Safety sheet

- Read the manual and this safety sheet. If safety sheet or manual is not available, request these documents at support@futurechemistry.com.
- The FlowStart is not designed, intended, or authorized for use in applications or as system components intended to support or sustain human life, as a clinical medical device for humans, or as a device in food or pharmaceutical applications.
- The FlowStart may be used and operated only by trained and skilled personnel capable of handling laboratory equipment and chemical material.
- During operation, surfaces of microreactor and temperature block may be hot. Before touching any of these parts, first switch off the system and wait for 10 minutes.
- During operation, make sure enough room for ventilation is present around all parts of the FlowStart. A minimum of 10 cm in all horizontal directions and above the parts is required.
- Always connect the temperature controller to a grounded AC power outlet using the cable provided.
- Disconnect power from the pumps and the temperature controller when connecting or disconnecting cables.
- Do not immerse the system, or any part of it, in liquid.
- Install system on a stable surface.
- Keep hands and loose clothing away from the pumps’ moving parts, the fan of the temperature block and the fan of the temperature controller.
- Keep fingers away from the product, microreactor and all other parts when the system is operating. Some surfaces become very hot during operation.
- Prevent liquids from entering openings in the temperature block, the temperature controller and the rear of the pump.
- Use only with the supplied power supplies connected to a power source as specified on the power supply label.
- Do not push objects of any kind into the chassis openings of any part of the system, except for appropriate cables and connectors to their designed and intended positions.
- When flow rates are set too high, pressure build up at the pumps may surpass the specification of the glass syringes (700 kPa). Please take notice of the following table with examples of liquids, their corresponding viscosities, flow rates and expected pressures, and never exceed pressure limits. If you need syringes with higher pressure ratings, FutureChemistry can supply them to you.
- The FlowStart is intended for use with chemical materials. Only use chemical compounds and other materials of which you are familiar with any safety precautions. Use this system with the same precautions as any other laboratory equipment intended to handle hazardous material. Be aware of the combination of hot surfaces and possible leaking combustible liquids; this can result in a fire. When a leak is suspected, immediately stop the FlowStart, clean the microreactor, fluidic parts and holder.
- When handling parts of the FlowStart and microreactors, be aware of chemical contamination. Always wear protective clothing for assembling, handling, operating, disassembling, cleaning and servicing the FlowStart or any related parts.
User’s Guide

This section of the FlowStart Support contains instructions for practical use of the FlowStart B-300, intended for common users like laboratory staff and students.

Key Features of B-300 FlowStart Education:

- User friendly, leak-free microfluidic connections
- Easy microreactor replacement thanks to the microreactor holder and cartridge
- Chemically inert materials (including connectors, tubing and microreactors)
- Large microreactor area to facilitate microscopic observations
- Package includes pumps, syringes and tubing for immediate start-up
- Accurate built-in temperature control for temperatures between 0° and 90°C

The FlowStart B-300 is designed to be a modular “plug-'n-play” system. Though straightforward in use, caution is advised for first-time users. Please read the documented User’s Manual first, on how to get started with FlowStart. Please consult the troubleshoot for additional support on operation of the FlowStart. If, however, any questions or problems are encountered, despite the instructions and tips supplied, please contact your inbound FlowStart Operator.

Information for FlowStart operators and instructors is filed under section 2 “Operator’s Guide”. Please ensure that content of the user’s guide is available to FlowStart B-300 users.
FlowStart - Practical Guide

Before using the FlowStart

1) Make sure that the FlowStart is installed on a stable surface and connected to the power supply.
2) Check if the correct microreactor has been placed into the holder and if all tubing is connected.*
3) Check the internal diameter settings of the syringes on the pumps by pressing [Diameter].*
4) Rinse the FlowStart for 10 minutes by filling every syringe with the desired solvent and set the flow rate of each pump at 15 μL/min.
5) Start your flow chemistry experiment.

* See FlowStart Support User’s Manual for operation details

After using the FlowStart

1) Set the temperature into the controller to 25 °C.
2) Rinse the FlowStart for 10 minutes by filling every syringe with the desired solvent and set the flow rate of each pump at 15 μL/min.
3) Check if fluid is observed near or around the ferrules due to a leaking fluidic connection and if necessary clean the microreactor and ferrules.
4) Turn off the temperature controller and pumps.

Plug ‘N Play:

Step 1: Insert microreactor
Step 2: Connect Tubing
Step 3: Start your flow chemistry
Smart, safe and clean chemistry

FlowStart B-300

User’s Manual
Revision: 2.03
Date: July, 2010
Introduction

In this manual, the operation of the B-300 FlowStart Education will be discussed step by step. Make sure the FlowStart B-300 is installed according to the installation guide describe in the Operator’s Manual. Keep these installation instructions handy for future reference.

1.1 Syringe Connection

To avoid air (bubbles) accumulating in the FlowStart system it is important to establish an air-free connection, which takes the following steps:

1. **Syringe filling**
   Fill each syringe with the desired liquids. Hold the syringe vertically and retract the plunger to extend the air bubble at the top. Then, retrieving any leaking liquids, purge the plunger so that all air is removed from the syringe (figure 4.1).

   ![Figure 4.1: Remove air from syringe](image)

2. **Syringe connecting**
   To make an air-free connection between tubing and syringe, connect the syringes to the appropriate PEEK connectors and fill the adapter piece with the used solution by pressing some droplets out of the syringe and connecting the syringe to the adapter (figure 4.2).

   ![Figure 4.2: Placing of few droplets in syringe adapter before making the connection](image)
1.2 Loading Syringes

After the syringes have been filled with the desired liquid, load them into the pumps by the following steps:

- Retract the pump slider (1) by pushing the white button (2) and sliding it to the left.
- Retract the fine adjustment by screwing the adjustment bolt (3) clockwise.
- Open the syringe clamp (4) by pulling it and rotating it by 90°.
- Place the syringe barrel on top of the pump.
- Replace the syringe clamp (4).
- Move the pump slider (1) to the right so that it makes contact with the syringe.
- Make a final adjustment by screwing the adjustment bolt (3) counter clockwise.

1.3 Pump Settings

Switch on the pumps using the on/off switch at the backside of the pump. To make good use of the pump check and set the correct parameters into both pumps by the user interface (figure 4.3)

1. Number input

Values displayed on the LCD of the pump can be changed by using the arrow keys (1 to 4) shown in figure 4.3. To change the position of the decimal indicator, press and hold the left arrow button (1). After the left digit passed ‘9’, the decimal indicator will start to shift. Release the button when the decimal has reached the desired position.

2. Syringe Diameter

The pump is preprogrammed for the 1 mL glass syringes as supplied with the pump module. Check the syringe diameter by pressing the [Diameter] button (7). The diameter should be 4.607 mm for the supplied 1 mL glass syringe. If this is not correct or you wish to use different syringes, change the diameter setting by pressing the [Diameter] button (7). Note: diameter can only be changed when the pump is not running.
3. **Flow Rate**
   The current flow rate setting can be displayed and changed by pressing the [Rate] button (5) once. The LEDs display the current flow rate unit (e.g. μL/min). The flow rate unit can be set by pressing the [Rate] button (5) for a second time and repeatedly pressing the right arrow button (4) to cycle through the different units possible.

4. **Pump Mode**
   The pump can be used either to infuse and to withdraw liquids. For microreactor applications, generally only infusing is used. Make sure the withdraw LED on the pump interface is not lit. When it is, press the ‘pump mode’ [ ] button (8) to switch back to infuse mode.

5. **Start / Stop**
   To start and stop the pump, press the [Start] button. When the pump is running the pumping LED is lit continuously. When the pump is off or paused the LED is off or blinking, respectively.

1.4 **Temperature Controller**
   Place the temperature block and controller on a stable surface. To operate the temperature controller and set the desired values, please follow the next steps:

1. **Ventilation**
   Make sure that on the left and right side of the module, a free space of at least 20 cm is present to enable ventilation (figure 4.4). Subsequently switch on the temperature controller using the on/off switch on the back side of the controller (figure 4.5). Wait a few seconds until the controller has initialized.

   ![Figure 4.4](image_url) **Figure 4.4:** Leave enough room for ventilation
   ![Figure 4.5](image_url) **Figure 4.5:** Backside of the temperature controller

   - **WARNING** —

   **CAUTION:** Leave enough room for ventilation around the temperature block!

2. **Temperature**
   The temperature controller has been preprogrammed and set at 25 °C. Settings of the controller can be changed by the user interface (figure 4.6). The set point of the temperature can be changed by first pressing and hold the ‘set’ button (4) for three
seconds. The set point temperature will be displayed. Next use the ‘lamp’ button (1) to select a digit, and the push either the ‘up arrow’ button (2) or ‘down arrow’ button (3) to change the value of the blinking digit. Press the ‘set’ button (4) once more to constitute the set point temperature. The ‘set’ button (4) must be pressed to store the new set point; otherwise, the controller will revert to the previous set point.

![User Interface of the temperature controller](image)

Figure 4.6: User Interface of the temperature controller

- WARNING -

Keep fingers away from the product, microreactor and all other parts when the system is operating. Some surfaces become very hot during operation.

Keep hands and loose clothing away from the fan of the temperature block and the fan of the temperature controller.
Troubleshoot

1. I cannot set the correct flow rate, because it does not fit in the pump’s display
   You can change the position of the decimal separator by pressing and holding the left most arrow button. After reaching a value of 9, the decimal will start to shift. When it has reached the desired position, release the button.

2. How to avoid air (bubbles) in the FlowStart
   To avoid air (bubbles) accumulating in the FlowStart system:
   - Make all syringes air-free. This is done by filling every syringe with the desired solution and pointing it upwards (figure 6.1). Next, tap the syringe’s side to displace all bubbles to the top. Then press out some of the solution until a small droplet is formed (figure 6.2).

   ![Figure 6.1: Remove air from syringe](image1.png)  ![Figure 6.2: Placing of few droplets in syringe adapter before making the connection](image2.png)

   - Apply all fluidic connections by placing the microreactor into the microreactor holder and connecting the inlet and outlet tubing to the microreactor. To make an air-free connection between tubing and syringe, connect the tubing to the adapter piece and fill the adapter piece with the used solution by pressing some droplets out of the syringe and connecting the syringe to the adapter.

3. The pumps are running, but no outlet flow is observed
   At very low flow rates, stabilisation of flow and pressure may take a long time (up to 30 minutes at flow rates below 1 μL/min). To calculate the minimum stabilisation time, the following rule of thumb can be used:

   \[
   \text{Stabilisation time} = 3 \times \frac{\text{Reactor Volume}}{\text{Total Flow Rate}}
   \]

   Total Flow Rate = the combined flow of all inlets except quench flow

   - First check on the pump that [Withdraw] mode is not enabled. Next, check if there is a potential leak in the FlowStart system. A leak can occur on several places:
   - Between syringe and plunger (figure 6.3). Check whether fluid is present behind the plunger or in the plunger’s ribs. Syringe leakage may occur when not fully-dried syringes are used. To avoid this, empty syringe, clean barrel and plunger first with water, then with acetone, and dry thoroughly. If still leaking, replace syringe.
• In the connection of syringe with tubing (figure 6.4). If droplets are observed at the bottom of the adapter piece or at the point where the tubing leaves the connector, carefully tighten both adapter and connector.

• In the connection of tubing with microreactor chip. If fluid is observed near or around one of the flat-bottom ferrules (figure 6.5) the connection is either too loose or too tight. Disconnect the leaking ferrule and reconnect by hand until a firm connection is made. If still leaking, remove reactor from microreactor holder, clean microreactor and all connections in an ultrasound bath (use solvent such as acetone, do not use chlorinated hydrocarbons), reassemble and tighten the connection slightly with the extender tool. If the connection is still leaking, the sealing may be worn out. In that case, replace the fitting and tubing (see section 3.4).

4. One of the pumps displays StaL or solution from one syringe enters the other syringe
In either of these cases, the back pressure of the system has become too high. The pump may stop because the forces are too high, or backflow from one inlet into the other might occur. If not, there probably is too much backpressure. Possible causes are:
• The flow rate is set too high. Decrease flow rate and try again. Maximum usable flow rate is microreactor-dependent.
• The tubing is clogged. Rinse tubing with acetone by connecting the tubing (without microreactor) to a syringe with subsequent manual purging.

• The microreactor is clogged. Disconnect all tubing from the chip and remove the slider from the microreactor holder. Clean the microreactor in an ultrasound bath for 30 to 45 minutes, with a solvent best suitable to dissolve any solid particles. If still clogged, replace the microreactor.

5. **The pump suddenly stops pumping, without displaying St.a.L**
   Check if the pump is connected to the power supply and the switch at the back is switched on. A maximum dispensable volume might be enabled. Press [Volume] and set to 0. Now, dispensing will continue until stopped manually (or at the end of the plunger stroke).

6. **The observed flow rates do not correspond to the set flow rates**
   A mismatch between the set and observed flow rate can have several possible causes:
   - Syringe diameters might be set to wrong values. Press [Diameter] and set to correct value (standard 1 mL glass syringe: 4.607).
   - There is a (minor) leak in the system. If this is indeed the case, follow the instructions to avoid leakage (please refer to question 3).
   - Back pressure is too high. Please refer to question 4.

7. **I cannot change the set temperature of the temperature controller**
   To reach the setting menu of the temperature controller, press and hold the [SET] button for three seconds. Set the temperature to the desired value by pressing the arrow buttons and pressing the [SET] button.

8. **The set temperature cannot be reached**
   The FlowStart system is designed for a temperature range of 0 - 90 C. Although the temperature controller can be set to temperatures beyond this range, this will rapidly wear out the conditions of the thermoelectric elements, used in the temperature block. When the elements are worn out too much, the actual temperature range will decrease. FutureChemistry can replace the elements, but they do not fall under guarantee if temperatures beyond specifications have been used. Two other reasons for the system not being able to reach the desired temperature are wrong voltage setting and changing the controllers PID settings by accident. To change these:
   - Voltage: keep the voltage selector at the back of the temperature controller at 7V.
   - PID settings: please refer to the Melcor MTC-1410 User Manual. PID settings used for the FlowStart are: P: 2, I: 2, D: 8. The C value (calibration) is set for each product individually and should not be changed. If the system is out of calibration, please contact FutureChemistry.

If reconfiguring the controller does not solve your problem, there might be an electrical problem or the thermoelectric elements have been worn out. Please contact FutureChemistry.

**- WARNING -**

**CAUTION: Do not change the voltage selector, leave it at 7 V**
9. The microreactor is clogged

- Solution 1: Try to run a solvent (see 10) through the system that is able to dissolve the solid particles. Fill the syringes with this solvent and set the pumps to 25 µL/min. If no solvent goes through the system, try to use a higher flow rate (max. 100 µL/min) in order to increase the pressure on the system. If this still doesn’t work, use a different solvent (see 10) and try again.
- Solution 2: Try to run the solvent through the FlowStart backwards using the outlet port as inlet.
- Solution 3: Disconnect all tubing from the microreactor holder and remove the microreactor from the holder. Clean the microreactor in an ultrasound bath for 30 to 45 minutes, with a solvent best suitable to dissolve any solid particles. Water/isopropanol is a good start.

10. How to choose a solvent in order to unclog the microreactor?

- First, try the solvent you used in your reaction.
- Second, try a solvent that dissolves salts (in a lot of cases, clogging is due to salt formation), like water, methanol, ethanol, isopropanol/water, acetonitrile.
- If this still doesn’t work, try acetone and dichloromethane.
- If there is still clogging, try (concentrated) acids (hydrochloric, sulfuric, acetic) and diluted sodium hydroxide. This should solve most clogging problems. In case you used an acid or base solution, rinse the system extensively with water after successful cleaning.
M-111 Basic Microreactor

Technical Specifications

Microreactor

The basic microreactor is designed for general two component chemical reactions. The basic microreactor is compatible with the FlowStart and FlowScreen and is supplied in a green cartridge for easy handling. This microreactor type is the most basic and consist of two inlets with a mixing unit, followed by a long channel compartment.

Channel Lay-out

The channel layout is shown in Figure 1. The basic microreactor consist of two inlets which are located on the left side of the microreactor, the outlet is situated at the right side. Please note that the channels in this drawing are schematic in two dimensions; the actual channel geometry is in three dimensions and cannot be represented by this scheme.

![Figure 1: Schematic view Basic Microreactor channel lay-out](image)

Specifications

<table>
<thead>
<tr>
<th>M-111 Basic Microreactor</th>
</tr>
</thead>
<tbody>
<tr>
<td>Outer dimensions</td>
</tr>
<tr>
<td>Material</td>
</tr>
<tr>
<td>Top diameter hole</td>
</tr>
<tr>
<td>Bottom diameter hole</td>
</tr>
<tr>
<td>Channel width (maximum)</td>
</tr>
<tr>
<td>Channel depth</td>
</tr>
<tr>
<td>Effective reaction volume</td>
</tr>
</tbody>
</table>
M-121 Basic Quench Microreactor

Technical Specifications

Microreactor

The basic quench microreactor is suited for general two-component chemical reactions, mixing and quenching. The basic quench microreactor is compatible with the FlowStart and FlowScreen and is supplied in a green cartridge for easy handling. This microreactor type consist of three inlets and a long channel compartment. The addition of a third inlet after the long channel compartment enables you to quench the reaction that takes place inside the microreactor.

Channel Lay-out

The channel layout is shown in Figure 1. The basic quench microreactor consist of three inlets. Two inlets are located on the left side of the microreactor, the third inlet and outlet are situated at the right side. Please note that the channels in this drawing are schematic in two dimensions; the actual channel geometry is in three dimensions and cannot be represented by this scheme.

Specifications

<table>
<thead>
<tr>
<th>M-121 Basic Quench Microreactor</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Outer dimensions</td>
<td>45.3 x 15.3 x 2.2 mm</td>
</tr>
<tr>
<td>Material</td>
<td>Borosilicate glass</td>
</tr>
<tr>
<td>Top diameter hole</td>
<td>300 μm</td>
</tr>
<tr>
<td>Bottom diameter hole</td>
<td>1170 μm</td>
</tr>
<tr>
<td>Channel width (maximum)</td>
<td>600 μm</td>
</tr>
<tr>
<td>Channel depth</td>
<td>500 μm</td>
</tr>
<tr>
<td>Effective reaction volume</td>
<td>92 μL</td>
</tr>
</tbody>
</table>
M-131 Short Quench Microreactor

Technical Specifications

Microreactor

The short quench microreactor pack suited for high reactive two-component chemical reactions, quenching and mixing. The short quench microreactor is compatible with the FlowStart and FlowScreen and is supplied in a green cartridge for easy handling. This microreactor type consist of three inlets and a short channel compartment. The addition of a third inlet after the long channel compartment enables you to quench the reaction that takes place inside the microreactor.

Channel Lay-out

The channel layout is shown in Figure 1. The short quench microreactor consist of three inlets. Two inlets are located on the left side of the microreactor, the third inlet and outlet are situated at the right side. Please note that the channels in this drawing are schematic in two dimensions; the actual channel geometry is in three dimensions and cannot be represented by this scheme.

![Figure 1: Schematic view Short Quench Microreactor channel lay-out](image)

Specifications

<table>
<thead>
<tr>
<th>M-131 Short Quench Microreactor</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Outer dimensions</td>
<td>45.3 x 15.3 x 2.2 mm</td>
</tr>
<tr>
<td>Material</td>
<td>Borosilicate glass</td>
</tr>
<tr>
<td>Top diameter hole</td>
<td>300 μm</td>
</tr>
<tr>
<td>Bottom diameter hole</td>
<td>1170 μm</td>
</tr>
<tr>
<td>Channel width (maximum)</td>
<td>120 μm</td>
</tr>
<tr>
<td>Channel depth</td>
<td>50 μm</td>
</tr>
<tr>
<td>Effective reaction volume</td>
<td>1 μL</td>
</tr>
</tbody>
</table>
# Table of contents

1. INTRODUCTION ............................................................................................................................... 3
   1.1 WARNINGS ................................................................................................................................. 4
   1.2 DISCLAIMER ............................................................................................................................... 5
   1.3 WARRANTY ................................................................................................................................. 5

2. PART LIST B-300 FLOWSTART EDUCATION ............................................................................... 7

3. INSTALLATION GUIDE.................................................................................................................... 8
   3.1 STEP 1: PARTS CHECK ............................................................................................................... 8
   3.2 STEP 2: POWER CONNECTION .............................................................................................. 8
   3.3 STEP 3: PLACEMENT OF THE MICROREACTOR ................................................................. 10
   3.4 STEP 4: FLUIDIC CONNECTION ........................................................................................... 10

4. OPERATION GUIDE .......................................................................................................................... 12
   4.1 STEP 1: SYRINGE CONNECTION ........................................................................................... 12
   4.2 STEP 2: LOADING SYRINGES ............................................................................................... 13
   4.3 STEP 3: PUMP SETTINGS ....................................................................................................... 13
   4.4 STEP 4: TEMPERATURE CONTROLLER ............................................................................... 14
   4.5 START YOUR FLOW CHEMISTRY EXPERIMENT ................................................................ 15

5. MAINTENANCE GUIDE ...................................................................................................................... 16
   5.1 AFTER USE ............................................................................................................................... 16
   5.2 MAINTENANCE OF THE FLOWSTART ................................................................................. 16

6. TROUBLESHOOT ............................................................................................................................... 17

7. SPECIFICATIONS .............................................................................................................................. 21

8. DECLARATION OF CONFORMITY ................................................................................................. 22

9. INDEX .................................................................................................................................................. 23

10. NOTES ................................................................................................................................................ 24
1 Introduction

Congratulations with purchasing the B-300 FlowStart Education. With the FlowStart, you can start working with flow chemistry at your university today. We want to get you starting as quickly and easily as possible, and therefore provide you with this operators manual. If, however, you have any questions and problems despite the instructions and tips, don’t hesitate to contact us.

This manual describes the installation and use of the FlowStart B-300 and contains:

- the installation of the microreactor
- the installation of the inlet and outlet module
- the installation of the pumps
- the installation of the temperature controller
- operation of the complete system

Please familiarize yourself with the FlowStart B-300’s operation by reading this manual. For future reference, record the serial numbers, located at front of the FlowStart temperature block, and the date of purchase.

The FlowStart B-300 is designed, intended and authorized solely for chemical R&D purposes, and not for use on humans.

FutureChemistry Holding BV can be contacted at:

Toernooiveld 100
6525 EC Nijmegen
The Netherlands
Phone: +31 24 711 4029
Fax: +31 24 890 1446
E-mail: support@futurechemistry.com
Web: www.futurechemistry.com

Copyright 2010, all rights reserved.
1.1 Warnings

Warnings:

- Read the safety sheet and this operator’s manual. If safety sheet or manual is not available, request these documents at support@futurechemistry.com.
- The FlowStart is not designed, intended, or authorized for use in applications or as system components intended to support or sustain human life, as a clinical medical device for humans, or as a device in food or pharmaceutical applications.
- Disconnect static from control cables before connecting by touching the cable to ground.
- Before touching the pump, discharge static by touching ground.
- During operation, surfaces of microreactor, microreactor and temperature block may be hot. Before touching any of these parts, first switch off the system and wait for 10 minutes.
- During operation, make sure enough room for ventilation is present around all parts of the FlowStart. A minimum of 10 cm in all horizontal directions and above the parts is required.
- Always connect the Temperature controller to a grounded AC power outlet using the cable provided.
- No user serviceable parts are inside.
- Disconnect power from the pumps and the temperature controller when connecting or disconnecting cables.
- Do not immerse the system, or any part of it, in liquid.
- Install system on a stable surface.
- Keep hands and loose clothing away from the pumps’ moving parts, the fan of the temperature block and the fan of the temperature controller.
- Keep fingers away from the product, microreactor and all other parts when the system is operating. Some surfaces become very hot during operation.
- The pumps can automatically start when the Pumping Program is operating or when attached to an external control device.
- Prevent liquids from entering openings in the temperature block, the temperature controller and the rear of the pump.
- Use only with the supplied power supplies connected to a power source as specified on the power supply label.
- Do not push objects of any kind into the chassis openings of any part of the system, except for appropriate cables and connectors to their designed and intended positions.
- If any part of the system becomes damaged, do not use unless repaired or certified safe by manufacturer. Damage includes, but is not excluded to, frayed cords and deterioration in performance.
- Do not set the controller to temperatures exceeding the limit of 100 °C. By ignoring this warning and setting the controller to a temperature exceeding 100 °C, the lifetime of the Peltier elements are dramatically reduced. The lifetime of the Peltier elements are guaranteed for three months; they can be replaced by FutureChemistry.
- Do not change the voltage selector, leave it at 7 V.
• This system is intended to be used for microreactors with the fluidic channels having extremely small diameters, therefore only homogeneous liquids should be used to prevent clogging. Only use homogeneous liquids for flow chemistry, and filtrate liquids before supplying them to the reactor. Also make sure that no solid particles form during reactions within the microreactor.

• When flow rates are set too high, pressure build up at the pumps may surpass the specification of the glass syringes (700 kPa). Please take notice of the following table with examples of liquids, their corresponding viscosities, flow rates and expected pressures, and never exceed pressure limits. If you need syringes with higher pressure ratings, FutureChemistry can supply them to you.

• The FlowStart is intended for use with chemical materials. Only use chemical compounds and other materials of which you are familiar with any safety precautions. Use this system with the same precautions as any other laboratory equipment intended to handle hazardous material. Be aware of the combination of hot surfaces and possible leaking combustible liquids; this can result in a fire. When a leak is suspected, immediately stop the FlowStart, clean the microreactor, fluidic parts and microreactor holder.

• When handling parts of the FlowStart and microreactors, be aware of chemical contamination. Always wear protective clothing for assembling, handling, operating, disassembling, cleaning and servicing the FlowStart or any related parts.

1.2 Disclaimer

FutureChemistry Holding BV makes no representations or warranties, expressed, statutory or implied, regarding the fitness or merchantability of this product for any particular purpose. Further, FutureChemistry Holding BV is not liable for any damages, including but not limited to, lost profits, lost savings, or other incidental or consequential damages arising from ownership or use of this product, or for any delay in the performance of its obligations under the warranty due to causes beyond its control. FutureChemistry Holding BV also reserves the right to make any improvements or modifications to the product described in this manual at any time, without notice of these changes. FutureChemistry Holding BV products are not designed, intended, or authorized for use in applications or as system components intended to support or sustain human life, as a clinical medical device for humans, or for any application in which the failure of the product could create a situation where personal injury or death may occur. All brand and product names used in this manual are the trademarks of their respective owners.

1.3 Warranty

FutureChemistry Holding BV’s FlowStart B-300 adheres to the highest quality standards and is free from defects in material, components and workmanship. This warranty covers repair or replacement of product, performed by FutureChemistry only, for a period of one (1) year from date of shipment. Customer is responsible for shipping product to FutureChemistry Holding BV freight prepaid. FutureChemistry Holding BV in turn will return the warranted product to customer freight prepaid, if within the period specified above. A return authorization number must be obtained from FutureChemistry Holding BV before returning a unit for repair. Warranty covered repairs will not be
performed without a return authorization number. Warranty coverage is in effect when the following operating conditions are continuously satisfied:

- Ambient temperature range is kept within 18 °C (60 °F) to 30 °C (86 °F).
- Operating microreactor temperature is kept within 0 °C (32 °F) to 90 °C (194 °F).
- Operating power for the Peltiers elements (voltage selector at the back of the Temperature Controller) is kept at 7 V.
- Working pressure is kept below 7 bar (100 psi).
- Line Voltage variation is kept within plus or minus 10% of nameplate rating.
- The temperature block is powered only by the supplied temperature controller power supply unit.
- The temperature controller is used only to power the temperature block.
- The FlowStart is used and operated only by trained and skilled personnel capable of handling laboratory equipment and chemical material

In addition, the following criteria must be met:

- Electrical installation and grounding must comply with local electrical and safety codes.
- Customer cannot abuse or mishandle the product in any way. Any modifications to the original unit will also void warranty.
- Compliance to user manuals or any other instructional guide provided by FutureChemistry Holding BV for the product.

The warranty does not cover damage by any cause including, but not limited to:

- Applications where product is being misapplied.
- Any malfunction, defect or failure caused by or resulting from unauthorized service or parts, improper maintenance, operation contrary to furnished instructions.
- Repair by the user, harsh environments, misuse, neglect, abuse, accident, fire, flood, other natural disasters, or normal wear and tear.
- Changes or modifications not approved by FutureChemistry Holding BV.
- Damages caused by shipping carrier or any other accident after product has left FutureChemistry Holding BV. Shipping claims are the responsibility of the customer and are to be completed in a timely manner.
- Reimbursement of labor for installation or removal of warranted product, or for parts and labor resulting from repairs performed by any other source besides FutureChemistry Holding BV.

This is the complete warranty and is in lieu of any other warranty expressed or implied, included but not limited to any implied warranty of merchantability or fitness for a particular purpose. FutureChemistry Holding BV will in no way be liable for incidental or consequential damage whatsoever or for any other claims by the customer for damages in connection with FutureChemistry Holding BV products, even if advised in advance of the possibility of such damage.
## 2 Part list B-300 FlowStart Education

<table>
<thead>
<tr>
<th>Qty</th>
<th>SKU</th>
<th>Product name</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>B-220</td>
<td><strong>Temperature Module</strong> including:</td>
</tr>
<tr>
<td></td>
<td></td>
<td>1 x B-222 FlowStart Temperature Block</td>
</tr>
<tr>
<td></td>
<td></td>
<td>1 x B-223 Temperature Controller</td>
</tr>
<tr>
<td>3</td>
<td>B-230</td>
<td>Pump Module</td>
</tr>
<tr>
<td>3</td>
<td>B-241</td>
<td>Inlet Module</td>
</tr>
<tr>
<td>3</td>
<td>B-242</td>
<td>Glass Syringe (1 mL)</td>
</tr>
<tr>
<td>1</td>
<td>B-243</td>
<td>Outlet Module</td>
</tr>
<tr>
<td>1</td>
<td>B-244</td>
<td>Collection Flask (50 mL)</td>
</tr>
<tr>
<td>1</td>
<td>B-246</td>
<td>Microreactor Holder</td>
</tr>
<tr>
<td>3</td>
<td>B-247</td>
<td>Glass Syringe (5 mL)</td>
</tr>
<tr>
<td>1</td>
<td>B-262</td>
<td>Extender Tool</td>
</tr>
<tr>
<td>1</td>
<td>M-140</td>
<td>Microreactor Starterspack</td>
</tr>
</tbody>
</table>

The list above is subject to modification without notice by FutureChemistry.
3 Installation Guide

In this section, the installation of the FlowStart B-300 will be discussed step by step. Read these installation instructions carefully before using the FlowStart B-300. Follow the applicable safety instructions described below. Keep these installation instructions handy for future reference.

3.1 Step 1: Parts Check

Check the part list on page 8 to see if all the parts are included. If the supplied FlowStart B-300 is not corresponding to the part list, please contact us at support@futurechemistry.com. Place all parts on a stable surface.

![Figure 3.1: All parts of the FlowStart displayed separately](image)

3.2 Step 2: Power Connection

The FlowStart B-300 can be connected to AC power outlet 110-120 V or 220-240 V, 50-60 Hz with the supplied plug. Power connection will be established by the following steps:

![Figure 3.2: Rear view of the syringe pump](image)
1. **Pump**
   The FlowStart B-300 is supplied with three syringe pumps. Connect all pumps to a grounded AC power outlet by plugging the round connector end of the power supply adapter into the power plug located on the lower right of the pump’s rear (figure 3.2).

2. **Temperature Controller**
   The FlowStart B-300 is supplied with a B-223 Temperature controller. Make sure that the temperature block is placed on a stable surface. Connect the controller to a grounded AC power outlet using the supplied AC power cable (figure 3.3). Before switching the controller on carry out the following steps:
   - Check the setting of the Voltage selector. The voltage selector should be set at 7 V and is sealed. Other voltages will impede proper functioning and will damage temperature block. FutureChemistry cannot be held liable for damage due to incorrect voltage settings and warranty on the Peltier elements void when the seal is broken.

   ![Figure 3.3: Backside of the temperature controller](image)
   ![Figure 3.4: Connecting temperature block power plug](image)

   - Connect the temperature controller to the temperature block by connecting the two metal plugs. The plugs only fit in one way. After making the connection, secure it by screwing the metal outer shells (figure 3.4). Make sure that on the left and right side of the module, a free space of at least 20 cm is present to enable ventilation.

   **- WARNING -**

   **CAUTION:** Do not change the voltage selector, leave it at 7 V!
   **CAUTION:** Leave enough room for ventilation around the temperature block!
3.3 Step 3: Placement of the Microreactor

The user-friendly design allows the user to slide the microreactor into the microreactor holder over the Peltier element (figure 3.5).

![Figure 3.5: Sliding the microreactor into the microreactor holder](image)

Slide in the microreactor into the holder with the arrow on the microreactor cartridge first and make sure that the FutureChemistry logo is facing upwards as shown below (figure 3.6).

![Figure 3.6 Schematic view of a microreactor in green cartridge](image)

3.4 Step 4: Fluidic Connection

Now the fluidic connections can be made. The FlowStart B-300 is supplied with one outlet module and each pump module includes one inlet module.

1. **Visual check**
   Check if the compression ring and ferrule are still in good condition as shown in figure 3.7. Over time, the ferrule may wear out due to mechanic stress and heat. Replacement tubing with connectors may be ordered using the order form. The order form can be found in the FlowStart Support (section 4).

![Figure 3.7: Fitting in good condition](image)  
![Figure 3.8: Tightening the connections](image)

2. **Fluidic connections**
   Apply all fluidic connections by connecting the inlet and outlet tubing to the microreactor by the following steps:
• Screw in the fittings loosely in the appropriate fluidic ports. Connect the inlet modules through the microreactor holder with the inlet ports of the microreactor, the outlet tubing is placed at the outlet port. In order to specify which ports of microreactor holder to use, please consult specification sheet of the microreactor in the FlowStart Support (section 1)
• After placing the fittings, they must be tightened “finger tight”: you should twist the connection with the tip of your thumb and index finger from the side (not from the top), until it resists too much to twist any further.
• After finger tightening, tighten the fittings by turning them another quarter by using the Extender Tool (figure 3.8).

- WARNING -

CAUTION: Do not over tighten the fittings; this might damage the microreactor!
4. Operation Guide

In this section, the operation of the B-300 FlowStart Education will be discussed step by step. Make sure the FlowStart is installed according to the installation guide describe in section 3. Keep these installation instructions handy for future reference.

4.1 Step 1: Syringe Connection

To avoid air (bubbles) accumulating in the FlowStart system it is important to establish an air-free connection, which takes the following steps:

1. Syringe filling
   Fill each syringe with the desired liquids. Hold the syringe vertically and retract the plunger to extend the air bubble at the top. Then, retrieving any leaking liquids, purge the plunger so that all air is removed from the syringe (figure 4.1).

   ![Figure 4.1: Remove air from syringe](image)

2. Syringe connecting
   To make an air-free connection between tubing and syringe, connect the syringes to the appropriate PEEK connectors and fill the adapter piece with the used solution by pressing some droplets out of the syringe and connecting the syringe to the adapter (figure 4.2).

   ![Figure 4.2: Placing of few droplets in syringe adapter before making the connection](image)
4.2 Step 2: Loading Syringes

After the syringes have been filled with the desired liquid, load them into the pumps by the following steps:

- Retract the pump slider (1) by pushing the white button (2) and sliding it to the left.
- Retract the fine adjustment by screwing the adjustment bolt (3) clockwise.
- Open the syringe clamp (4) by pulling it and rotating it by 90°.
- Place the syringe barrel on top of the pump.
- Replace the syringe clamp (4).
- Move the pump slider (1) to the right so that it makes contact with the syringe.
- Make a final adjustment by screwing the adjustment bolt (3) counter clockwise.

4.3 Step 3: Pump Settings

Switch on the pumps using the on/off switch at the backside of the pump. To make good use of the pump check and set the correct parameters into both pumps by the user interface (figure 4.3)

1. Number input
Values displayed on the LCD of the pump can be changed by using the arrow keys (1 to 4) shown in figure 4.3. To change the position of the decimal indicator, press and hold the left arrow button (1). After the left digit passed ‘9’, the decimal indicator will start to shift. Release the button when the decimal has reached the desired position.

2. Syringe Diameter
The pump is preprogrammed for the 1 mL glass syringes as supplied with the pump module. Check the syringe diameter by pressing the [Diameter] button (7). The diameter should be 4.607 mm for the supplied 1 mL glass
syringe. If this is not correct or you wish to use different syringes, change the diameter setting by pressing the [Diameter] button (7). Note: diameter can only be changed when the pump is not running.

3. Flow Rate
   The current flow rate setting can be displayed and changed by pressing the [Rate] button (5) once. The LEDs display the current flow rate unit (e.g. μL/min). The flow rate unit can be set by pressing the [Rate] button (5) for a second time and repeatedly pressing the right arrow button (4) to cycle through the different units possible.

4. Pump Mode
   The pump can be used either to infuse and to withdraw liquids. For microreactor applications, generally only infusing is used. Make sure the withdraw LED on the pump interface is not lit. When it is, the ‘pump mode’ button (8) to switch back to infuse mode.

5. Start / Stop
   To start and stop the pump, press the [Start] button . When the pump is running the pumping LED is lit continuously. When the pump is off or paused the LED is off or blinking, respectively.

6. Additional functions
   For detailed information on pump operation and additional functions, please refer to the enclosed B-230 Pump Module Manual (section 3, 4, 6 and 7).

4.4 Step 4: Temperature Controller

Place the temperature block and controller on a stable surface. To operate the temperature controller and set the desired values, please follow the next steps:

1. Ventilation
   Make sure that on the left and right side of the module, a free space of at least 20 cm is present to enable ventilation (figure 4.4). Subsequently switch on the temperature controller using the on/off switch on the back side of the controller (figure 4.5). Wait a few seconds until the controller has initialized.

Figure 4.4: Leave enough room for ventilation   Figure 4.5: Backside of the temperature controller
2. **Temperature**

The temperature controller has been preprogrammed and set at 25 °C. Settings of the controller can be changed by the user interface (figure 4.6). The set point of the temperature can be changed by first pressing and hold the ‘set’ button (4) for three seconds. The set point temperature will be displayed. Next use the ‘lamp’ button (1) to select a digit, and the push either the ‘up arrow’ button (2) or ‘down arrow’ button (3) to change the value of the blinking digit. Press the ‘set’ button (4) once more to constitute the set point temperature. The ‘set’ button (4) must be pressed to store the new set point; otherwise, the controller will revert to the previous set point.

![Figure 4.6: User Interface of the temperature controller](image)

3. **PID Settings**

The correct PID setting are already stored in the supplied temperature controller. Changing these settings may prevent the system from working correctly and temperature block may be damaged. For detailed information on temperature controller operation, please refer to the B-223 Temperature Controller Manual.

---

**- WARNING -**

Keep fingers away from the product, microreactor and all other parts when the system is operating. Some surfaces become very hot during operation.

Keep hands and loose clothing away from the fan of the temperature block and the fan of the temperature controller.

---

4.5 **Start your flow chemistry experiment**

After the FlowStart is installed as described in chapter 3 and the right parameters have been set. Please before using the FlowStart please make sure to:

- Rinse the FlowStart for 10 minutes by filling every syringe with the desired solvent and set the flow rate of each pump at 15 μL/min.
- Start your flow chemistry experiment!

A practical guide is provided in the FlowStart Support (section 1) which describes the acts that need to be taken in order to start using the FlowStart. We advise to keep this guide handy for all users.
5  Maintenance Guide

5.1  After Use

After using the FlowStart:

- Set temperature into the controller to 25 °C
- Rinse the FlowStart for 10 minutes by filling every syringe with the desired solvent and set the flow rate of each pump at 15 μL/min.
- Check if fluid is observed near or around the ferrules due to a leaking fluidic connection and if necessary clean the microreactor and ferrules (paragraph 5.2).
- Turn off the temperature controller and pumps.

A practical guide is provided in the FlowStart Support (section 1) which describes the acts that need to be taken after using the FlowStart. We advise to keep this guide handy for all users.

- WARNING -

CAUTION: Be aware of chemical contamination when handling parts of the FlowStart B-300 and microreactors. Always wear protective clothing for assembling, handling, operating, disassembling, cleaning and servicing the FlowStart B-300 or any related parts.

5.2  Maintenance of the FlowStart

1. Temperature Block

In order to clean the microreactor holder, it can be removed from the temperature block. To do so, carefully slide the microreactor holder in its length direction to one side. To replace, reverse the action, while keeping in mind that the microreactor holder slides over the supporting screws in the temperature block. The microreactor holder and temperature block contain no serviceable parts and cannot be disassembled. In case of a malfunction, please contact FutureChemistry to service the part(s).

2. Temperature Controller

The temperature controller does not contain any serviceable parts inside. Do not remove its cover or disassemble it in any way. In case of a malfunction, please contact FutureChemistry to service the part(s).

3. Syringe Pump

Placing and removing the syringe from the pump is part of normal operation and described in section 4. The pumps do not contain any serviceable parts inside. Do not remove its cover or disassemble it in any way. In case of a malfunction, please contact FutureChemistry to service the part(s).
6 Troubleshoot

1. I cannot set the correct flow rate, because it does not fit in the pump’s display
   You can change the position of the decimal separator by pressing and holding the left most arrow button. After reaching a value of 9, the decimal will start to shift. When it has reached the desired position, release the button.

2. How to avoid air (bubbles) in the FlowStart
   To avoid air (bubbles) accumulating in the FlowStart system:
   • Make all syringes air-free. This is done by filling every syringe with the desired solution and pointing it upwards (figure 6.1). Next, tap the syringe’s side to displace all bubbles to the top. Then press out some of the solution until a small droplet is formed (figure 6.2).

   ![Figure 6.1: Remove air from syringe](image)
   ![Figure 6.2: Placing of few droplets in syringe adapter before making the connection](image)

   • Apply all fluidic connections by placing the microreactor into the microreactor holder and connecting the inlet and outlet tubing to the microreactor. To make an air-free connection between tubing and syringe, connect the tubing to the adapter piece and fill the adapter piece with the used solution by pressing some droplets out of the syringe and connecting the syringe to the adapter.

3. The pumps are running, but no outlet flow is observed
   At very low flow rates, stabilisation of flow and pressure may take a long time (up to 30 minutes at flow rates below 1 µL/min). To calculate the minimum stabilisation time, the following rule of thumb can be used:

   \[
   \text{Stabilisation time} = 3 \times \frac{\text{Reactor Volume}}{\text{Total Flow Rate}}
   \]

   \[
   \text{Total Flow Rate} = \text{the combined flow of all inlets except quench flow}
   \]

   • First check on the pump that [Withdraw] mode is not enabled. Next, check if there is a potential leak in the FlowStart system. A leak can occur on several places:
   • Between syringe and plunger (figure 6.3). Check whether fluid is present behind the plunger or in the plunger’s ribs. Syringe leakage may occur when not fully-dried syringes are used. To avoid this, empty syringe, clean barrel and plunger first with water, then with acetone, and dry thoroughly. If still leaking, replace syringe.
Figure 6.3: Leaking syringe due to incorrect assembly or worn plunger

- In the connection of syringe with tubing (figure 6.4). If droplets are observed at the bottom of the adapter piece or at the point where the tubing leaves the connector, carefully tighten both adapter and connector.

Figure 6.4: Possible locations of leakage from syringe connection

- In the connection of tubing with microreactor chip. If fluid is observed near or around one of the flat-bottom ferrules (figure 6.5) the connection is either too loose or too tight. Disconnect the leaking ferrule and reconnect by hand until a firm connection is made. If still leaking, remove reactor from microreactor holder, clean microreactor and all connections in an ultrasound bath (use solvent such as acetone, do not use chlorinated hydrocarbons), reassemble and tighten the connection slightly with the extender tool. If the connection is still leaking, the sealing may be worn out. In that case, replace the fitting and tubing (see section 3.4).

Figure 6.5: Leaking fluidic connection

4. One of the pumps displays Stal or solution from one syringe enters the other syringe
   In either of these cases, the back pressure of the system has become too high. The pump may stop because the forces are too high, or backflow from one inlet into the other might occur. If not, there probably is too much backpressure. Possible causes are:
   - The flow rate is set too high. Decrease flow rate and try again. Maximum usable flow rate is microreactor-dependent.
The tubing is clogged. Rinse tubing with acetone by connecting the tubing (without microreactor) to a syringe with subsequent manual purging.

The microreactor is clogged. Disconnect all tubing from the chip and remove the slider from the microreactor holder. Clean the microreactor in an ultrasound bath for 30 to 45 minutes, with a solvent best suitable to dissolve any solid particles. If still clogged, replace the microreactor.

5. **The pump suddenly stops pumping, without displaying St a L**
   Check if the pump is connected to the power supply and the switch at the back is switched on. A maximum dispensable volume might be enabled. Press [Volume] and set to 0. Now, dispensing will continue until stopped manually (or at the end of the plunger stroke).

6. **The observed flow rates do not correspond to the set flow rates**
   A mismatch between the set and observed flow rate can have several possible causes:
   - Syringe diameters might be set to wrong values. Press [Diameter] and set to correct value (standard 1 mL glass syringe: 4.61).
   - There is a (minor) leak in the system. If this is indeed the case, follow the instructions to avoid leakage (please refer to question 3).
   - Back pressure is too high. Please refer to question 4.

7. **I cannot change the set temperature of the temperature controller**
   To reach the setting menu of the temperature controller, press and hold the [SET] button for three seconds. Set the temperature to the desired value by pressing the arrow buttons and pressing the [SET] button.

8. **The set temperature cannot be reached**
   The FlowStart system is designed for a temperature range of 0 - 90 C. Although the temperature controller can be set to temperatures beyond this range, this will rapidly wear out the conditions of the thermoelectric elements, used in the temperature block. When the elements are worn out too much, the actual temperature range will decrease. FutureChemistry can replace the elements, but they do not fall under guarantee if temperatures beyond specifications have been used. Two other reasons for the system not being able to reach the desired temperature are wrong voltage setting and changing the controllers PID settings by accident. To change these:
   - Voltage: keep the voltage selector at the back of the temperature controller at 7V.
   - PID settings: please refer to the B-223 Temperature Controller Manual. PID settings used for the FlowStart are: P: 2, I: 2, D: 8. The C value (calibration) is set for each product individually and should not be changed. If the system is out of calibration, please contact FutureChemistry.

If reconfiguring the controller does not solve your problem, there might be an electrical problem or the thermoelectric elements have been worn out. Please contact FutureChemistry.

---

**CAUTION: Do not change the voltage selector, leave it at 7 V**
9. **The microreactor is clogged**
   - Solution 1: Try to run a solvent (see 10) through the system that is able to dissolve the solid particles. Fill the syringes with this solvent and set the pumps to 25 µL/min. If no solvent goes through the system, try to use a higher flow rate (max. 100 µL/min) in order to increase the pressure on the system. If this still doesn't work, use a different solvent (see 10) and try again.
   - Solution 2: Try to run the solvent through the FlowStart backwards using the outlet port as inlet.
   - Solution 3: Disconnect all tubing from the microreactor holder and remove the microreactor from the holder. Clean the microreactor in an ultrasound bath for 30 to 45 minutes, with a solvent best suitable to dissolve any solid particles. Water/isopropanol is a good start.

10. **How to choose a solvent in order to unclog the microreactor?**
    - First, try the solvent you used in your reaction.
    - Second, try a solvent that dissolves salts (in a lot of cases, clogging is due to salt formation), like water, methanol, ethanol, isopropanol/water, acetonitrile.
    - If this still doesn't work, try acetone and dichloromethane.
    - If there is still clogging, try (concentrated) acids (hydrochloric, sulfuric, acetic) and diluted sodium hydroxide. This should solve most clogging problems. In case you used an acid or base solution, rinse the system extensively with water after successful cleaning.
# Specifications

## General

<table>
<thead>
<tr>
<th>Specification</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Maximum working pressure</td>
<td>7 bar / 100 psi</td>
</tr>
<tr>
<td>Ambient temperature range</td>
<td>18 – 30 °C (60 - 86 °F)</td>
</tr>
</tbody>
</table>

## B-223 Temperature Controller

<table>
<thead>
<tr>
<th>Specification</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Minimum temperature</td>
<td>0 °C (32 °F)</td>
</tr>
<tr>
<td>Maximum temperature</td>
<td>90 °C (194 °F)</td>
</tr>
<tr>
<td>Control</td>
<td>Local interface (no computer required)</td>
</tr>
<tr>
<td>AC Power</td>
<td>110-120 V / 220-240 V, 50-60 Hz</td>
</tr>
<tr>
<td>Working Voltage</td>
<td>7 V</td>
</tr>
<tr>
<td>Temperature Accuracy</td>
<td>+/- 0.5 °C (+/- 0.9 °F)</td>
</tr>
<tr>
<td>Materials</td>
<td>Aluminum</td>
</tr>
<tr>
<td>Maximum Power</td>
<td>28 Watt</td>
</tr>
</tbody>
</table>

## B-230 Pump Module (when used with Syringe B-242)

<table>
<thead>
<tr>
<th>Specification</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Minimum Flow Rate</td>
<td>0.73 μL/hr</td>
</tr>
<tr>
<td>Maximum Flow Rate</td>
<td>35 mL/hr</td>
</tr>
<tr>
<td>Control</td>
<td>Local interface (no computer required)</td>
</tr>
<tr>
<td>AC Power</td>
<td>110-120 V / 220-240 V, 50-60 Hz</td>
</tr>
</tbody>
</table>

## B-241 Inlet Module and B-243 Outlet Module

<table>
<thead>
<tr>
<th>Specification</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Outer Diameter</td>
<td>1.59 mm (1/16”)</td>
</tr>
<tr>
<td>Inner Diameter</td>
<td>0.25 mm (1/100”)</td>
</tr>
</tbody>
</table>

## B-246 Microreactor Holder

<table>
<thead>
<tr>
<th>Specification</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Materials</td>
<td>PEEK, stainless steel</td>
</tr>
<tr>
<td>Fluidic connection</td>
<td>Flat bottom ferrule</td>
</tr>
</tbody>
</table>

## B-262 Extender Tool

<table>
<thead>
<tr>
<th>Specification</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Compatibility</td>
<td>6-32 and 6-40 UNF headless fittings</td>
</tr>
</tbody>
</table>
8 Declaration of Conformity

Suppliers Details

Name
FutureChemistry Holding BV

Address
FutureChemistry Holding BV
Toernooveld 100, 6525 EC Nijmegen, The Netherlands

Product Details

Product Name
FlowStart - Temperature Module

Model Name
B-220

Trade Name
FutureChemistry

Applicable Directives

EMC Directive 2004/108/EG
GPSD: Risk analysis according to EN-ISO 14121-1:2007

Area

This product is certified for the European, US and Canadian market

Declaration

I hereby declare under our sole responsibility that the product mentioned above to which this declaration relates complies with the above mentioned standards and directives.

Name
P.J. Nieuwland
Research Director

Issued Date
October 29th, 2009

FutureChemistry Holding BV
Toernooveld 100, 6525 EC Nijmegen, The Netherlands
Tel: +31-24-7114029
e-mail: support@futurechemistry.com

Signature of representative
9 Index

Air-free 17
Clean 21
Diameter 12, 19, 22
Extender Tool 11
Fitting 10
Flow rates 12, 19
Fluidic connections 10
Leakage 18
PID settings 20
Pump 13
Stabilisation 17
StaL 19
Syringe 6
Syringe adapter 13
Syringe leakage 17
Temperature controller 15
Withdraw 17
10 Notes
Application Notes

FutureChemistry has in-house laboratories, used to support and expand FlowStart B-300 operations. The FlowStart B-300 is commonly used to explore the first step of validating traditional synthesis in a flow interface. Previous research conducted internally has been translated into easy-to-access application notes; some of which have been included in this section of the FlowStart Support.

The FlowStart Support contains a selection of our application notes:

1.1 Deprotection of p-methoxyphenyl (PMP) protected amines
2.1 Selective α-ketone bromination
3.1 Paal-Knorr pyrrole synthesis
4.1 Droplet generation in the FlowStart

While familiarizing with the FlowStart operations, please read the included application notes to gain insight in the varied ways flow chemistry can aid and improve chemical processes. For more application notes also describing optimisation with the FlowScreen and upscaling with the FlowSyn please visit the FutureChemistry Portal at: www.futurechemistry.com/portal
Product Support

FutureChemistry can deliver flow chemistry equipment which fits the needs of the customer and the FlowStart B-300 is part of FutureChemistry’s extended product line. More information on FutureChemistry’s products and services are included in this section. Note that product support material is aimed at non-technical users and may be freely distributed.

FutureChemistry offers advice and equipment for the implementation of flow chemistry at your company. The implementation trajectory consists of several research stages, starting with identifying a chemical problem. This is then followed by translating the batch conditions to continuous flow. Next a feasibility study will be carried out, in which pilot reactions are run and concluding in production on tones scale. FutureChemistry provides three different product platforms, each one designed for chemical research at the different stages. For the realization of tone scale production a collaboration with Flowid has been established. Moreover as an alternative, our experts offer the service to carry out the implementation of flow chemistry at our facilities. Thereby the problem of setting up flow chemistry in your company is taken out of hands.

If you have any questions about FutureChemistry microreactors or flow chemistry equipment, please contact us on +31 (0) 24 711 4029 or go to www.futurechemistry.com/webshop
FutureChemistry Holding BV  
Toernooiveld 100  
6525 EC Nijmegen  
Netherlands

**Complete systems:**

<table>
<thead>
<tr>
<th>Productcode</th>
<th>Productname</th>
<th>Description</th>
<th>Quantity</th>
</tr>
</thead>
<tbody>
<tr>
<td>B-200</td>
<td>FlowStart</td>
<td>Learning platform for exploring flow chemistry &amp; microfluidics</td>
<td></td>
</tr>
<tr>
<td>B-300</td>
<td>FlowStart</td>
<td>Complete set-up for educational purposes, including courses</td>
<td></td>
</tr>
<tr>
<td>C-300</td>
<td>FlowScreen</td>
<td>Platform for automated reaction screening and optimization</td>
<td></td>
</tr>
<tr>
<td>Q-1020MF</td>
<td>FlowSyn</td>
<td>Flow system for prep-scale synthesis</td>
<td></td>
</tr>
</tbody>
</table>

**Accessories:**

<table>
<thead>
<tr>
<th>Productcode</th>
<th>Productname</th>
<th>Description</th>
<th>Quantity</th>
</tr>
</thead>
<tbody>
<tr>
<td>B-230</td>
<td>Syringe Pump</td>
<td>Syringe pump for FlowStart</td>
<td></td>
</tr>
<tr>
<td>B-241</td>
<td>Inlet Module</td>
<td>Connects syringe with fluidic interface</td>
<td></td>
</tr>
<tr>
<td>B-242</td>
<td>Glass Syringe (Gastight)</td>
<td>Suitable for fluid or gaseous chemicals</td>
<td></td>
</tr>
<tr>
<td>B-243</td>
<td>Outlet Module</td>
<td>Extend exit port on the fluidic interface</td>
<td></td>
</tr>
<tr>
<td>B-244</td>
<td>Collection Flask (50mL)</td>
<td>Standard 50mL borosilicate flask</td>
<td></td>
</tr>
<tr>
<td>B-246</td>
<td>Microreactor Holder</td>
<td>Fluidic interface for FlowStart</td>
<td></td>
</tr>
<tr>
<td>B-250</td>
<td>USB Microscope</td>
<td>Monitor microreactor processes visually</td>
<td></td>
</tr>
<tr>
<td>B-262</td>
<td>Extender Tool</td>
<td>Establishes firm connector attachment</td>
<td></td>
</tr>
<tr>
<td>B-250</td>
<td>FlowSyn Microreactor Module</td>
<td>Fluidic interface including 0.65 mL microreactor</td>
<td></td>
</tr>
</tbody>
</table>

**Microreactors:**

<table>
<thead>
<tr>
<th>Productcode</th>
<th>Productname</th>
<th>Description</th>
<th>Quantity</th>
</tr>
</thead>
<tbody>
<tr>
<td>M-110</td>
<td>Basic Microreactor*</td>
<td>For two component chemical reactions</td>
<td></td>
</tr>
<tr>
<td>M-120</td>
<td>Basic Quench Microreactor*</td>
<td>Basic design with added quench channel</td>
<td></td>
</tr>
<tr>
<td>M-130</td>
<td>Short Quench Microreactor*</td>
<td>Minute volume for ultrafast reactions</td>
<td></td>
</tr>
<tr>
<td>M-140</td>
<td>Microreactor Starters Pack*</td>
<td>Pack with 3 microreactor designs: 1x basic, 1x basic quench and 1x short quench</td>
<td></td>
</tr>
<tr>
<td>Q-1040</td>
<td>FlowSyn Quench Microreactor**</td>
<td>Microreactor pack for FlowSyn platform</td>
<td></td>
</tr>
</tbody>
</table>

\*Microreactor is supplied in sets of three microreactors.  
\**Microreactor for FlowSyn is supplied in sets of two microreactors.
Practical Courses

On order to train new employees, researchers and students in practical work with the FlowStart B-300; FutureChemistry has developed, and continuously develops, a series of practical courses. These courses are designed to be neatly integrated in both existing corporate and academic curricula. Current use of these courses is applied to our own workforce, partner educational institutes and other clients, all working with FlowStart B-300.

Introducing new FlowStart B-300 users with these practical courses will greatly enhance the adjustment to, and familiarization with, the new hardware. It is highly recommended to keep your workforce educated, especially when new innovative products are implemented, like FlowStart B-300.

This section contains practical courses for FlowStart B-300. If you are interested in training your own workforce using these courses, please contact us on +31 (0) 24 711 4029 or info@futurechemistry.com.