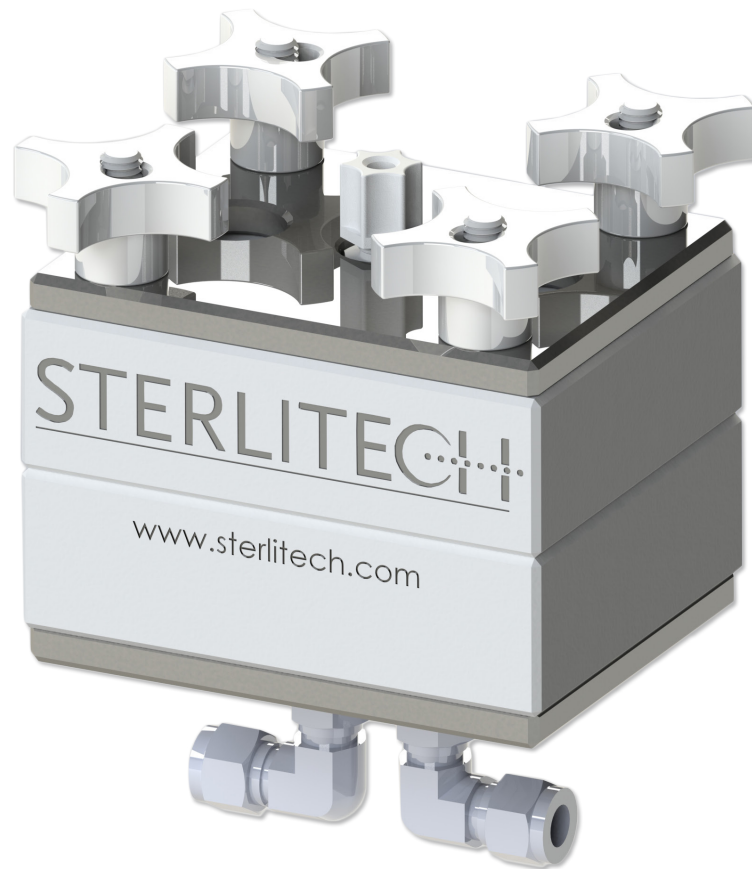


STERLITECH

C o r p o r a t i o n

CF016D CELL ASSEMBLY & OPERATION MANUAL



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1. INTRODUCTION

The CF016D Cell is a laboratory-scale crossflow filtration unit that is designed to evaluate 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.

Table 1 outlines the operational parameters and technical specifications of the CF016D Cell.

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

Table 1: CF016D Features and Technical Specification

Parameter	Description
Membrane Active Area	20.6 cm ² (3.1 in ²)
CF016D	Delrin
Maximum Pressure	69 bar (1000 psig)
Maximum Temperature	82 °C (180 °F)
O-rings	Buna* (Other materials available)
pH Range	Membrane Dependent
Cross Flow Velocity	Variable
Dimensions	
Slot Depth	2.28 mm (0.09 inches)
Slot Width	40 mm (1.54 inches)

2. CF016D CELL COMPONENTS

The cell body consists of the tightening knobs, cell top, sintered metal support, O-rings, and cell bottom. **Figure 1** (see *page 2*) illustrates a typical assembly of the CF016D.

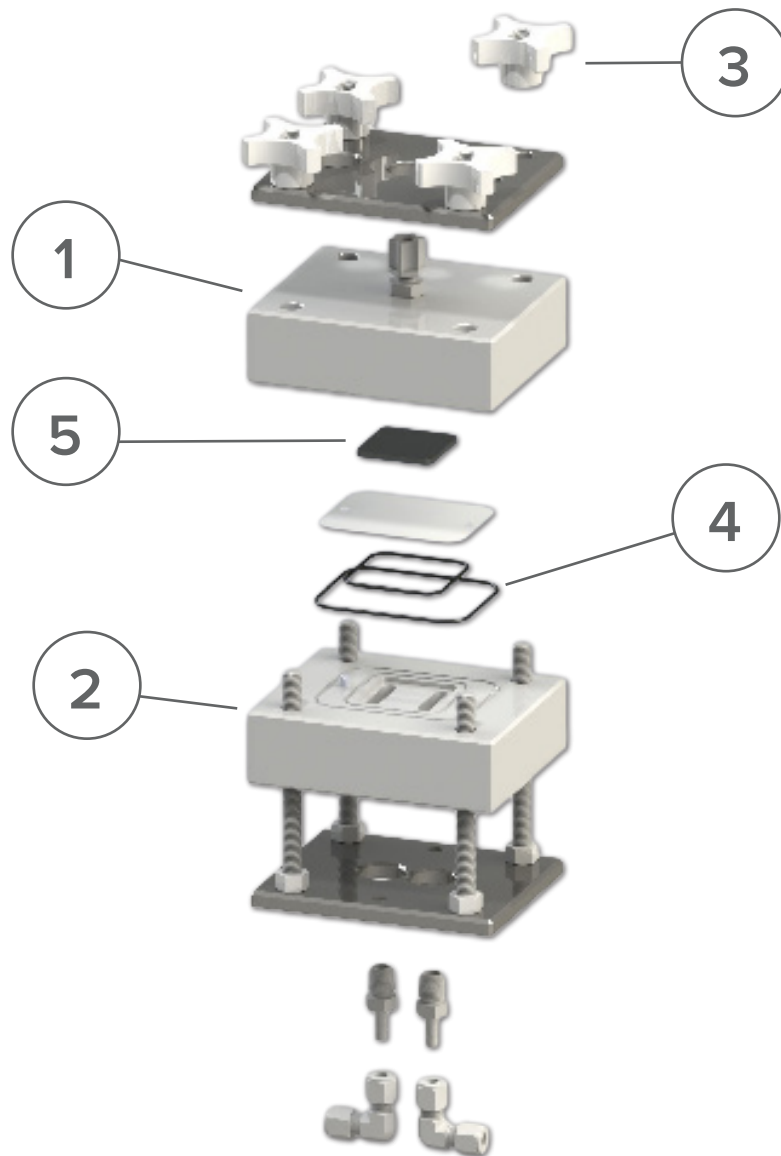
The CF016D is also packaged with a length of permeate tubing and membrane cutting template.

2.1 ADDITIONAL EQUIPMENT

The CF016D cell also requires additional equipment to operate that are sold separately:

- Feed Pump
- Feed Tank
- Filtration membrane packs

Figure 1: CF016D Crossflow Cell Body Assembly



Legend:

1. Cell top
2. Cell bottom
3. Tightening knobs
4. O-rings
5. Sintered metal support

3. CF016D CELL ASSEMBLY

After verifying that all of the necessary components were shipped and present, you can begin the assembly of the crossflow cell.

To assemble the CF016D crossflow cell:

1. Wet the O-rings with a small amount of water or the fluid to be processed and install them into the grooves on the cell bottom.

Caution: *Make sure that 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 the O-rings are not installed correctly.*

2. Place a piece of pre-cut membrane onto the cell bottom using the two alignment pins to hold the membrane in position. The membrane should be installed with the shiny or active side facing the feed solution.

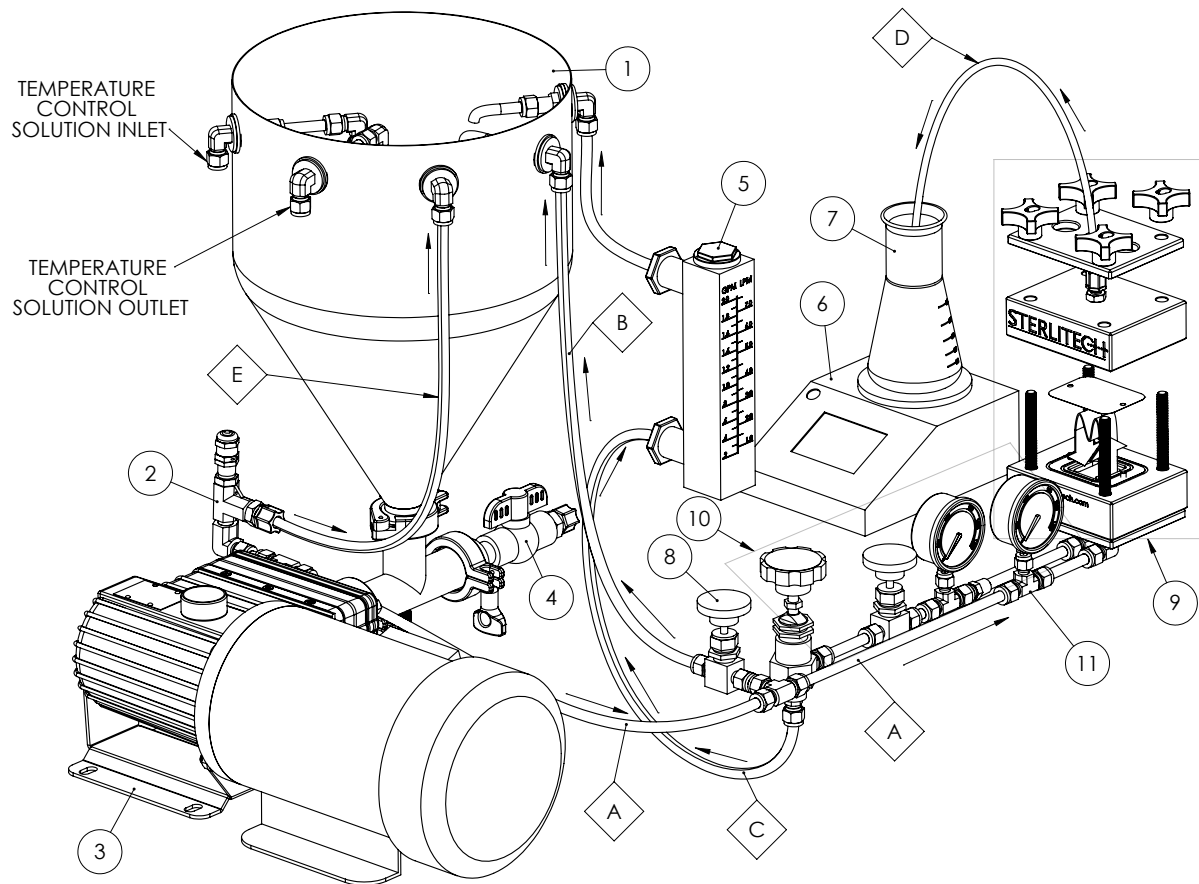
Note: *If you are cutting your own membranes, the membrane's outer edge should fit between the inner and outer O-rings in the cell body to prevent leakage.*

3. Place the cell top.
4. The alignment holes in the top should fit over the alignment pins in the cell bottom.
5. Insert one of the brass washers into each of the four holes at the corners of the cell top.
6. Secure the cell top by inserting and tightening one of the provided screws into each of the corner holes.

The CF016D crossflow Cell is now assembled and ready to be connected to a feed pump for operation.

4. CF016D CELL CONNECTIONS AND PARTS

Figure 2: Example CF016D Flow Diagram



CF016D FLOW DIAGRAM	
ITEM NO.	PART DESCRIPTION
1	CONICAL FEED TANK
2	PRESSURE RELIEF VALVE
3	FEED PUMP
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	CF016D CELL ASSEMBLY
10	CONCENTRATE/ CONTROL VALVE ASSEMBLY (0-1000 PSI)
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



Figure 2 shows typical plumbing connections that need to be made for the operation of the CF016D 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 outlet of the cell body 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 CF016D cell. These components are sold separately and can be found in the Membrane/Process Development section of the Sterlitech website (<http://www.sterlitech.com/membrane-process-development.html>). The final assembly of the crossflow system will vary with the feed vessels, pumps, and tubing used.

5. OPERATION OF THE CF016D CELL

Once the CF016D Cell has been assembled and connected to a feed system, it can be used in variety of applications that includes reverse osmosis, ultrafiltration, nanofiltration, and microfiltration.

To operate the CF016D Cell:

1. Open all of 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 of the valves to relieve any pressure build up.

To replace a membrane filter:

1. Turn the feed flow pump OFF.
2. Open all of the valves in the system to relieve any pressure build up.
3. Loosen the screws in the cell top.
4. Separate the cell body top from the cell bottom.
5. Remove the membrane.
6. Install the new membrane.
7. Reassemble the cell top and bottom.
8. Secure the cell top to the cell bottom using the screws.
9. Turn the feed flow pump on.

6. SUPPLEMENTARY OPERATING INFORMATION

6.1 MEMBRANE PERFORMANCE RESULTS

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.

6.2 MEMBRANE PERFORMANCE

Other parameters such as viscosity, pressure, and suspended solids may also affect performance/operation. Experimentation with the CF016D 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.

6.3 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
CF016D Cell	82 °C (180 °F)
Membrane Elements	Variable
O-rings	
Viton	200° C (400° F)
EPDM	150° C (300° F)
Buna-N	121° C (250° F)

6.4 MEMBRANE CLEANING

The CF016D 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. Clean-In-Place 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.

7. ACCESSORY AND SPARE PART ORDERING INFORMATION

Accessories and spare parts for the CF016D Crossflow 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
CF016D Cell, for operation to 69 bar (1000 psig)	4.5 kg (10 lbs)	CF016D
Feed Flow Pump	Contact Sterlitech	Contact Sterlitech
Accessories		
Feed Spacer Assortment Pack 17, 31, 47, and 65 mil	0.5 kg (1 lb)	1142820
CF016 Stainless Steel Stand	3.1 kg (7 lbs)	1230031
Spare Parts		
Viton O-rings	28 g (1 oz)	1220138
Concentrate Control Valve Assembly	0.9 kg (2 lbs)	1200013
Membrane Packs	Contact Sterlitech	Contact Sterlitech

8. 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. CF016D 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.

9. 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.

10. 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: CF016D CELL APPLICATIONS

The following studies utilized the CF042 Cell in their method and are listed here to illustrate the potential applications for the CF016. These studies are good references for understanding the operation of the CF016D Cell.

APPLICATION	STUDY CITATION
Reverse Osmosis (Desalination)	Sachit, Dawood Eisa. "Analysis of reverse osmosis membrane performance during desalination of simulated brackish surface waters." <i>Journal of Membrane Science</i> . 453. (2014): 136-154.
Forward Osmosis and Low Pressure Reverse Osmosis	Yangali-Quintanilla, Victor, Zhenyu Li, et al. "Indirect desalination of Red Sea water with forward osmosis and low pressure reverse osmosis for water reuse." <i>Desalination</i> . 280. (2011): 160-166.
Ultrafiltration (Food Processing)	Post, Antonie, Hanna Sampels, et al. "A comparison of micellar casein and β -casein as sources of basic peptides through tryptic hydrolysis and their enrichment using two-stage ultrafiltration." <i>International Journal of Dairy Technology</i> . 65.4 (2012): 482-489.
Ultrafiltration and Nanofiltration (Protein Production)	Ranamukhaarachi, Sahan, Lena Meissner, et al. "Production of antioxidant soy protein hydrolysates by sequential ultrafiltration and nanofiltration." <i>Journal of Membrane Science</i> . 429. (2013): 81-87.
Membrane Development	Qadir, Ahmad. Development of new membranes for desalination pre-treatment. MA thesis. University of Illinois at Urbana-Champaign, 2011. Web. < https://www.ideals.illinois.edu/handle/2142/26369 >.

APPENDIX 2: STERLITECH BENCH SCALE FILTRATION PRODUCTS

Membrane & Process Development Product Families

	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: 276 bar (400 psi) Delrin/SS316/Hastelloy™: 69 bar (1,000 psi)	PTFE/Acrylic: 276 bar (400 psi) Delrin/SS316/Hastelloy™: 69 bar (1,000 psi)	Acrylic: 276 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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