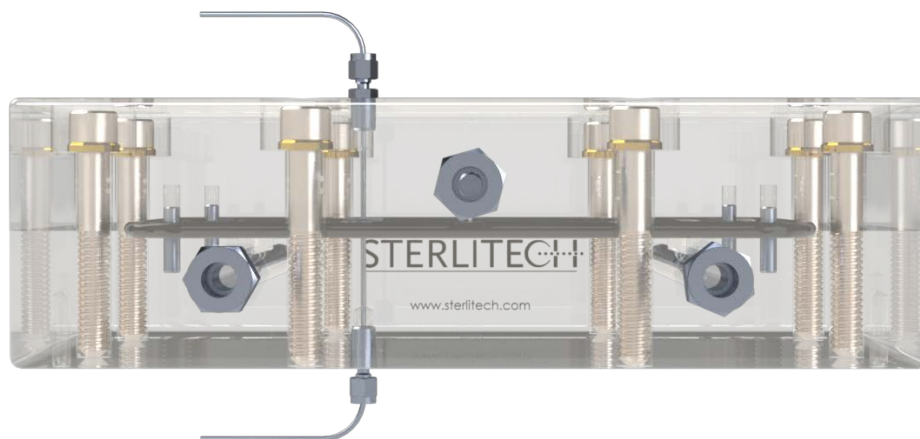




ACRYLIC SEPA ELECTRODE MODIFIED CELL ASSEMBLY & OPERATION MANUAL



CONTENTS

1. INTRODUCTION.....	1
2. ACRYLIC SEPA ELECTRODE MODIFIED CELL COMPONENTS	2
3. ACRYLIC SEPA ELECTRODE MODIFIED CELL ASSEMBLY	3
4. OPERATION OF THE ACRYLIC SEPA ELECTRODE MODIFIED CELL.....	5
5. SUPPLEMENTARY OPERATING INFORMATION	7
6. ACCESSORY AND SPARE PART ORDERING INFORMATION.....	8
7. RETURN MATERIAL AUTHORIZATION	9
8. WARRANTY	9
9. TECHNICAL ASSISTANCE.....	9
APPENDIX 1: ACRYLIC SEPA ELECTRODE MODIFIED CELL APPLICATIONS	10
APPENDIX 2: BENCH SCALE FILTRATION PRODUCTS.....	11

1. INTRODUCTION

The Acrylic Sepa Electrode Modified Cell is a laboratory-scale crossflow filtration unit that is designed to evaluate the performance of flat sheet membranes in a variety of applications. It simulates the flow dynamics of larger, commercially available membrane elements, such as industrial spiral wound membrane elements. Users can vary the operating conditions and fluid dynamics over broad ranges by using a combination of stainless steel (SS) shims, feed spacers, and membranes.

Prior to operating or servicing this device, this manual must be read and understood.

Table 1 outlines the operational parameters and technical specifications of the Acrylic Sepa Electrode Modified Cell.

Table 1: Acrylic Sepa Electrode Modified Features and Specifications

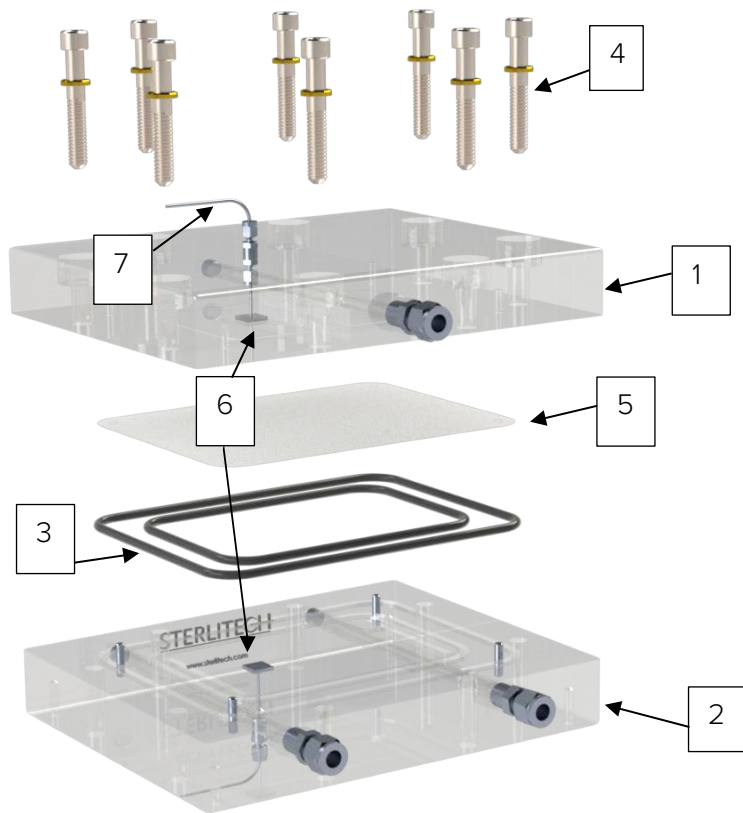
Parameter	Description
Membrane Active Area	140 cm ² (22-inch ²)
Hold-Up Volume	70 ml (2.4 ounces)
Maximum Operating Pressure	15 bar (220 psig)
Maximum Temperature: Acrylic Cell Body	88 °C (190.4 °F)
Maximum Bolts Torque Setting	45 (in-lbs)
Maximum Fittings Torque Setting	25 (in-lbs)
O-rings	Viton* (Other materials available)
Electrode	Titanium Wire (1/16 inch OD)
Cross Flow Velocity	Variable
pH Range	Membrane Dependent
Dimensions	
Slot Depth	0.86 mm (0.034 inches)
Slot Width	146 mm (5.750 inches)

2. ACRYLIC SEPA ELECTRODE MODIFIED CELL COMPONENTS

Verify that the Acrylic Sepa Electrode Modified Cell was shipped complete, intact, and undamaged.

Figure 1 illustrates a typical assembly of the Acrylic Sepa Electrode Modified Crossflow Assembly.

Figure 1: Typical Acrylic Sepa Electrode Modified Cell Assembly



Legend:

- 1 Acrylic Top Plate
- 2 Acrylic Bottom Plate
- 3 Inner and Outer O-Rings
- 4 8 SS316 Bolts (7/16-14 x 2 1/4" long) and washers
- 5 Membrane Coupon
- 6 Titanium Shims (0.083" thickness)
- 7 Titanium Electrode (1/16")

2.1 ADDITIONAL EQUIPMENT

The Acrylic Sepa Electrode Modified Cell also requires additional equipment to be operated, which are sold separately:

- Feed Pump
- Feed Tank
- Filtration membrane packs
- Assortments of shims and additional spacers
- Assortments of feed spacers and shims
- Concentrate/back pressure control valve with pressure gauge

3. ACRYLIC SEPA ELECTRODE MODIFIED CELL ASSEMBLY

After verifying that all the necessary components were shipped and present, you can begin the assembly of the Acrylic Sepa Electrode Modified Cell. To assemble the Acrylic Sepa Electrode Modified Cell:

1. Connect the concentrate/back pressure control valve to the cell bottom by wrapping PTFE tape around the valve's male NPT end and screwing it into the concentrate outlet port.

Note: *The cell bottom has four alignment pins and the cell top has holes to accept the alignment pins.*

2. Install the O-rings into the grooves on the cell bottom and wet them with a small amount of water or the fluid to be processed.

Caution: *Make sure the O-rings lie flat in the grooves of the cell bottom. Leaking may occur if the O-rings do not lie flat in the grooves. The O-rings will be cut or crushed when the system is operating if they are not installed correctly.*

3. Place a shim, if needed, in the cavity inside of the inner O-ring.

4. Install the feed spacer into the central cavity, on top of the shim. The feed spacer must lie flat and be fully contained within the cavity.

Note: *The feed spacer and the permeate carrier look similar and are cut in the same size. The permeate carrier is thinner with a tight weave, while the feed spacer has large gridding.*

Place a piece of pre-cut membrane over the feed spacer using the four guideposts to hold the membrane in position.

The membrane should be installed with the shiny (or active) side down, facing toward the feed spacer.

Note: *If you are cutting your own membranes, note that the membrane outer edge should fit between the inner and outer O-rings in the cell body to prevent leakage.*

5. Wet the permeate carrier with water or the fluid to be processed and place it in the cavity in the cell top. The surface tension caused by wetting the carrier will keep it in place.
6. Complete the assembly of the cell body by placing the cell top onto the cell bottom. The alignment holes should fit snugly over the alignment pins in the cell bottom.
7. Lay the brass washers in the grooves.
8. Put all the bolts in and tighten with maximum torque.

Note: *A good practice is to tighten all the bolts simultaneously. The torque setting on the bolts and fittings must not exceed the maximum values as noted in **Table 1**.*

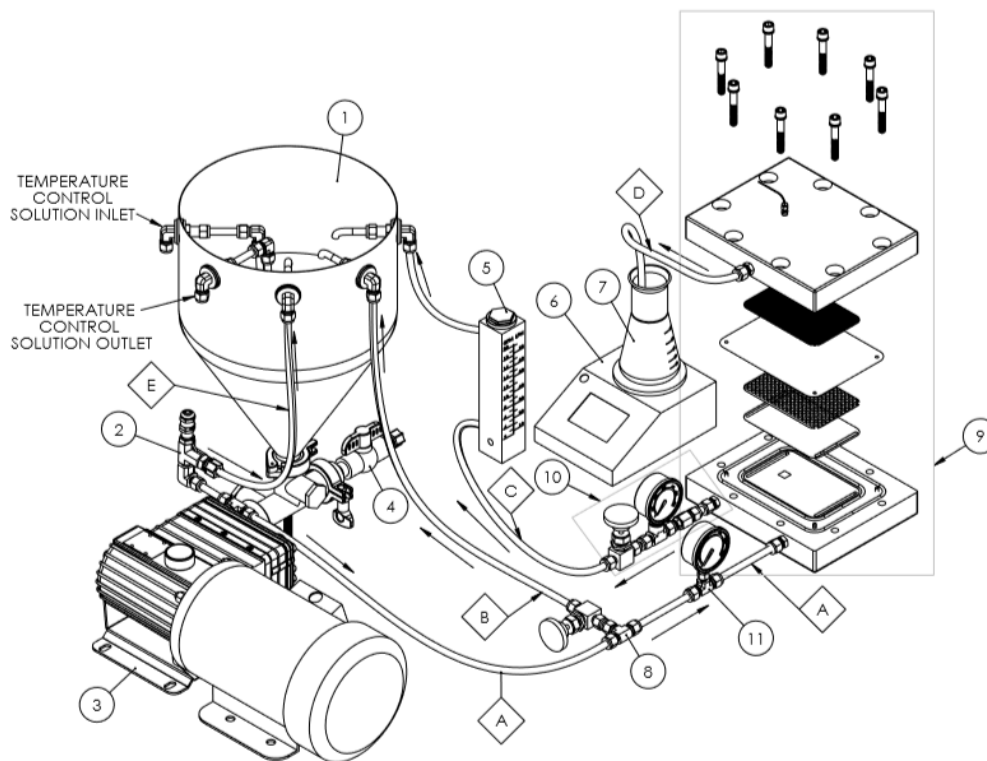
3.1 ACRYLIC SEPA ELECTRODE MODIFIED CELL CONNECTIONS AND PARTS

Figure 2 shows typical plumbing connections that need to be made for the operation of the Acrylic Sepa Electrode Modified Cell. The configuration can change slightly depending on the objectives of the user. In general, the connections to be made are:

1. Feed vessel to the inlet pump
2. Pump outlet to the feed inlet of the cell body
3. Concentrate flow control valve to the feed vessel
4. Permeate outlet to the permeate collection vessel

Figure 2 also lists the additional components that are necessary to operate the Acrylic Sepa Electrode Modified Cell. These components are sold separately and can be found in the Membrane/Process Development section of the Sterlitech website: www.sterlitech.com/membrane-process-development.html. The final assembly of the crossflow system will vary with the feed vessels, pumps, and tubing used.

Figure 2: Example Acrylic Sepa Electrode Modified Flow Diagram



ELECTRODE MODIFIED DISTILLATION SEPA FLOW DIAGRAM	
ITEM NO.	PART DESCRIPTION
1	CONICAL FEED TANK
2	PRESSURE RELIEF VALVE
3	MOTOR & PUMP ASSEMBLY
4	DRAIN VALVE
5	FLOW METER
6	SCALE FOR MEASURING PERMEATE FLUX
7	PERMEATE COLLECTOR
8	BY-PASS NEEDLE VALVE WITH 3/8" "T" TUBE FITTING
9	EMD SEPA ASSEMBLY
10	CONCENTRATE CONTROL VALVE ASSEMBLY (0-400psi)
11	FEED PRESSURE GAUGE
A	3/8" HIGH PRESSURE FLEX OR RIGID TUBING, FEED LINE
B	3/8" LOW PRESSURE TUBING, BY-PASS
C	3/8" LOW PRESSURE TUBING, RETURN LINE
D	1/4" LOW PRESSURE TUBING, PERMEATE OUTPUT LINE
E	3/8" LOW PRESSURE TUBING



4. OPERATION OF THE ACRYLIC SEPA ELECTRODE MODIFIED CELL

Once the Acrylic Sepa Electrode Modified Cell has been assembled and connected to a feed system, it can be used in variety of applications. These include reverse osmosis, ultrafiltration, nanofiltration, and microfiltration.

To operate the Acrylic Sepa Electrode Modified Cell:

1. Open all the valves in the system to relieve any pressure build-up before turning on the feed pump.
2. Turn the feed pump on.
3. Set the feed pressure to be less than or equal to 400 psig by gradually closing the concentrate valve.

Note: *A good starting point may be to set the system at 1.7 bar (25 psig) pressure for ultrafiltration or 17.2 bar (250 psig) for reverse osmosis. If this does not produce the desired results then the parameters can easily be adjusted and different membranes can be used.*

4. Verify the feed pressure reading on the concentrate pressure gauge (sold separately).
5. Adjust the concentrate flow control valve to obtain the desired pressure and flow. Experimentation enables you to determine the optimum settings for pressure, flow rate, and shim/spacer combination to use on the chosen membrane and the fluid being processed.
6. Once the experiment is complete, shut down the system by turning the feed pump off and opening all the valves to relieve any pressure build up.

To replace a membrane filter:

1. Turn the pump OFF.
2. Turn the pressure relief valve knob on the hydraulic pump counterclockwise to release the hydraulic pressure in the system.
3. Loosen the tightening screws on the cell top and separate the cell body top from the cell bottom.
4. Remove the membrane.
5. Install the new membrane (and, if necessary, spacers/permeate carrier).
6. Reassemble the cell top and bottom.
7. Turn the flow pumps on.

5. SUPPLEMENTARY OPERATING INFORMATION

5.1 MEMBRANE PERFORMANCE RESULTS

This cell is designed to mimic the hydrodynamic conditions of larger membrane elements. Spiral wound membranes containing mesh spacers are usually operated with a fluid velocity across the membrane surface of 0.1–0.5 m/sec (0.3–1.6 ft/sec). Higher velocities in membranes may lead to excessive pressure differential across the membrane and possible damage. Hollow fiber membranes, tubular membranes, and membranes with tubular spacers may be operated at higher velocities, but this may not contribute to a more effective operation.

5.2 MEMBRANE PERFORMANCE

Other parameters such as viscosity, pressure, and suspended solids may also affect performance/operation. Experimentation with the Acrylic Sepa Electrode Modified Cell can help predict the best operating parameters. If your pump is delivering too much flow, a portion of the flow can be diverted back to the feed container before entering the feed inlet of the cell body. This requires installation of an optional bypass valve and fitting on the pump outlet (**Figure 2, #8**), which is not supplied with the system.

5.3 TEMPERATURE LIMITS

The membranes, feed spacer, permeate, O-rings, and cell body materials construction dictate the maximum operating temperatures.

Table 2: Upper Temperature Limits

Component	Maximum Temperature
Acrylic Cell Electrode Modified	88 °C (190.4 °F)
Membrane Elements	Variable
Feed Spacer (PP)	82 °C (180 °F)
Permeate Carrier (PP)	82 °C (180 °F)
O-rings	
Viton	200° C (400° F)
EPDM	150° C (300° F)

5.4 MEMBRANE CLEANING

The Acrylic Sepa Electrode Modified Cell can be cleaned easily after the membrane is removed. However, you may wish to simulate the actual cleaning conditions of Cleaning-In-Place (CIP) in larger systems with spiral-wound or tubular membranes. This can be done with CIP. CIP chemically cleans without removing the membrane to mechanically scrub the unit. During CIP, cleaning solutions are re-circulated and, in some cases, allowed to sit for a period of time within the cell body. In some cases, the feed pump can be used to re-circulate the cleaning solutions.

6. ACCESSORY AND SPARE PART ORDERING INFORMATION

Accessories and spare parts for the Sepa Cell can be ordered by calling Sterlitech Corporation at 1-877-544-4420 or by visiting www.sterlitech.com.

Table 3: Accessory and Spare Part Ordering Information

Product	Shipping Weight	Ordering Number
Acrylic Sepa Electrode Modified Cell, for operation to 27 bar (400 psig)	5.4 kg (11.85 lbs)	1160131
Accessories		
Permeate Carrier Pack (PP)	0.5 kg (1 lb)	1142817
17 mil Feed Spacer (PP, 5/pack)	0.5 kg (1 lb)	1142816
31 mil Feed Spacer (PP, 5/pack)	0.5 kg (1 lb)	1142818
47 mil Feed Spacer (PP, 5/pack)	0.5 kg (1 lb)	1143763
47 mil Parallel Feed Spacer (PP, 5/pack)	0.5 kg (1 lb)	1142814
65 mil Feed Spacer (PP, 5/pack)	0.5 kg (1 lb)	1142819
Feed Spacer Assortment Pack (PP): 17, 31, 47, and 65 mil¹	0.5 kg (1 lb)	1232558
Shims (12 total/pack):		
<ul style="list-style-type: none"> • 4 of 2 mil • 4 of 5 mil • 2 of 10 mil • 1 of 15 mil • 1 of 25 mil 	0.5 kg (1 lb)	1231104
Spare Parts		
Membrane Packs	Contact Sterlitech	Contact Sterlitech
Viton O-rings	28 g (1 oz)	1143205
Concentrate/Back Pressure Control Valve, 400 psi	0.9 kg (2 lbs)	1149428

¹Other materials and sizes are available. Contact Sterlitech Corporation for more information.

7. RETURN MATERIAL AUTHORIZATION

If materials are to be returned to Sterlitech for repair, evaluation, or warranty consideration, a Return Material Authorization (RMA) number and form must be obtained from Sterlitech prior to the return. Contact Sterlitech's Customer Service Department for these forms.

The form must be completed and returned with the material. Be sure to include a complete, detailed written reason for the return. Also, include serial numbers, installation and removal dates, and any other pertinent information that is available. Acrylic Sepa Electrode Modified Cells have a serial number imprinted on the cell bottom.

Indicate the proposed disposition of the material, and reference the RMA number on all packages or cartons. All material must be shipped to Sterlitech with freight prepared by the customer.

8. WARRANTY

The following is made in lieu of all other warranties expressed or implied. Sterlitech Corporation guarantees equipment to be free from defects in material and workmanship when operated in accordance with written instructions for a period of one year from receipt. Parts not manufactured by Sterlitech are covered by their manufacturer's warranties, which are normally for one year.

Manufacturers and Seller's only obligation shall be to issue credit against the purchase or replacement of equipment proved to be defective in material or workmanship. Neither manufacturer nor seller shall be liable for any injury, loss or damage, direct or indirect, special or consequential, arising out of the use of, misuse, or the inability to use such product.

The information contained herein is based on technical data and tests, which we believe to be reliable, and is intended for use by persons having technical skill at their discretion and risk. Since conditions of use are outside Sterlitech's control, we can assume no liability whatsoever for results obtained or damages incurred through the application of the data presented. This information is not intended as a license to operate under, or a recommendation to infringe upon, any patent of Sterlitech or others covering any material or use. The foregoing may not be altered except by a written agreement signed by officers of the manufacturer.

9. TECHNICAL ASSISTANCE

Please contact us if you have any questions or technical inquiries about our products by calling Sterlitech Corporation at 1-877-544-4420 or by visiting www.sterlitech.com.

APPENDIX 1: ACRYLIC SEPA ELECTRODE MODIFIED CELL APPLICATIONS

The following studies utilize Electrode Modified Cell in their methods, and are listed here to illustrate potential applications.

APPLICATION	STUDY CITATION
Ultrafiltration	H. Mao, M. Qiu, X. Chen, H. Verweij, "Fabrication and in-situ fouling mitigation of a supported carbon nanotube/ γ -alumina ultrafiltration membrane", <i>Journal of Membrane Science</i> , 550 (2018) 26-35
Microfiltration (separation of macromolecules)	R.J. Wakeman and E.S. Tarleton, "Membrane fouling prevention in crossflow microfiltration by the use of electric fields", <i>Chemical Engineering Science</i> , 42 (4) (1987) 829-842.
Nanofiltration	C.F. de Lannoy, D. Jassby, et al. "Aquatic Biofouling Prevention by Electrically Charged Nanocomposite Polymer Thin Film Membranes", <i>Environ. Sci. Technol.</i> , 47 (6), (2013) 2760-2768.

	Discoverer	Innovator	Explorer	Developer	Investigator
					
Filter Holder	HP4750(X)	CF016	CF042	Sepa	1812
Membrane Active Area	14.6 cm ² (2.26 in ²)	20.6 cm ² (3.2 in ²)	42 cm ² (6.5 in ²)	140 cm ² (24 in ²)	0.27-0.46 m ² (3-5 ft ²)
Typical Permeate Flow Rate (per Cell)	1.5-15 mL/min	1-10 mL/min	2-20 mL/min	7-70 mL/min	350-2,300 mL/min
System Capacity	0.7-7 L/day (0.2-2 GPD)	1.5-15 L/day (0.4-4 GPD)	3-30 L/day (0.5-5 GPD)	10-100 L/day (2.6-26 GPD)	194-1,940 L/day (51-510 GPD)
Min. Batch Volume (per Cell)	300 mL	3.7 L (1 gal)	3.7 L (1 gal)	3.7 L (1 gal)	15 L (4 gal)
Max. Pump Capacity	N/A	6.8 LPM (76 bar) 1.8 GPM (1,100 psi)	6.8 LPM (76 bar) 1.8 GPM (1,100 psi)	6.8 LPM (76 bar) 1.8 GPM (1,100 psi)	6.8-38 LPM (76 bar) 1.8-10 GPM (1,100 psi)
Cell Material	SS316, Hastelloy™	PTFE, Delrin, Acrylic, SS316, Hastelloy™	PTFE, Delrin, Acrylic, SS316, Hastelloy™	Acrylic, SS316, Hastelloy™	SS316
Max. Operating Pressure	HP4750: 69 bar (1,000 psi) HP4750X: 172 bar (2,500 psi)	PTFE/Acrylic: 27.6 bar (400 psi) Delrin/SS316/Hastelloy™: 69 bar (1,000 psi)	PTFE/Acrylic: 27.6 bar (400 psi) Delrin/SS316/Hastelloy™: 69 bar (1,000 psi)	Acrylic: 27.6 bar (400 psi) SS316/Hastelloy™: 69 bar (1,000 psi)	41.4 bar (600 psi)
Filtration Mode(s)	Dead-End Stirred Cell	Cross Flow, Forward Osmosis	Cross Flow, Forward Osmosis	Cross Flow, Forward Osmosis	Cross Flow

NOTES:

Founded in 2001 in Kent, WA, Sterlitech Corporation manufactures and markets filtration- focused laboratory products to a broad spectrum of scientific and industrial sectors. Its line of flat sheet membranes and tangential flow cells deliver industry-leading performance and reliable results. Configured for reverse osmosis, nanofiltration, ultrafiltration, and microfiltration applications, Sterlitech's bench scale test equipment provides the versatility required to innovate.

Sterlitech's comprehensive line of products is supported by the expertise of its technical specialists who can assist with application-specific product selection, and provide customized solutions where necessary. Unique problem-solving approaches, flexibility, and consistent quality have made Sterlitech Corporation a renowned global provider of filtration products and equipment.

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