about our products.

- **The OB1 unboxing video** shows the elements provided in a typical customer parcel to assist you with the basic installation steps. It is important to note that the **OB1 unboxing video** provides only a general overview and may not describe all the items in your unique parcel. For more specific details, refer to the following User Guide. You can find the video on our YouTube Page.
- The **Flow rate control tuning** guide gives you full information on the control of a flow rate, the set of a flow control feedback loop and the use of microfluidic resistances.

5. Preventive maintenance

Check the air cleaner filter on the back of the OB1 (Fig 20.a) regularly and drain the accumulated water by pressing the button at the bottom of the filter. We advise to replace the air cleaner filter at least once a year.

We advise to replace the backflow filters at the front of the OB1 (Fig 20.b) at least once a year or any time it gets into contact with some liquid.

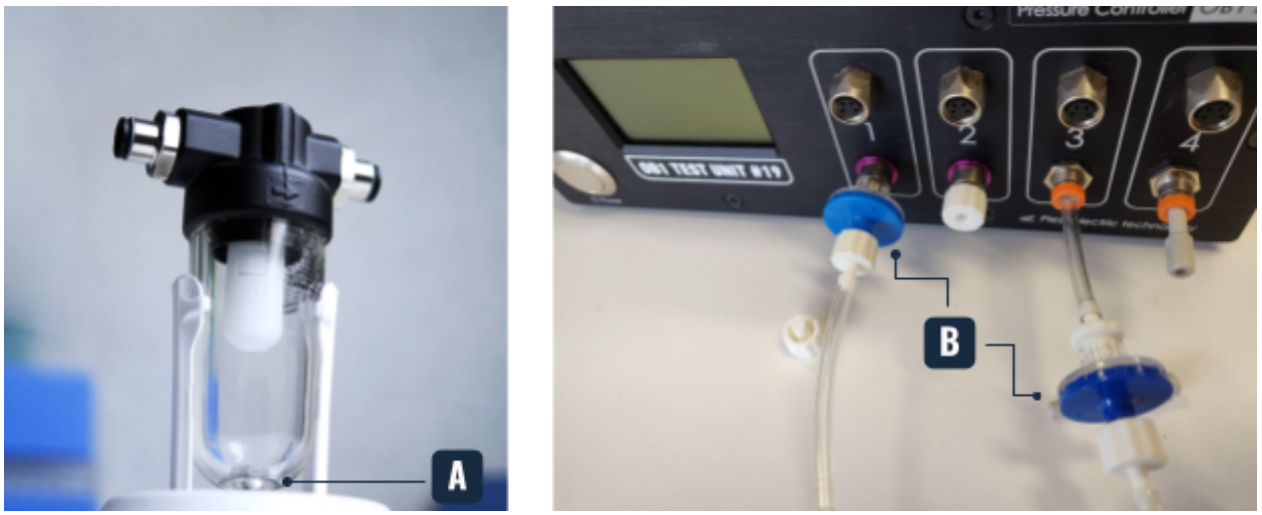


Fig 20. *OB1 maintenance: replace the filters at least once a year*

6. Upgrade

If you purchased an OB1 containing only 1, 2, or 3 channels, the inactive channel(s) will be protected by a plug added during the fabrication of the device. Should you wish to add a new pressure channel or replace an existing one, the instrument must be returned to the factory, where our experts can remove the plugs and install the new channel.
The typical OB1 channel installation is a quick operation followed by a test on a test bench to ensure the upgraded OB1 meets Elveflow's high performance and quality standards. As soon as we ensure all is fine, we will ship the upgraded OB1 back to you.

To do an upgrade of your instrument, contact the support team at customer@elveflow.com.

7. OB1 troubleshooting guide

Connection issues

If you encounter issues connecting your OB1 to the ESI software, we recommend to:

- check that the ESI version on your computer is the more recent. You can download the most recent version of the ESI software on the Elveflow website.
- refresh the ESI main window (Fig 21). If your OB1 has been previously added to the software, it should automatically appear. However, if not, a simple refresh of the software might solve the issue.

Fig 21. *Refresh the ESI window*

- start OB1 installation from scratch. This procedure is recommended when connection problems persist. Find the ConfigESI.ini and .log files (Fig 22) and erase them. These files are located in C: \ Users \ Public \ Documents \ Elvesys \ ESI \ data. Once the files have been deleted, start the addition of the OB1 to the software as explained in the “Add your OB1 to the ESI software” section.

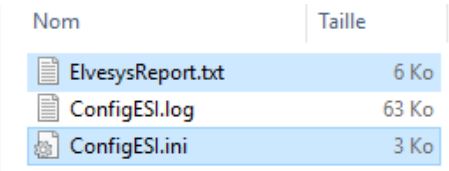


Fig 22. *ConfigESI files*

ESI messages after calibration

Instrument calibrated - Channel X: pressure too low

This means that the maximum pressure of your OB1 channel is not reached.

Solution:

- Check the pressure source connected to the OB1. It might be because the inlet pressure is not 0.5 bar above the maximum pressure of your OB1 ranges.
- Check all the connections and assess any potential leakages.
- Check that the power supply used with the OB1 is the one provided with the instrument (24V/1,5A).

Instrument calibrated - Channel X: Couldn't go below -600[1] mbar

This means that the negative pressure (vacuum) of your OB1 channel can not go below a certain value.

Solution:

- This issue might happen because your vacuum source is not powerful enough.
- Check that the vacuum source is connected to the OB1.

No pressure detected

This means that no pressure is entering your OB1 device.

Solution:

- Check the connection of the pressure source to the equipment.
- Check that the pressure source is on and delivering pressure.

8. Customer Support

You are welcome to browse through our online Elveflow Support Portal. You will find extensive information and guidance regarding all our product lines. It is very likely that the answers you are looking for can be found there. In case you have further questions or need clarification, please contact the support at customer@elveflow.com.

With the critical information readily available, the Elveflow Support team will be better able to help you.

The essential troubleshooting elements are:

1. The serial number of the Elveflow device(s) (Sensors, Instrument).
2. Screenshots of the error messages received, if applicable.
3. Pictures or movies of your setup and your issue. You can use WeTransfer to send us a big folder and files up to 2GB. Make sure to add the download link to your reply.

[1] Values may vary depending on your settings and equipment.

9. Kit fittings starter pack luer lock

You may have received a starter pack with your OB1 pressure controller (Fig 23).
It contains all the fittings and accessories you need to connect the OB1 pressure controller to a pressure / vacuum source and reservoirs. It is the perfect toolbox to help you set up your experiments.

Fig 23. *Kit Fittings starter pack luer*

Only some accessories are highlighted in this section as most of them have already been mentioned earlier in this user guide.

Pneumatic adapters

The kit includes a set of pneumatic adapters (Fig. 24) to easily connect the OB1 pressure controller to a pressure (or vacuum) inlet nozzle in a laboratory. The pneumatic Tee or Cross tube-to-tube adapters for 6 mm OD tubing divide the pressure to help you connect numerous equipment to a single pressure line.

Fig 24. *Pneumatic adapters*

Microfluidics flow resistances

A set of flow resistances is included in the pack, along with the microfluidic tubing cutter (Fig 25). When cutting the resistance tubings, ensure to make clean cuts in order to avoid clogging the tubings. To understand how to use this set of microfluidic flow resistances, please read the MFS and the flow control tuning guides.

Fig 25. *Set of flow resistances and the microfluidic tubing cutter*

Cleaning kit

To ease the cleaning steps, a syringe and its tip are included in the pack (Fig 26). Use this syringe to push manually rinsing solutions in your tubings and sensors for cleaning procedures.

Fig 26. *Syringe and tip*

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Technical support

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General information

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