FC 270 / 271 / 274 / 275
Operator's Manual

The models FC 270 / 271 / 274 / 275 flow cell designs are based on the FC 71 but accommodate two growth channels, rather than one. This design allows biofilms to be grown side by side for duplicate or "control – treatment" experiments. Biofilms growing in each channel can be easily compared microscopically by simply moving the microscope stage backwards or forwards. The body of the flow cell consists of a polycarbonate or anodized aluminum flow channel. Glass viewing ports allow reflected, fluorescent, and confocal microscopy of biofilm growth in the flow channels.

FC 270-PC

Viewing Window

The viewing window consists of a no. 2, 24mm x 60mm cover slip. The glass viewing window is held in place by an anodized aluminum cover plate. The cover plate also compresses the silicone rubber gasket material to provide a leak-proof flow cell.

The glass viewing windows are held in place by a pair of anodized aluminum cover plates. The cover plates also compress the silicone rubber gasket material to provide a leak-proof seal.

Coupons

Each flow channel has been recessed to accept standard FC71 coupons: one 6mm x 25mm x 2mm rectangular coupon; three 10mm diameter x 2mm thick disc coupons (shown above); or two 0.5in diameter x 0.15in thick (same coupons as used in the CDC, RDR, and Bio-inLine Biofilm Reactors).

Injection ports

The FC 271 and 275 flow cells come equipped with two autoclavable injection ports which may be used for inoculation, the addition of microscopy stains, or chemicals such as antimicrobial agents, etc.

1. Flow Cell Assembly and Operation

It is very important that the flow cells be assembled properly to provide a leak-proof seal. The flow cell is designed for a **maximum flow rate of 3.5 mL/minute**. Flow rates in excess of 3.5mL/minute could damage the flow cell or cause leaks.

Disassembly

1. Remove the seventeen (17) screws holding the cover plates in place.
2. Remove the cover plate (most likely the gaskets and glass viewing ports will remain with the flow cell).
3 Carefully remove the glass cover slip from the gasket material. If the cover slip is broken, remove and discard the cover slip.
4. Carefully clean the gasket surface, removing all glass and other debris. **It is very important no residual glass or other material be left on the gasket surface.**
5. Clean the flow channel surfaces using water and laboratory detergent. **Do not scrub or mar the glass/flow channel mating surfaces.**

Assembly

1. Carefully position a clean, unbroken cover slip in the shallow recessed slot on the flow channel. It is very important the cover slip be properly positioned in the recessed slot. **Improper placement will result in cover slip breakage upon tightening the cover plates.**
2. Carefully position the clean gasket on the other cover plate (plate with recessed beveled screw holes). Align the screw holes in the gasket and the cover plate.
3. Put several screws through the beveled holes on the cover plate (center) and through the holes on the gasket. These screws will help hold the gasket in place as it is placed onto the flow channel and align the cover plate onto the flow channel.
4. Carefully place the cover plate with gasket onto the flow channel. **It is very important the cover slips remain properly positioned in the recessed slots (improper placement will result in cover slip breakage and or leaking).** **[**Screws inserted into the cover plate while installing the cover plate will help align the plate as it is lowered onto the cover slip and flow channel. Do not move the cover plate once it has contacted the cover slip, as the cover slip will move out of the channel, resulting in breakage upon tightening the screws.]
5. Place the screws into the beveled screw holes and tighten evenly around the perimeter, alternating sides as the screws are tightened.
   It is important the screw holes in the cover plate align with the holes in the gasket material. Improper alignment may result in leaking.

6. Install tubing on the tube ports and pump liquid through the flow cell to confirm a liquid tight seal.

CAUTION: To avoid damaging flow cell, do not overtighten metal fittings and screws in polycarbonate models. Compression O-rings on fittings do not require excessive force to seal.

2. Autoclaving Instructions

The FC 270 series Flow Cell is autoclavable up to 121°C, at 20 minutes. Using temperatures or times past what is suggested may cause unnecessary stress to some materials and will not be covered under warranty. Polycarbonate plastic will degrade with a numerous autoclave cycles and may eventually require replacement.

BioSurface Technologies recommends always using the slow (liquid) exhaust option. The screws holding the cover plates on the flow cell should be loosened to allow for material expansion when autoclaving the polycarbonate flow cell. Tubing connected to the flow cell should allow free exchange of steam with the surrounding environment. BST recommends using a gas permeable material to cover the tubing ends such as autoclave paper instead of a gas-impermeable material, such as tin foil (for the polycarbonate flow cell, slowly tighten the screws as the flow cell cools or wait until the flow cell is completely cooled before tightening the screws). Align all tubing connected to the flow cell to minimize stress on the flow cell fittings.

3. Spare Parts

Included with the flow cell:

- Spare screws (4-40, stainless steel)
- Spare gaskets
- Additional cover slips (no. 2, 24mm x 60mm)

With proper care, the gaskets should be re-useable for numerous experimental evaluations. The spare gaskets provided require removal of the clear protective polymer sheeting from both sides of the gasket prior to installation. The gasket material is 0.020 inches thick silicone rubber. Other materials may be used.

4. Troubleshooting

Problem: Glass viewing ports keep breaking
Solution:

- Check to ensure the glass is properly positioned in the recessed slot.
- Ensure the gasket surfaces and flow channel mating surfaces are total free of debris.

Problem: Flow cell leaks
Solution:

- Tighten screws further to compress gasket.
- Make sure flow channel and hose barbs are free and clear of obstructions.
- Make sure glass viewing ports are not cracked or broken.
- Check gasket for rips or tears. Clear of all debris. Replace as necessary.
- High flow rates may create too much back pressure to contain leakage. Reduce flow rate. **The flow cell is designed for a maximum flow rate of 3.5 ml/minute.**
- Glass slide well depth is machined to a precise depth to accommodate 1.00 mm thickness glass slides. A tolerance of +/- 0.02 mm glass slide thickness variation is acceptable. If the flow cell is leaking from the glass slide side of the flow cell, try a thicker glass slide to generate a seal.

5. Flow Cell Ancillary Equipment List

NOTE: *BioSurface Technologies does not sell or supply the ancillary equipment described below. This or comparable equipment is required to complete the reactor system set-up. Please check with your local vendors for availability and current pricing. Equipment listed is not recommended equipment, but an aid to help you identify compatible equipment.*

Pump: There are many types of peristaltic pumps available, and you may opt for alternative types and pump head configurations (multi-channel versus single channel, higher/lower rpm range, etc.). Depending on what you need to add to the reactor during operation, you may require more than 1 pump or a multi-head pump (media for growth and biofilm treatment chemical for some duration that may require an additional pump).

- **Masterflex® L/S® Digital Precision Modular Drive with Remote I/O and Benchtop Controller, 1 to 100 rpm; 90 to 260 VAC**
  (VWR Item#: MFLX07557-10)
- **Masterflex® Ismatec® Minicartridge Multichannel Pump Head for Masterflex® L/S® Drives, 8-Channel, 8-Roller**
  (VWR Item#: MFLX07623-10)
    - Has 8 channels; will accommodate 8 influent lines. Alternate pump heads are available for 2 or 4 channel systems.

Tubing: The tubing you choose depends on the chemical compatibility, gas permeability, wear resistance in peristaltic pumps, and pricing. You must choose the tubing that best fits your needs. C-Flex tubing (listed below) is similar to silicone tubing but has a low gas-permeability compared to silicone. If gas-permeability is not an issue, standard silicone tubing is acceptable.

- **Masterflex® L/S® Precision Pump Tubing, C-Flex®, L/S 16; 25 ft**
  (VWR Item#: MFLX06424-16)

    - Accepts the 1/8” barbed connectors (3.2 mm connectors).
    - To connect to the media supply reservoir and flow cell connections.
- **Masterflex® Fitting, Polypropylene, Straight, Male Luer to Hose Barb Adapter, 1/8" ID; 25/PK**
  (VWR Item#: MFLX30800-24)
- **Masterflex® Transfer Tubing, C-Flex®, Opaque White, 1/4" ID x 7/16" OD; 25 Ft**
  (VWR Item#: MFLX06424-72)
    - A few lengths and adapters to get from the carboy to the smaller diameter tubing, and as a siphon tube inside the carboy.
- **Masterflex® Fitting, Nylon, Straight, Hose Barb Reducer, 1/4" ID x 1/8" ID; 10/PK**
  (VWR Item#: MFLX30622-28)
    - Needed to get from the 3/16” or 1/4” ID to the 1/8” tubing.

Carboy: Carboys should be selected based on experiment needs and may be larger or smaller than what is suggested below. Ported lids can be purchased from suppliers, but standard lids are easily converted to ported lids using the following fittings or similar.

- **Azlon® Bottle, Rounded Octagonal, Polypropylene, Dynalon, 10L**
  (VWR Item#: 30620-188)
- **Azlon® Bottle, Rounded Octagonal, Polypropylene, Dynalon, 20L**
  (VWR Item#: 76210-720)
- **Nalgene® Barbed Bulkhead Fittings, Thermo Scientific, 6.4 mm ($^1/_4$")**
  (VWR Item#: 16331-102)
- **Nalgene® Barbed Bulkhead Fittings, Thermo Scientific, 12.7 mm ($^1/_2$")**
  (VWR Item#: 16225-232)
- **Cole-Parmer PTFE Syringe Filters, Non-Sterile; 0.45 µm, 50 mm Diameter**
  (Cole Parmer P/N: EW-02915-30)

Suggested Ancillary Equipment Suppliers:

VWR: 800-932-5000 (www.vwr.com)
Cole Parmer: 800-323-4340 (www.coleparmer.com)
Fisher Scientific: 800-766-7000 (www.fishersci.com)