

UNISWITCH™ SYRINGE SELECTOR

USER'S GUIDE

2/97

A-1871

Introduction

Syringe pumps are designed to deliver fluid from a mounted syringe at a constant flow rate by controlling the forward movement of the plunger. Consistent flow is required for microdialysis sampling experiments. Analytes diffuse across the dialysis membrane when a concentration gradient is formed between the fluid flowing inside a probe and the fluid on the exterior of the probe membrane. The rate of diffusion tracks the flow rate from the syringe pump. If flow is erratic, so is the rate of diffusion. This will become evident by variations in concentration of the analyte collected in the dialysate.

With these concepts in mind, it is clear that a syringe changeover during a microdialysis experiment is a serious event. If the pump is stopped while tubing from one syringe is moved to another syringe, the flow will also stop, causing a major disturbance in the dialysis gradient. Analyte recovery will be affected. When tubing is reattached, air will be introduced into the fluid stream. Air bubbles may become trapped against the interior of the dialysis membrane and impede recovery along the covered region of the membrane.

The UniSwitch was developed to allow a syringe change during microdialysis or other perfusion experiments without interrupting flow or introducing air bubbles into the system.

Applications

- Perfuse with fluid loaded in one syringe followed by changeover to different fluids in up to two additional syringes.
- Extend perfusion beyond the limit imposed by the syringe volume. Begin perfusion in one syringe and switch over to another as the first syringe empties (requires independent pumps at same flow, i.e. the BAS Bee with Hive controller). This application encourages the use of smaller syringe sizes for better pump performance without sacrificing perfusion time due to smaller volume.
- Flush void volume of system using a larger volume syringe then switch to a smaller, more accurate syringe for perfusion.

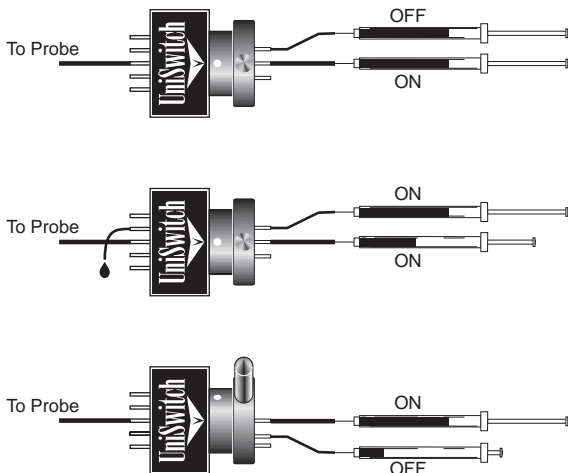


Fig. 1. The Neverending Perfusion. Syringes on two independent pumps are attached to the UniSwitch. As one syringe is emptied, the other waits in reserve. Before the first syringe is empty, the second pump is started to purge air from tubing and cannula. The switch is made to the second syringe without stopping flow. The first syringe is refilled and the cycle repeats.

Design

The inlet side of the UniSwitch has three stainless steel cannulas. These are connected to as many as three syringes mounted on one pump, or independent pumps.

The outlet side has five cannulas. The center of these five is routed to the destination device (probe, electrode, etc.). The pairs of cannulas on either side of the center cannula are normally used for waste.

Flow from each syringe is aligned with the center outlet cannula by pulling a lever on the UniSwitch. Figure 3 demonstrates the flow path of fluid from three syringes through the UniSwitch at each position setting. An alignment dot on the UniSwitch rotor indicates which syringe is being routed to the destination device.

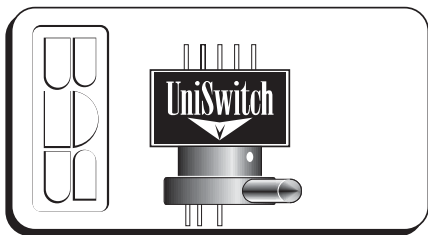


Fig. 2. The BAS UniSwitch.

Specifications

Inlet Cannula: 2.92 μ L

Outlet Cannula: 1.58 μ L

Dead Volume: 0 μ L

The UniSwitch is a zero-crossover device with no unswept volume.

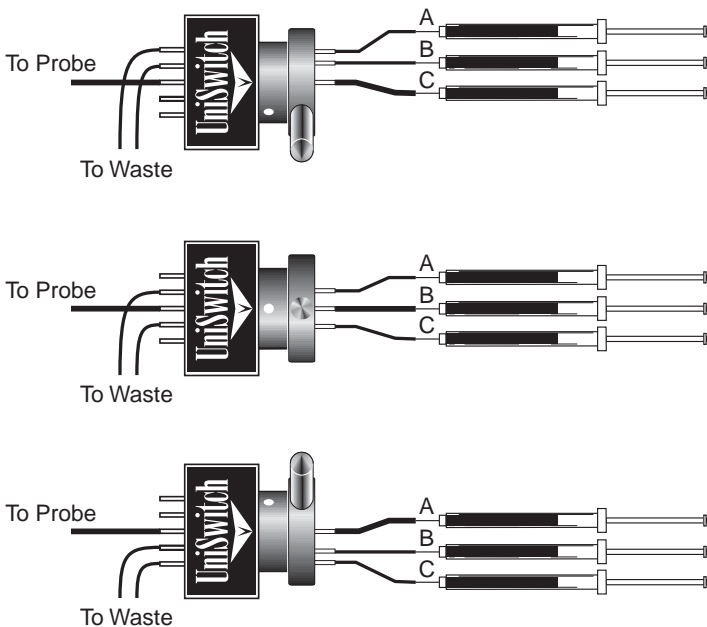


Fig. 3. Changing Perfusion Fluid with the BAS UniSwitch.

The UniSwitch was designed to allow a change of syringe during a perfusion without stopping flow and without removing fluid lines. In this illustration, the perfusion fluid is being delivered to a microdialysis probe. Three syringes are filled with different solutions. The syringes may be mounted on one syringe pump, or three independent pumps operating at the same flow rate.

If the syringes are mounted on the same pump, all three of them will deliver fluid through the UniSwitch. However, only one line will be connected to the probe, while the other two are routed to a waste vessel. The lever has three positions, which match the relative positions of the three syringes. To change to the fluid in another syringe, pull the lever to realign the cannulas.

If the syringes are mounted on three independent pumps, each pump should be started to ensure that the fluid lines through the UniSwitch are flushed free of air. The non-active pumps can then be turned off to conserve perfusion fluid and started again just before the lever is switched.

Operation

1. Remove the package containing FEP teflon tubing and flanged tubing connectors from the blue shipping box. Two meters of tubing are provided. Determine the desired length of tubing required to connect:
 - Each syringe to each inlet cannula
 - Center outlet cannula to destination device
 - Four waste cannulas to waste vessel

Example:

Normally the UniSwitch is located adjacent to the syringe pump, so the length of tubing required for this connection can be short, e.g. ≤ 20 cm. Three syringes would use $3 \times 20 = 60$ cm of tubing.

The destination device is a more important consideration. If 20 cm of tubing is used for the other 7 connections, 60 cm of tubing should remain for this connection. The void volume of the tubing is approx. $1.2 \mu\text{L}/10$ cm. Some attention should be paid to the fact that the remnants of the previous perfusion fluid will exist in this length of tubing after the syringe switch is made. In a 60 cm tube, this amounts to $7.2 \mu\text{L}$ of fluid. At a flow rate of $1 \mu\text{L}/\text{min}$, it will take 7.2 min. before the new fluid arrives at the destination device.

The waste vessel for the UniSwitch can be a small beaker or vial. Again, this is located adjacent to the UniSwitch. Tubing length is not critical and this connection is often made using leftover tubing. Usually pieces ≤ 20 cm are sufficient.

2. Cut tubing to desired length using a razor blade or sharp scalpel. Make a clean, blunt and perpendicular cut. **DO NOT USE SCISSORS!** Scissors squeeze tubing closed as they cut.

Always use clean, filtered solutions. Filtration with a 0.2 μm membrane filter is recommended for all solutions used in microdialysis sampling. Use BAS centrifugal microfilters (MF-5500) to filter up to 2 mL of fluid.

3. Load the filled syringes into the syringe pump(s). Arrange so that the syringe with normal perfusion fluid will be connected to the center cannula. Place syringes filled with enriched perfusion fluids on either side. Enrichments may include drugs, toxins, nutrients or other additives.
4. Connect the syringes to the three inlet cannulas using the flanged tubing connectors and FEP teflon tubing provided with the UniSwitch. Create connections with no gaps. The flanged connectors will stretch slightly as you place them over either the FEP tubing or the 23 gauge blunt-tip needles on the syringes. You should be able to coax the connector until a tight connection is made with no space between the tubing and syringe needle.

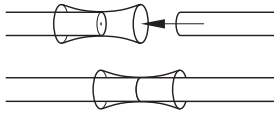


Fig. 4. Treat UniSwitch cannulas gently when connecting or removing tubing. Slide connectors parallel to cannula until the tubing touches the cannula end. Avoid bending.

5. Start the syringe pump(s). Fluid should flow from three of the outlet cannulas.
6. Holding the base of the UniSwitch with one hand, turn the steel lever with the other hand to a new dot position. If the white dot is aligned with the

arrow, turn the lever either all the way to the right or all the way to the left.

If the white dot is either to right or left of the arrow, turn the lever until the dot aligns with the arrow and you feel a light click through the lever arm.

7. Keep switching and checking fluid flow after each switch, according to the flow diagram in Figure 3. Stop the syringe pump.
8. Connect the destination device to the center of the five outlet cannulas using the procedure in step 2.
9. Connect the waste cannulas using the same procedure as step 2. The ends of the waste cannulas should drain into a small vial or beaker. Do not submerge the ends in waste fluid.
10. Turn the lever to align UniSwitch with the desired syringe. Start flow again. Check tubing connections and correct them if leaks are observed.

After Use

Immediately after use, **replace each syringe with a syringe filled with filtered, distilled water and flush the UniSwitch thoroughly.** During flushing, turn the lever to each position so that all five outlet cannulas are flushed. If the switch is not flushed thoroughly salt crystals will form as perfusion fluid evaporates. Salts can block cannulas or scratch inner seals.

Wipe away any spillage during and after use. Clean the exterior of the UniSwitch only by rinsing with distilled water. **Do not use alcohol or other solvents.**

Extended Storage

After flushing the UniSwitch and allowing it to dry, store the device in its original blue shipping box, using the foam insert provided. This will prevent damage to cannulas and keep the UniSwitch in a dust-free environment.

Warranty

The UniSwitch is warranted for a period of 6 months after the initial shipping date by Bioanalytical Systems Inc. (BAS) against defects in material or workmanship. BAS is liable only to the extent of replacement of defective items for claims registered within 30 days of the shipping date. BAS will not be liable for any personal injury, property damage, or consequential damages of any kind whatsoever arising from the use of the UniSwitch. This warranty does not cover damage to inner seals or cannulas through lack of proper maintenance or inappropriate handling by the user. The foregoing warranty is in lieu of all other warranties expressed or implied but not limited to the implied warranties of merchantability and fitness for a particular purpose.

Ordering Information

- | | |
|---------|--|
| MD-1508 | UniSwitch Syringe Selector, includes 2 meters of FEP tubing and 12 flanged tubing connectors |
| MF-5164 | FEP Teflon Tubing, 0.65 mm OD x 0.12 mm ID, clear, 1 meter |
| MF-5366 | PEEK Tubing, 0.65 mm OD x 0.12 mm ID, tan, 1 meter |
| MD-1510 | Flanged Tubing Connectors, 20/pkg. |

Note: FEP tubing is most commonly used for connections. PEEK tubing offers an alternative material which is less flexible but also less oxygen-permeable than FEP.

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