

STERLITECH

CF047/CF090 CELL Assembly & Operation Manual

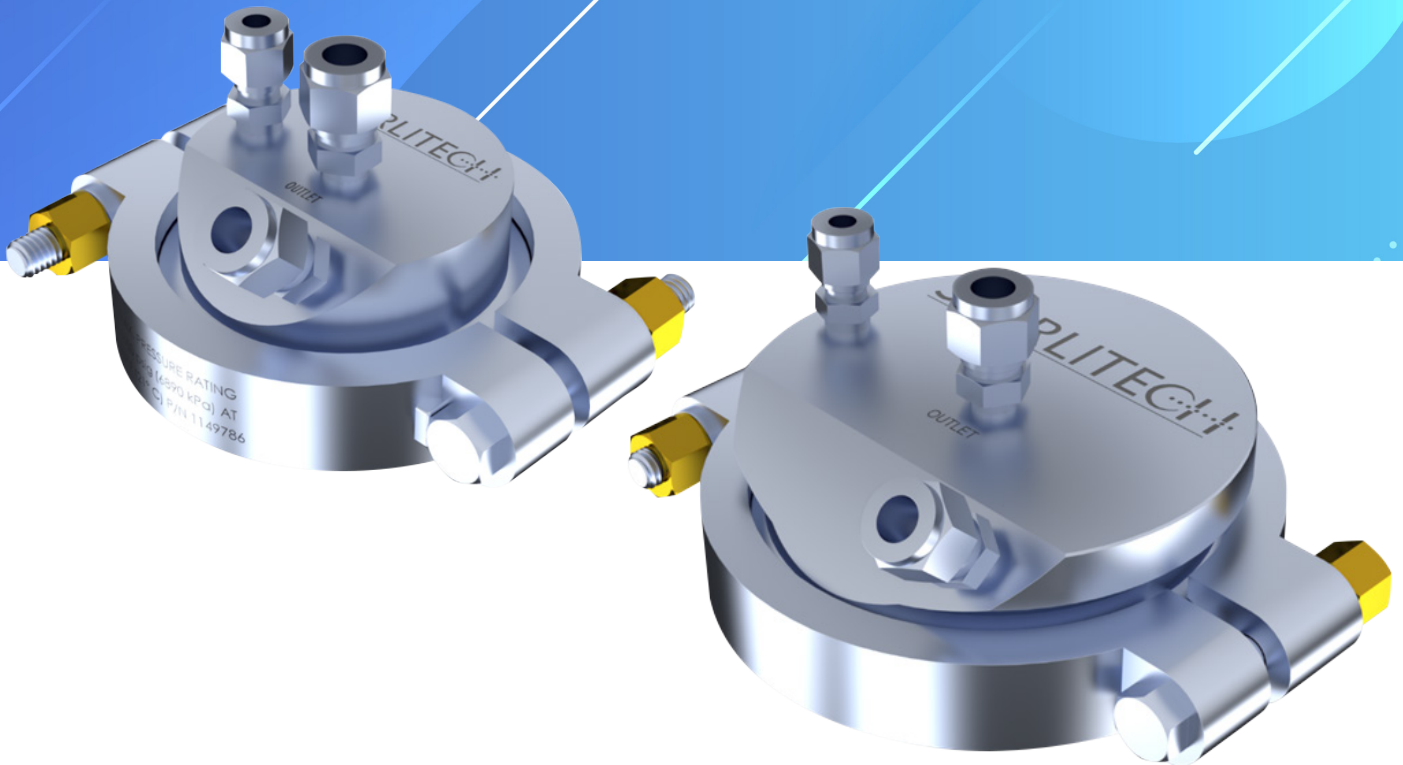


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1. Introduction

The CF047/CF090 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 CF047/CF090 Cell.

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

Table 1: CF047/CF090 Features and Technical Specification

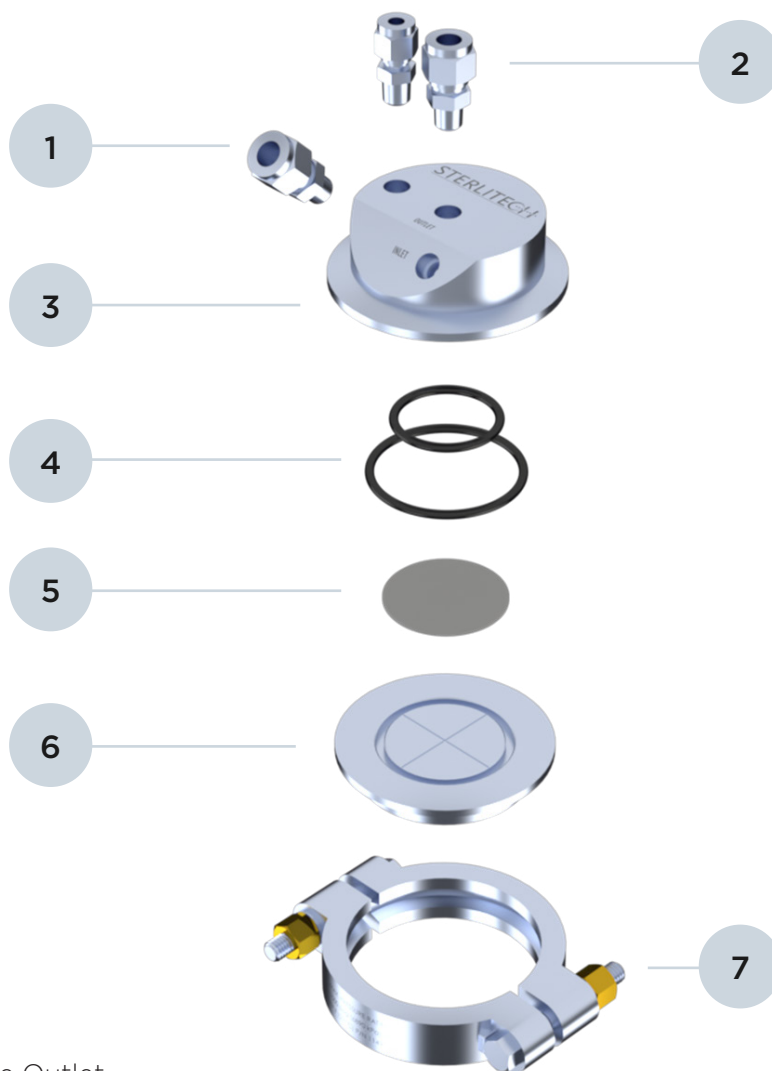
Parameter	Description
Membrane Size	CF047: 47-49 mm CF090: 90-92 mm
Membrane Active Area	CF047: 14.6 cm ² (2.26 inch ²) CF090: 53 cm ² (8.2 inch ²)
Cell Body Material	316 Stainless Steel
Maximum Pressure*	69 bar (1000 psig) @ 22°C, 71.6°F
Maximum Temperature*	150°C (302°F)
O-rings	Viton* (Other materials available)
pH Range	Membrane Dependent
Cross Flow Velocity	Variable
Connections	
Inlet/Outlet Size (Tube OD)	3/8" Compression
Permeate Size (Tube OD)	1/4" Compression
Securing Method	High Pressure Tri-Clamp (Sanitary) Fitting

* Note: Maximum Pressure and Temperature ratings are dependent on a variety of factors involved in MPD testing. Listed values are guidelines based upon material properties and cannot be guaranteed in every application.

2. CF047/CF090 Cell Components

The cell assembly consists of the cell top, sintered metal support, O-rings, cell bottom, high pressure clamp and associated bolts. **Figure 1** illustrates a typical assembly of the CF047/CF090.

Figure 1: CF047/CF090 Crossflow Cell Body Assembly



Legend:

- 1. Permeate outlet
- 2. Feed Inlet and Concentrate Outlet
- 3. Cell top
- 4. Inner and outer O-Rings
- 5. Sintered metal support
- 6. Cell bottom
- 7. High Pressure Clamp Assembly

2.1. Additional Equipment

The CF047/CF090 cell also requires additional equipment to operate that are sold separately:

- Feed Pump
- Feed Tank
- Filtration membrane packs
- Flow control valves
- High pressure hoses
- Pressure gauges

3. CF047/CF090 Cell Assembly

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

To assemble the CF047/CF090 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 top.



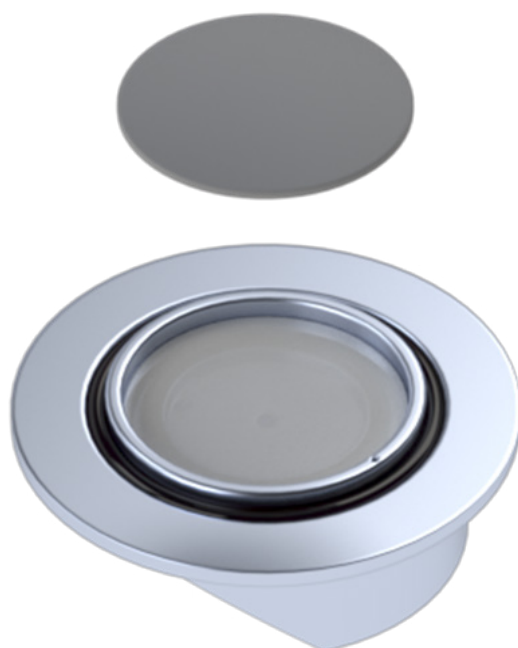
Caution: Ensure the O-rings lie flat in the grooves of the cell top. Leaking may occur if the O-rings do not lie flat in the grooves. The O-rings will be cut or crushed when the system is operating if the O-rings are not installed correctly.

2. Place piece of pre-cut membrane inside the cell top, centered over the inner o-ring. The membrane should be installed with the shiny or active side down toward the cavity in the cell top.

Note: When cutting membranes, ensure the membrane diameter extends past the outer edge of the inner O-ring to prevent leakage.



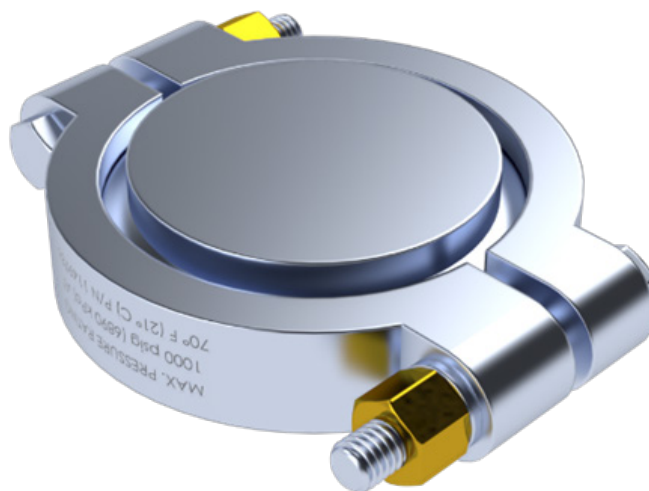
3. Place the sintered metal support disk on top of the membrane to hold the membrane in place.



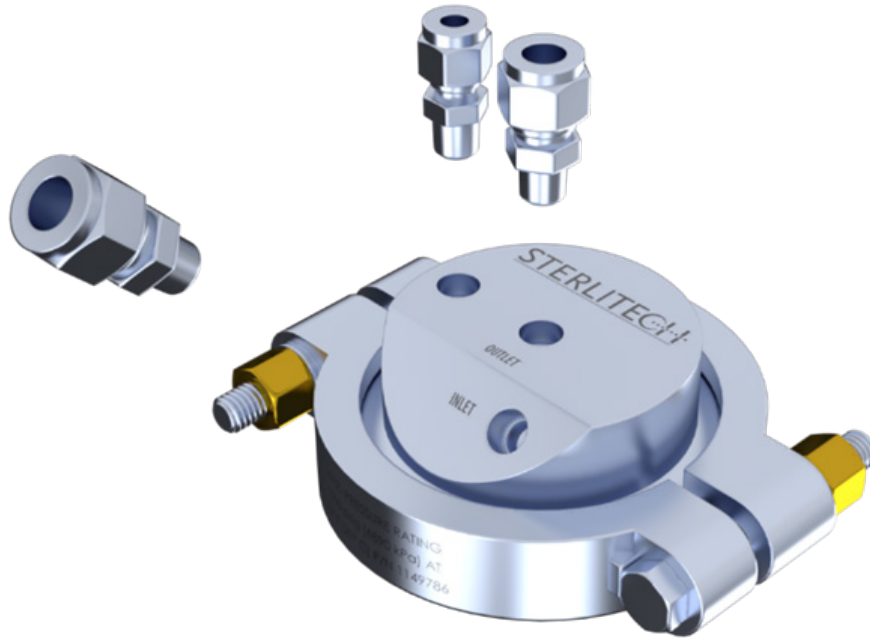
4. Place the cell bottom on the assembled cell top



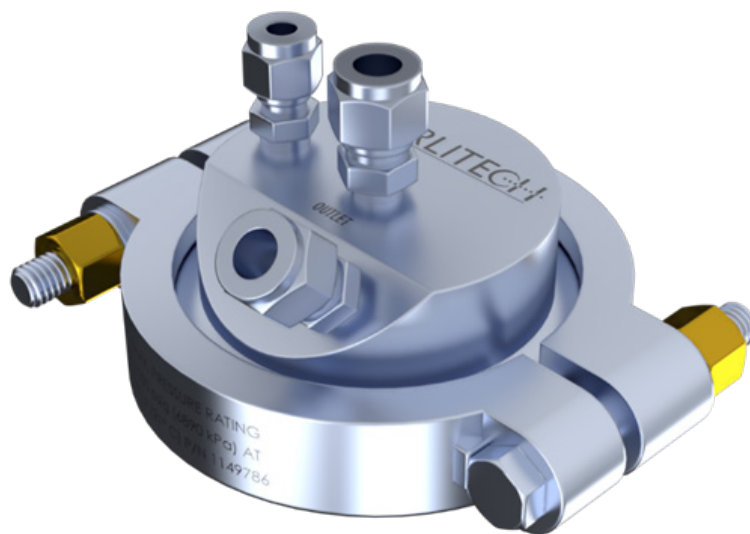
5. Use the 3-inch high pressure coupling to clamp the cell bottom to the cell body. Tighten the high pressure coupling with 27 Nm (20 ft-lb) of torque for 69 bar (1000 psig) operation.



6. Flip the cell over and install the feed inlet/outlet and permeate fittings as shown, if they have not been previously installed. Use PTFE tape and thread sealant when installing fittings into the cell.

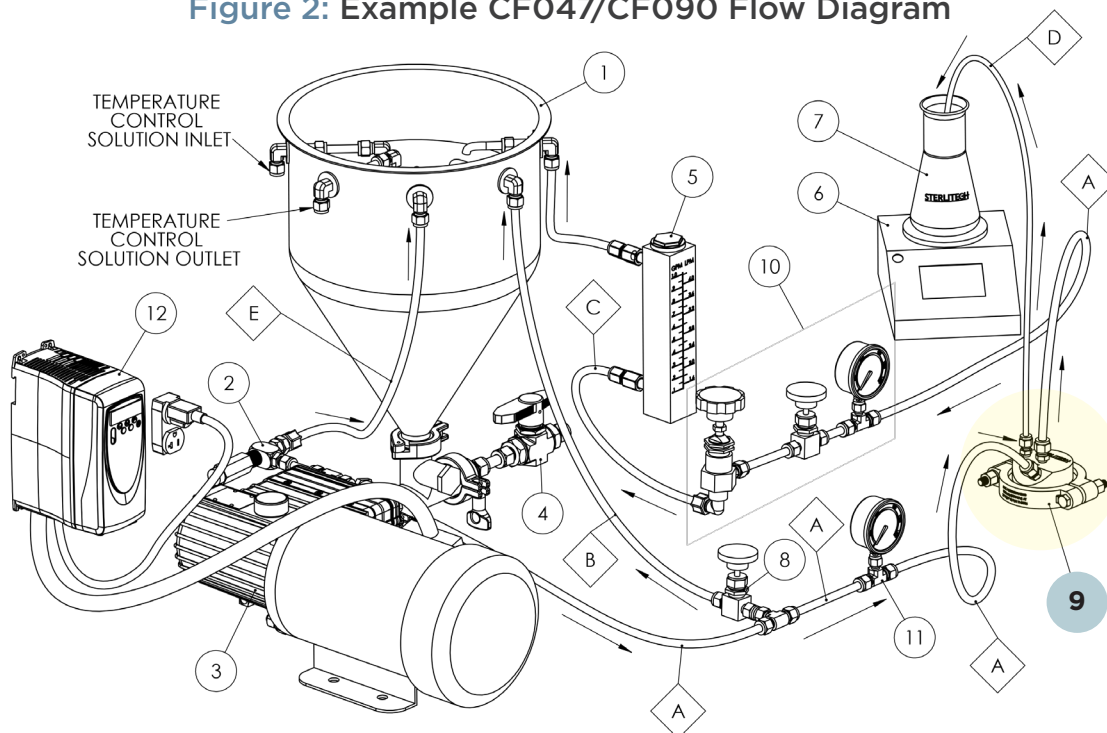


7. The CF047/CF090 Crossflow Cell is now assembled and ready for operation.

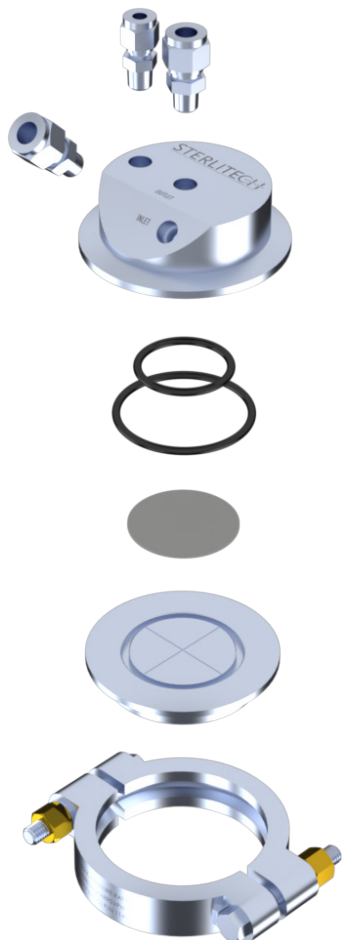


4. CF047/CF090 Cell Connections And Parts

Figure 2: Example CF047/CF090 Flow Diagram



Crossflow System Flow Diagram for CF047 & CF090 Cells



Item No.	Part Description
1	5 GAL CONICAL FEED TANK W/ TEE & CHILLER COIL
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 WITH 3/8" "T" FITTING
9	CF047/CF090 CELL ASSEMBLY
10	CONCENTRATE CONTROL VALVE ASSEMBLY
11	FEED PRESSURE GAUGE
12	VARIABLE FREQUENCY DRIVE (VFD)
A	3/8" HIGH PRESSURE FLEX OR RIGID TUBING, FEED LINE
B	3/8" LOW PRESSURE TUBING, BY-PASS LINE
C	3/8" LOW PRESSURE TUBING, RETURN LINE
D	1/4" LOW PRESSURE TUBING, PERMEATE OUTPUT LINE
E	3/8" LOW PRESSURE TUBING, RELIEF RETURN LINE

Figure 2 shows typical plumbing connections that need to be made for the operation of the CF047/CF090 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 pump inlet
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 CF047/CF090 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-processdevelopment.html>). The final assembly of the crossflow system will vary with the feed vessels, pumps, and tubing used.

5. Operation Of The CF047/CF090 Cell

Once the CF047/CF090 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 CF047/CF090 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. Adjust the flow using the by-pass line or by adjusting the pump speed.
4. Adjust the concentrate/back pressure control valve to obtain the desired pressure.
5. 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.

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.

To replace a membrane filter:

1. Turn the feed flow pump OFF.
2. Open all the valves in the system to relieve any pressure build up.
3. Open the high-pressure clamp
4. Separate the cell body top from the cell bottom.
5. Remove the support disk and the used membrane.
6. Install the new membrane, followed by the support disk.
7. Reassemble the cell top and bottom.
8. Secure the cell top to the cell bottom using the high-pressure clamp.
9. Reconnect inlet, outlet, and permeate fittings to the cell as required. Resume operation as outlined above.

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 CF047/CF090 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 a bypass valve and fitting on the pump outlet (**Figure 2, #8**).

6.3 Temperature Limits

The membrane, O-rings, and cell body materials construction dictate the maximum operating temperatures. Listed values are guidelines based upon material properties.

Table 2: Upper Temperature Limits

Component	Maximum Temperature
CF047/CF090 Cell	150 °C (302 °F)
Membrane	Variable
O-rings	
Viton	200° C (400° F)
EPDM	150° C (300° F)
Buna-N	121° C (250° F)

6.4 Membrane Cleaning

The CF047/CF090 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 can be purchased online at www.sterlitech.com or by calling us at 1-877-544-4420

Table 2: Accessory and Spare Part Ordering Information

Product	Shipping Weight	Ordering Number
CF047 Cell, for operation to 69 bar (1000 psig)	2.3 kg (5 lbs.)	1160354
CF090 Cell, for operation to 69 bar (1000 psig)	3.2 kg (7 lbs.)	1160361
Accessories		
47mm Diameter Steel Rule Die	0.85 lb.	1230118
90mm Diameter Steel Rule Die	0.85 lb.	1560008
Spare Parts for CF047		
EPDM O-Ring Kit	28 g (1 oz)	1160385
Viton O-Ring Kit	28 g (1 oz)	1160384
Buna-N O-Ring Kit	28 g (1 oz)	1160383
Spare Parts for CF090		
EPDM O-Ring Kit	28 g (1 oz)	1160382
Viton O-Ring Kit	28 g (1 oz)	1160381
Buna-N O-Ring Kit	28 g (1 oz)	1160380
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. CF047/CF090 Cells have a serial number imprinted on the cell top.

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

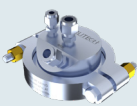


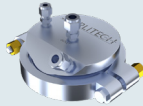

Please contact us if you have any questions or technical inquiries about our products by calling Sterlitech Corporation at 1-877-544-4420 or by visiting www.sterlitech.com.

Appendix 1: CF047/CF090 Cell Applications

The following studies utilized Sterlitech cells in their method and are listed here to illustrate the potential applications for the CF047/CF090. These studies are good references for understanding the operation of a flat sheet membrane test 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

	Pioneer	Innovator	Explorer	Researcher	Developer
					
Filter Holder	CF047	CF016	CF042	CF090	Sepa
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)	53 cm ² (8.2 in ²)	140 cm ² (22 in ²)
Typical Permeate	1-10 mL/min	1-10 mL/min	2-20 mL/min	2.5-25 mL/min	7-70 mL/min
Flow Rate (per Cell)	1-10 L/day (0.4-4 GPD)	1.5-15 L/day (0.4-4 GPD)	3-30 L/day (0.5-5 GPD)	4-38 L/day (0.6-6 GPD)	10-100 L/day (2.6-26 GPD)
Cell Material	SS316	PTFE, Delrin, Acrylic, SS316, Hastelloy™	PTFE, Delrin, Acrylic, SS316, Hastelloy™	SS316	Acrylic, PEEK, SS316, Hastelloy™
Max. Operating Pressure	69 bar (1,000 psi)	Material Dependent	Material Dependent	69 bar (1,000 psi)	Material Dependent
Filtration Mode(s)	Cross Flow	Cross Flow, Forward Osmosis	Cross Flow, Forward Osmosis	Cross Flow	Cross Flow, Forward Osmosis

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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