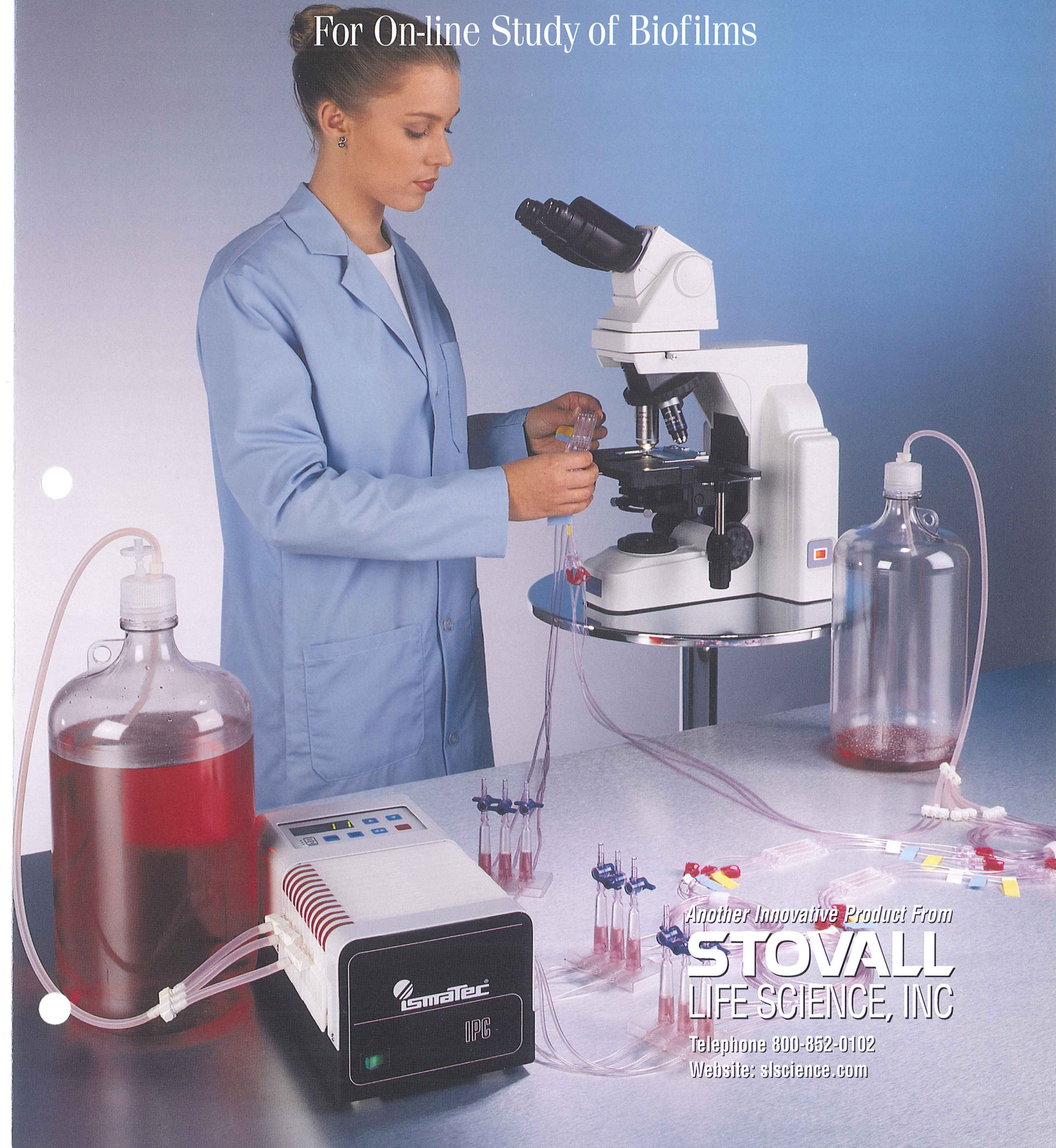


• The Stovall Flow Cell

For On-line Study of Biofilms



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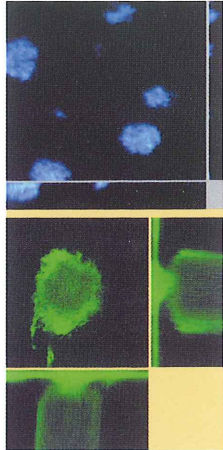
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CONTINUOUS CULTURE CHAMBERS FOR REAL TIME, NON DESTRUCTIVE, MICROSCOPIC STUDY OF BIOFILMS

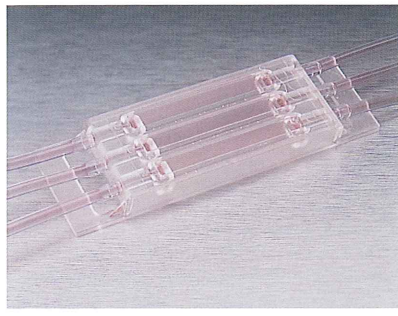
Stovall Life Science offers the biofilm investigator an affordable, sterile, consumable flow cell apparatus for creation of biofilms, and for direct, non-destructive, on-line microscopic examination of biofilms. The gamma irradiated flow cell, bubble trap and connective tubing necessary for experiments is completely assembled in its airtight package, and needs only to be opened and connected to a reservoir of culture medium and a peristaltic pump to start a biofilm experiment. This single use set-up eliminates the possibility of carryover from one experiment to the next, and eliminates time consuming sterilization methods which either require equipment not easily accessible to most researchers (ethylene oxide chambers) or are, in fact, disinfection methods (hypochlorite). Moreover, the bubble trap design creates a low positive pressure on the flow of medium, thus mitigating the undesirable peristaltic pulsation in liquid delivery to the flow cell.



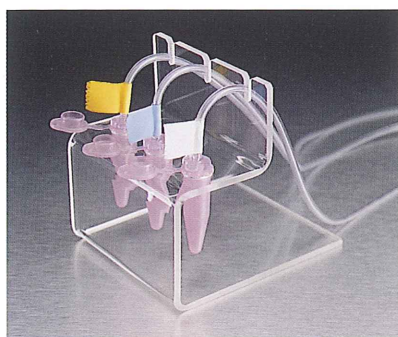
Traditional vs. confocal microscopy for study of biofilms.
Traditional transmission light microscopy may be used to follow biofilm development. However, as the biofilm thickness increases, it becomes more difficult to obtain good images due to the contribution from unfocused parts of the viewing field. Above, the scanning confocal laser microscope solves this problem by scanning several planes interspersed by short distances, thus reconstructing virtual three-dimensional images of the biofilm.



Bubble Trap
The triple cylinder bubble trap with air release cocks captures air bubbles released from the flowing culture medium. Inside the cylinder a "fountain" spout directs the flow of liquid upward for better release of air bubbles. The air release cocks allow the investigator to control the amount of air captured & govern the pressure on the passing liquid to help mitigate peristaltic pulsation.



Single 3 Channel flow cell with tubing attached & glass cover slip.
The triple channels of the flow cell are covered with a #1 glass cover slip, attached to the cell with acrylic adhesive. The cover slip can be scored & removed for access to the biofilm for further analysis. Each channel measures 1 mm D x 4 mm W x 40 mm L. Influent & effluent tubing is attached by barbed fittings. Write-on multicolored flags index the tubing at two junctures.



Luer Connector & Tube Rack for Effluent Capture.
The luer connectors in the effluent tubing can be unlocked briefly to collect effluent for analysis. The tube rack accessory for effluent capture is also illustrated here.

References for the Stovall Flow Cell Apparatus

Prototypes of the Stovall flow cell apparatus have been used successfully for biofilm cultures by numerous scientists over the past 3 years. Below are publications by some of these investigators who have used the flow cell apparatus:

Christensen BB, Sternberg C, Andersen JB, Palmer RJ Jr, Nielsen AT, Givskov M, Molin S.
Molecular tools for study of biofilm physiology. Methods Enzymol. 1999;310:20-42. Review.

Heydorn A, Ersboll BK, Hentzer M, Parsek MR, Givskov M, Molin S. Related Articles
Experimental reproducibility in flow-chamber biofilms. Microbiology. 2000 Oct;146 (Pt 10):2409-15.

Mathee K, Ciofu O, Sternberg C, Lindum PW, Campbell JI, Jensen P, Johansen AH, Givskov M, Ohman DE, Molin S, Hoiby N, Kharazmi A.
Mucoid conversion of Pseudomonas aeruginosa by hydrogen peroxide: a mechanism for virulence activation in the cystic fibrosis lung. Microbiology. 1999 Jun;145 (Pt 6):1349-57.

Nielsen AT, Tolker-Nielsen T, Barken KB, Molin S.
Role of commensal relationships on the spatial structure of a surface-attached microbial consortium. Environ Microbiol. 2000 Feb;2(1):59-68.

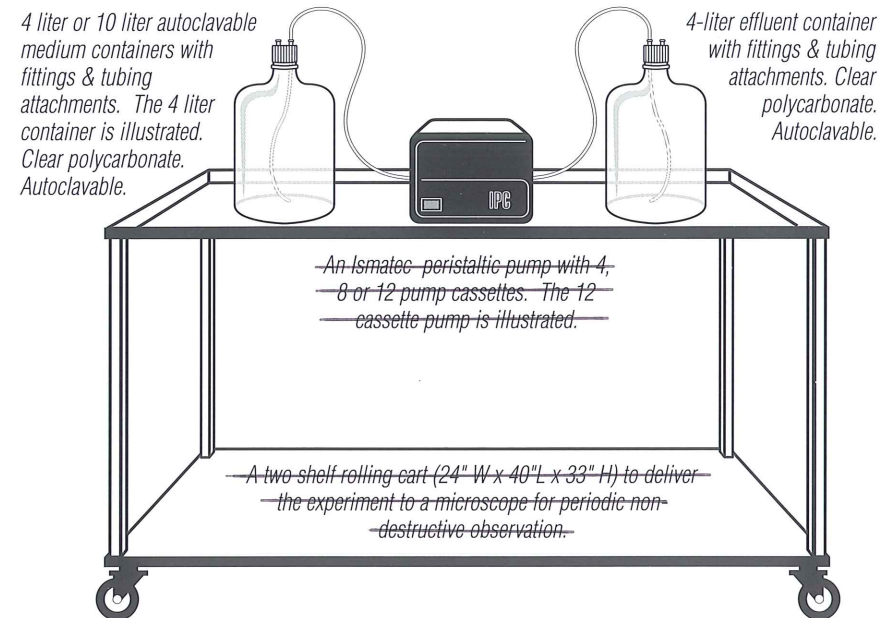
Ramos C, Licht TR, Sternberg C, Krogfelt KA, Molin S.
Monitoring bacterial growth activity in biofilms from laboratory flow chambers, plant rhizosphere, and animal intestine. Methods Enzymol. 2001;337:21-42.

Sternberg C, Christensen BB, Johansen T, Toftgaard Nielsen A, Andersen JB, Givskov M, Molin S. Related Articles
Distribution of bacterial growth activity in flow-chamber biofilms. Appl Environ Microbiol. 1999 Sep;65(9):4108-17.

Tolker-Nielsen T, Molin S.
Spatial Organization of Microbial Biofilm Communities. Microb Ecol. 2000 Aug;40(2):75-84.

HARDWARE FOR START UP LABORATORIES

Many labs are already adequately equipped to use the Stovall flow cell perfusion system. However, for those labs needing set up equipment, Stovall offers the various hardware elements which can be purchased in part or whole for biofilm experiments.



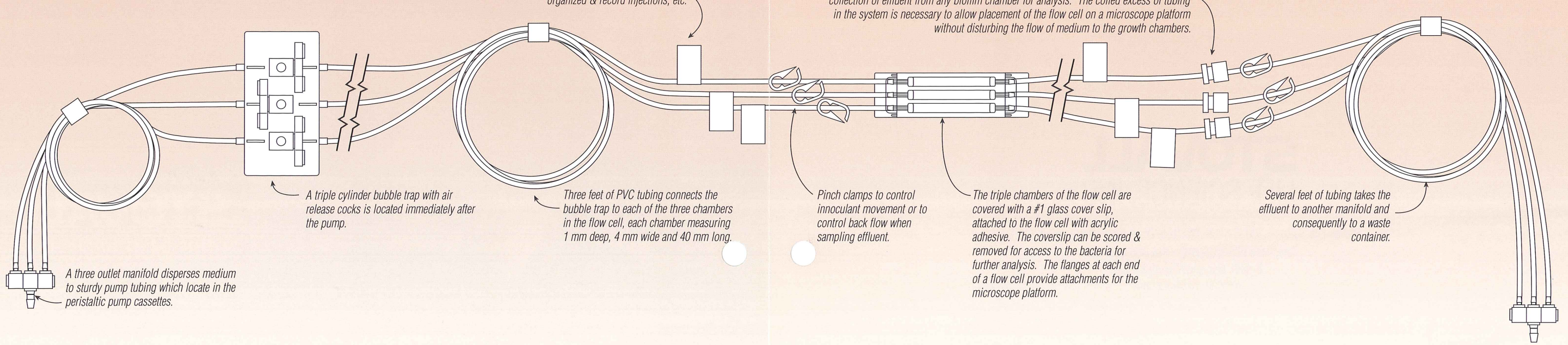
Each flow cell has three separate growth channels and each channel requires a single pump cassette to supply culture medium to it. The Stovall cart is designed to accommodate a maximum of 4 flow cells (I.E.: 12 growth channels) for a single experiment.

Custom Coatings for Flow Cell Glass Cover Slips.

The standard three chambered flow cell has a #1 glass coverslip (0.13 - 0.16 mm thick) attached. Stovall, in conjunction with specialized suppliers, can offer a wide range of metal, polymer and other coatings for the glass coverslips. These thin coatings do not interfere with microscope on-line observations of the development of the biofilms attached to the coated glass. Write or call us to discuss the kinds of coatings you require for your experiments. Our e-mail address is slscience@earthlink.net.

ELEMENTS OF THE CONTINUOUS FLOW CELL SYSTEM

As illustrated below, the assembled flow cell system consists of the following:



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