



## Cleaning Guidelines



The New  
Standard For  
Dissolved Gas Control



[www.liqui-cel.com](http://www.liqui-cel.com)

<b>CONTENTS</b>	<b>Page</b>
1. Intent of Document	2
2. Cleaning Parameters	2
3. Chemical Compatibility / Sanitizing / Detergents	3
4. Cleaning Solution Flow Rate and Back Pressure Guidelines	4
5. High Temperature Cleaning / CIP	5
6. Cleaning Protocol for Biological Soil Removal	6
7. Cleaning Protocol for Mineral Deposits Removal	9
8. Cleaning Protocol for Particle Fouling	11
9. Membrane Drying	12
10. Membrane Contactor Integrity Test	14
11. Storage and Handling Guidelines	15
12. Contactor Decontamination for Return to MEMBRANA	16

<b>Schematics</b>	<b>Page</b>
1. Biological Soil Removal	8
2. Acid Cleaning for Mineral Deposit Removal	10
3. Particle Fouling Cleaning	11
4. Bulk and Final Drying	13

## IMPORTANT INFORMATION - PLEASE READ CAREFULLY

### 1.0 INTENT OF DOCUMENT

---

There are many different types of contaminants that may adhere to the membrane. The cleaning protocol, which covers chemical cleaning agents, concentrations, time and flow rates, will be specific to your system. The cleaning guidelines contained in this document represent a starting point and may require modification to suit your specific application.

### 2.0 CLEANING PARAMETERS

---

There are four parameters that affect the cleaning process:

- Time (duration and frequency)
- Temperature
- Mechanical agitation
- Chemical type (caustic, acid, alcohol, etc.)

Changing any of these parameters can affect the others. Therefore, it is important to develop a specific cleaning protocol that best suits your application. The following guidelines will help you to begin and guide you through the cleaning process. We recommend that you start with cleaning chemicals that are generally used within your industry.

The initial performance of the contactor should be monitored to establish its baseline performance. This baseline performance can be compared to the performance of the contactor after cleaning. Other considerations for establishing the best protocol for your applications are:

- Experimentation with *time* (frequency and duration), *temperature*, *chemical concentration* and *flow rate* will determine the best method for cleaning the contactor.
- Refer to the Liqui-Cel Membrane Contactor product data sheet for maximum temperature and pressure ratings. Take into account the temperature rise that occurs during a chemical reaction (caustic in water) or from pumping.
- An aggressive cleaning protocol may clean the contactor in a shorter time period, but can also reduce the contactor service life.

The frequency of cleaning can generally be determined by monitoring a drop in the system performance.

### 3.0 CHEMICAL COMPATIBILITY / SANITIZATION / DETERGENTS

For general questions about chemical resistance, refer to the Liqui-Cel® Membrane Contactor **Chemical Resistance Guide** available at [www.liqui-cel.com](http://www.liqui-cel.com) or from your Membrana representative.

Table 1 shows the maximum recommended exposure times for several chemicals, which can be used to clean or sanitize a Liqui-Cel Membrane Contactor. To determine the total exposure time as a function of concentration, divide the value shown in column 2 of Table 1 by your actual chemical concentration. The resulting value is the total number of hours the contactor can be exposed to a specific chemical concentration.

**Table 1: Sanitizing Guidelines**

	<b>Column 2</b>	<b>Column 3</b>
<b>Chemical</b>	<b>Concentration-hours at Room Temperature</b>	<b>Maximum Recommended Chemical Concentration *</b>
Chlorine pH > 7	24000 ppm-hours	100 ppm
Hydrogen Peroxide	4800 %-hours	10% wt.
Peracetic acid	4800 ppm-hours	100 ppm

\* Exposure times were determined when the fiber tensile strength and elongation values just began to decrease. The test conditions did not exceed these maximum concentrations, and testing was completed at 23°C. Using higher concentrations is not recommended, and at elevated temperatures the expected life is much shorter.

#### Exposure Time Calculations

**Case 1: 2% hydrogen peroxide sanitation everyday for 30 minutes.**

- What is the total exposure time for a solution of hydrogen peroxide at 2% concentration at room temperature?
- What is the maximum number of 30 minute cycles that the contactor can be subjected to using this solution at room temperature?
- Assume the desired number of cycles will be 365 times per year and the contactor will have a lifetime of 3 years. Should this cleaning chemical protocol be used?

**Solution**

- Divide 4800 % - hours by 2%. Total exposure time = 2400 hours.
- Divide 2400 hours by 0.5 hours (30 minutes). Total number of cycles = 4800.
- Using 365 cycles per year and an expected lifetime of 3 years, the total number of exposure cycles is 1095 (365 \* 3 years). It would be safe to use this chemical for daily cleaning for 30 minutes per day at 2% concentration at room temperature since 1095 cycles < 4800 cycles.

The total life expectancy of a Liqui-Cel Membrane Contactor is affected by many factors, one of which is the chemical cleaning cycle. Do not assume the total number of exposure cycles can be used to predict the ultimate lifetime of a contactor. Use this total number of cycles to judge whether the contactor lifetime will be affected by the cleaning cycle. In the case above, compare the number of theoretical cleaning cycles (4800 cycles) to the desired number of cleaning cycles over the expected lifetime of the contactor (1095 cycles). The conclusion in this example is that cleaning cycles will probably not reduce the 3-year lifetime of the membrane.

Case 2 illustrates a cleaning protocol that we **DO NOT RECOMMEND**.

**Case 2: 200 ppm peracetic acid sanitization every day for 30 minutes.**

- a) *What is the total exposure time for a solution of peracetic acid at 200 ppm concentration at room temperature?*
- b) *What is the maximum number of 30 minute cycles that the contactor can be subjected to using this solution at room temperature?*
- c) *Assume the desired number of cycles will be 365 times per year and the contactor will have a lifetime of 3 years. Should this cleaning chemical protocol be used?*

**Solution**

- a) *Divide 4800 ppm - hours by 200 ppm. Total exposure time = 24 hours.*
- b) *Divide 24 hours by 0.5 hours (30 minutes). Total number of cycles = 48.*
- c) *Using 365 cycles per year and an expected lifetime of 3 years, the total number of exposure cycles is 1095 (365 \* 3 years). It would NOT be safe to use this chemical for daily cleaning for 30 minutes per day at 200 ppm concentration at room temperature since the required number of cycles (1095) is much greater than the maximum number of 48 cycles.*

However, the protocol could be used if the cleaning frequency was changed to 4 times per year for 3 years = 12 cycles, which is less than maximum number of 48 cycles.

**IMPORTANT NOTES FOR CLEANING SOLUTION SELECTION:**

**DO NOT USE STRONG OXIDIZING AGENTS** such as ozone.  
**Do NOT use any chemicals that contain DETERGENTS or surfactants.**  
*Surfactants may allow liquids to pass through the membrane. This phenomenon is called break-through or wet-out. The membrane can be restored to a hydrophobic state by rinsing the detergent from the contactor and then drying it but this is a time consuming process.*

**4.0 CLEANING SOLUTION FLOW RATE AND BACKPRESSURE GUIDELINES**

It is important to apply a backpressure to the system to insure a liquid-full system during the cleaning cycle. To increase the cleaning solution backpressure, slowly close the outlet flow valve. Refer to Table 2 for general guidelines. Indicated flow rate is for a single unit and should be used just as a guideline. Depending on the fouling nature, the flow rate should be adjusted accordingly.

**Table 2: Cleaning Solution Flow Rate and Backpressure Guidelines**

Contactors Size	MiniModule® Contactors	2 × 6 Contactor	2.5 × 8 Contactor	4 × 28 & 6 × 28 Contactor	10 × 28 Contactor	14 × 28 Contactor
Shellside Flow Rate	≤ 0.13 gpm (≤ 500 ml/min)	≤ 0.26 (≤ 1 lit/min)	1 – 2 gpm (0.23 – 0.45 m <sup>3</sup> /h)	10 – 30 gpm (2.3 – 6.8 m <sup>3</sup> /h)	30 – 40 gpm (4.5 – 9.0 m <sup>3</sup> /h)	50 – 60gpm (11.4 – 13.6 m <sup>3</sup> /h)
Shellside Backpressure	10 – 30 psig (30 psig/2.1 kg/cm <sup>2</sup> )	10 – 30 psig (30 psig/2.1 Kg/cm <sup>2</sup> )	10 – 30 psig (30 psig/2.1 Kg/cm <sup>2</sup> )	10 – 30 psig (30 psig/2.1 kg/cm <sup>2</sup> )	10 – 30 psig (30 psig/2.1 kg/cm <sup>2</sup> )	10 – 30 psig (30 psig/2.1 kg/cm <sup>2</sup> )
Lumenside Flow Rate	≤ 0.08 gpm (≤ 300 ml/min)	Not Applicable	≤0.5 gpm (≤ 0.11 m <sup>3</sup> /h)	3 - 7 gpm (0.68 - 1.60 m <sup>3</sup> /h)	10 - 20 gpm (2.3 - 4.5 m <sup>3</sup> /h)	10 - 20 gpm (2.3 - 4.5 m <sup>3</sup> /h)
Lumenside Backpressure	5 – 10 psig (0.35-0.70 kg/cm <sup>2</sup> )	5 – 10 psig (0.35-0.70 kg/cm <sup>2</sup> )	5 – 10 psig (0.35-0.70 kg/cm <sup>2</sup> )	5 – 10 psig (0.35-0.70 kg/cm <sup>2</sup> )	5 – 10 psig (0.35-0.70 kg/cm <sup>2</sup> )	5 – 10 psig (0.35-0.70 kg/cm <sup>2</sup> )

**NOTE:** Shellside = Outside of fiber. Liquid flows shellside for 2x6, 2.5, 4, 6, 10 and 14-inch contactors  
 Lumenside = Inside of fiber. MiniModules run with liquids on the lumenside. Since gas normally flows through lumenside with 2 x 6, 2.5, 4, 6, and 10-inch contactors, lumenside cleaning is less frequent.

To prepare a cleaning solution when using untreated raw water, it is important to know the water chemistry. We recommend using water that has been filtered and de-chlorinated. We recommend using de-ionized water for cleaning if possible. We also recommend paying attention to metals, such as Mg, iron, Al, and to SiO<sub>2</sub>. These elements can precipitate onto the membrane when there is a pH shift in the water.

## 5.0 HIGH TEMPERATURE & CIP CLEANING

Hot water or hot caustic can be used to clean Liqui-Cel Membrane Contactors in stainless steel housings, depending upon the specific contactor. Please contact your representative prior to using temperatures above 122°F (50°C) at 105 psi (7.4 kg/cm<sup>2</sup>). Circulate all solutions through the shellside.

**Table 3: CIP Cleaning Guidelines**

Step	Description	Chemical Solution	Time (min.)
1	Water flush / once through	10 micron filtered, ambient to cold water	5
2	Alkaline wash / recirculated	2% to 5.5% w/w caustic (NaOH or KOH) solution, using 10 micron filtered water. Suggested temperature ambient-122°F (ambient-50°C)	30 min – 2 hours
3	Water flush / once through	10 micron filtered, ambient to cold, water	Until neutral pH is achieved
4	Acid rinse / recirculated	5% w/w citric, or 3% Nitric or phosphoric, or 3% hydrochloric or a combination of 3% Nitric and 3% phosphoric acid solution or 3% Nitric and 3% HCL using filtered (10 micron) water at ambient temp.	30 – 60
5	Water flush / once through	10 micron filtered, ambient to cold, water	Until neutral pH is achieved
6	Purge lumens	CO <sub>2</sub> , N <sub>2</sub> , air, or gas at maximum flow rate. If operating in combo mode, use maximum sweep gas in combination with your vacuum pump.	Until no water droplets appear from exit sweep port

**NOTE:** in steps 1 - 6, always keep a water backpressure less than 30 psig.

- Do not use a commercial caustic that contains surfactants.
- Do not purge CO<sub>2</sub> during alkaline wash. If vacuum is in the system, pull a vacuum during Hot CIP. Always purge with gas after the Hot CIP process is complete. (So long as the contactor has cooled down to room temperature, air sweep can be used for a final lumen purge).

## 5.0 HIGH TEMPERATURE & CIP CLEANING CONTINUED

Once the membrane has been cleaned, it is ready for the high temperature sanitization guidelines below. Be careful not to exceed 85°C. Also note that only SS vessels are recommended for Hot CIP cycles to 85°C.

**Table 4: High Temperature Sanitization Guidelines Stainless Steel Housings, X40 Fiber in 4 and 10-inch sizes. X-50 in 4-inch Only**

Maximum Temperature	Maximum Operating Pressure	Maximum exposure cycles (at 30 minutes per cycle)
181°F-185°F (83 - 85°C)	30 psig (2.11 kg/cm <sup>2</sup> )	1000

NOTE: The lumenside should have N<sub>2</sub> or vacuum flow, if available, during high temperature cleaning cycle. Always purge with gas after the Hot CIP process is complete. (So long as the contactor has cooled down to room temperature, air sweep can be used for a final lumen purge).

To maintain the product warranty, the maximum normal operating feed water temperature should not exceed 122°F (50°C).

The water temperature during the sanitization cycle should be accurately controlled so it does not exceed 185°F (85°C).

## 6.0 CLEANING PROTOCOL FOR BIOLOGICAL SOIL REMOVAL

### A. Biological Soil Removal

If the performance of the contactor is decreasing, the contactor probably needs to be cleaned. If the soil has not penetrated the membrane pore structure, surface cleaning of the wetted side of the membrane (normally the shellside) is usually sufficient to restore performance. If the performance is not restored after two cleaning cycles, then use the **Severe Biological Soil Cleaning Protocol – see 6.0 section B**.

**Table 5: Normal Biological Soil Cleaning Protocol**

Step	Description	Chemical Solution	Time (min.)
1	Water flush / once through	Ambient to cold water filtered to 10 micron	5
2	Alkaline wash / recirculate	2% w/w caustic (NaOH or KOH) solution, using 10 micron filtered water. Suggested temperature ambient-104°F (up to-40°C)	45 min to 2 hrs.
3	Drain Contactor		
4	Acid rinse / recirculated	5% w/w citric, or 3% Nitric or phosphoric, or 3% hydrochloric or a combination of 3% Nitric and 3% phosphoric acid solution or 3% Nitric and 3% HCL using filtered (10 micron) water at ambient temp.	45 min to 2 hrs.
5	Rinse Contactor / once through	Ambient to cold water filtered to 10 micron	15-30 or until neutral pH is achieved

NOTES: in steps 1 - 6, always keep a water backpressure less than 30 psig.

- Do not use a commercial caustic that contains surfactants.
- Do not purge the lumens with CO<sub>2</sub> during an alkaline wash.

## B. Severe Biological Soil Cleaning Protocol

Wet-out occurs when the membrane loses its hydrophobic property, thus allowing liquids to pass through the pore structure. Wet-out can also occur when the membrane is exposed to protein containing liquids such as beer, wine, or fruit juice. Removing the biological deposits that have penetrated the membrane pore structure will restore the membrane hydrophobicity. To remove the proteins adhering to the polymer surface, a Severe Biological Soil cleaning Protocol is recommended. This Severe Biological Soil Cleaning protocol uses an alcohol-water solution followed by caustic solution and a drying step. The frequency of cleaning will depend upon the types and concentrations of proteins. In order to prevent wet-out, a daily cleaning protocol should be used until an appropriate cleaning frequency for your system is determined.

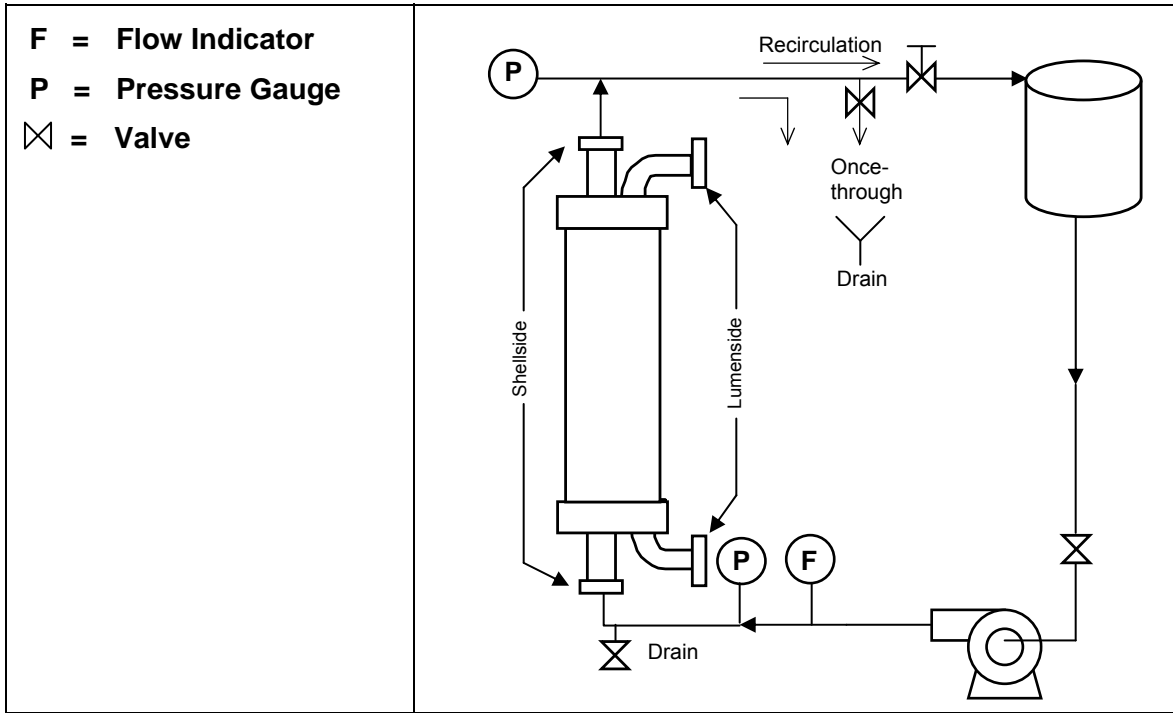
The drying step is critical in removing any liquid remaining in the pore structure. If liquid remains in the pore structure, any liquid that is introduced into the contactor will pass through the membrane. **Therefore, the contactor must be dried before it is put back into service.** Contact your Membrana representative to learn more about contract cleaning services available in our facility for your convenience.

**Table 6: Severe Biological Soil Cleaning Protocol**

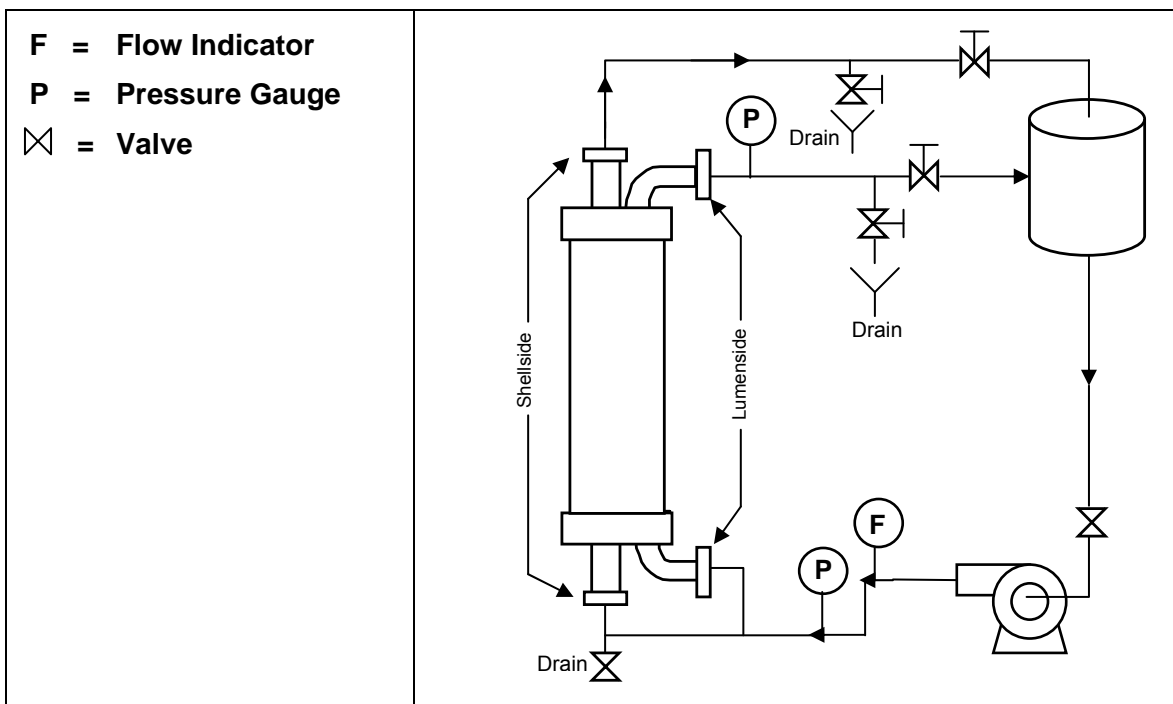
Step	Description / Flow Schematic	Chemical Solution	Time (min.)
1	Water flush/Once-through	Filtered (10 micron) water	5
2	Wet-out membrane/ Recirculate	50% isopropyl alcohol + 50% filtered (10 micron) water (v/v).	15-30
3	Pressurize shell side and let liquid come out of lumen sides		
4	Alkaline wash / recirculate	2-5% w/w. caustic (NaOH or KOH) solution using filtered (10 micron) water. Suggested temperature 86°F – 122°F (30°C – 50°C)	1 to 4 hrs.
5	Drain contactor		
6	Acid rinse / recirculated	5% w/w citric, or 3% Nitric or phosphoric, or 3% hydrochloric or a combination of 3% Nitric and 3% phosphoric acid solution or 3% Nitric and 3% HCL using filtered (10 micron) water at ambient temp.	1 to 2 hrs.
7	Drain contactor		
8	Water flush/Once-through	Filtered (10 micron) water – ambient temperature. Flush until pH in = pH out.	20-30
9	Drying	Inert gas is preferred. Clean, dry, oil free air can also be used. Do not exceed 122°F (50°C) gas temperature when using air to dry the contactors	See section 8.0
10	Membrane Integrity Test		See section 9.0

*\*Note that the air temperature should not exceed 30°C (86°F) in normal operations. Higher temperatures are only recommended for short cleaning/drying cycles.*

**Flow Schematics for Normal Biological Soil Removal**



**Flow Schematics for Severe Biological Soil Removal**



## 7.0 CLEANING PROTOCOL FOR MINERAL DEPOSITS REMOVAL

The inlet water should be treated to prevent mineral precipitation. For example changes in pH due to carbon dioxide removal may initiate a *precipitation reaction*.

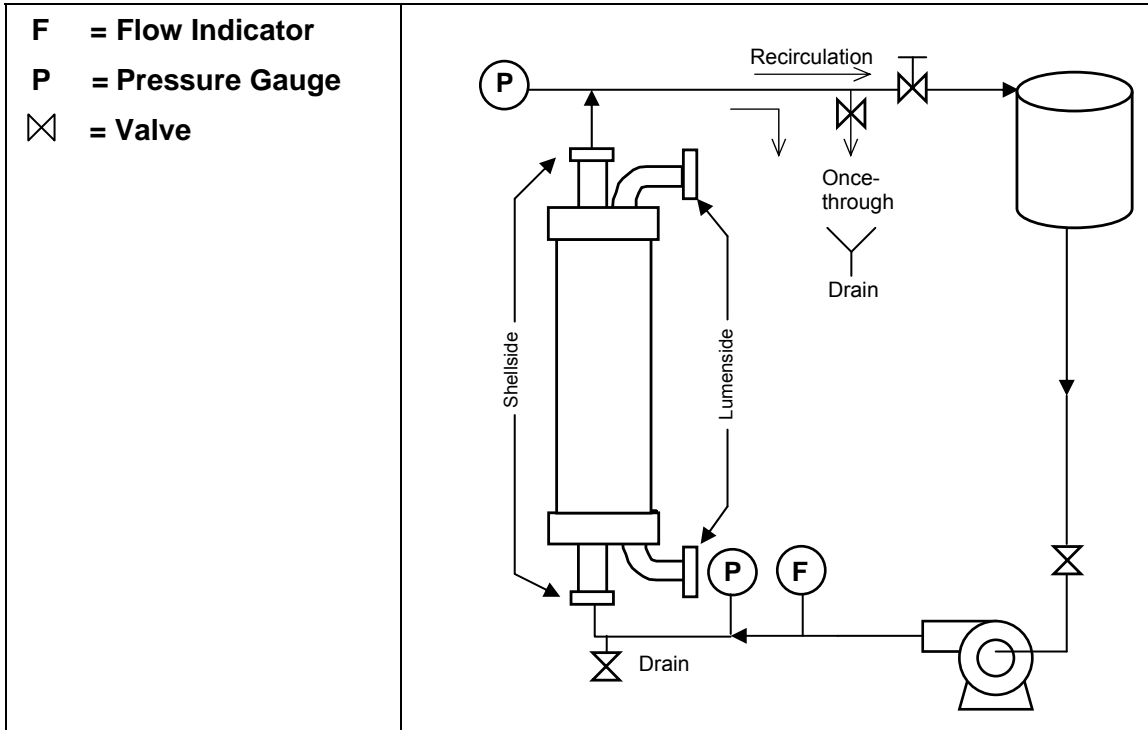
If the performance of the contactor decreases and the inlet water source is not treated to remove minerals, such as calcium carbonate, it is likely that a layer of mineral scale has formed on the wetted side (normally the shellside) of the contactor. A simple acid clean followed by a water flush should restore the performance. The contactor does not need to be dried after this protocol. Also note that phosphoric acid is more efficient for removing hard mineral deposits or other precipitated deposits.

**Table 7: Cleaning Protocol for Mineral Deposit Removal**

Step	Description / Flow Schematic	Chemical Solution	Time (min.)
1	Water flush/Once-through	Filtered (10 micron) water	5
2	Acid wash / recirculate (repeat if necessary)	5% w/w citric, or 3% Nitric or phosphoric, or a combination of 3% Nitric and 3% phosphoric acid solution using filtered (10 micron) water – ambient temperature	30-60
3	Drain contactor		
4	Water flush / Once through	Filtered (10 micron) water Flush until pH in = pH out	5-10

If silica, aluminum or a combination of these is found in the inlet water source, it is likely that they will precipitate on the membrane surface. If CO<sub>2</sub> is used as a sweep gas, precipitation can occur depending on the concentration and the water pH shift. For aluminum precipitation follow the mineral deposit removal procedure. For Silica precipitation use the Biological soil removal procedure, but increase the caustic concentration to 5.5% by weight and increase the temperature to 50 C. If possible try to clean the contactors using similar process water flow rates and do not change the direction of the water flow.

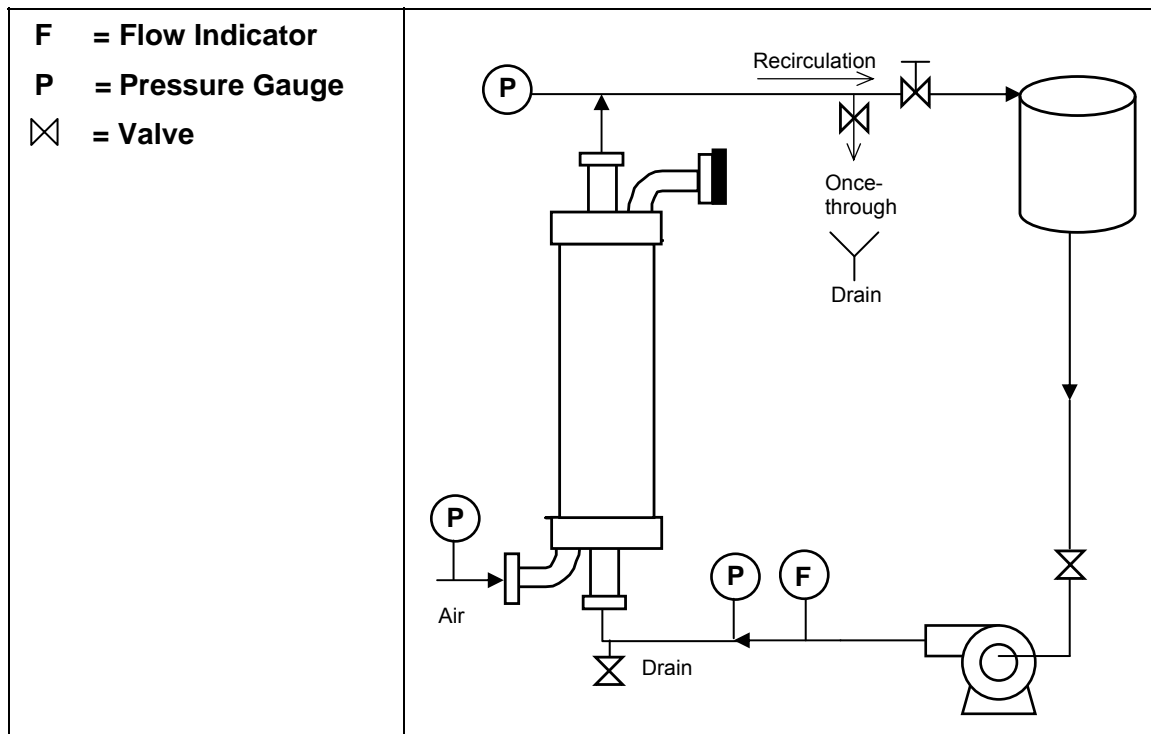
**Flow Schematics for Acid Cleaning to Remove Mineral Deposits**



### 8.0 CLEANING PROTOCOL WHEN PARTICLE FOULING IS SUSPECTED

Follow the steps described in Sections 6.0(a.) and 7.0, with the following exceptions:

- Backflush the cleaning solutions (i.e. introduce the cleaning solutions in the direction opposite of the normal operating flow direction).
- Once the cleaning solution is flowing into the contactor, introduce clean, dry, and oil free compressed air into one gas port, in the same direction as the liquid flow. Valve off, or cap, the other gas port.
- Regulate the air pressure 5-10 psig GREATER than the liquid pressure, such that the air will bubble vigorously into the cleaning solution.
- At the end of the cleaning procedure, shut off the air supply first, then the liquid.



## 9.0 MEMBRANE DRYING

The drying process involves two steps:

- Bulk Water Removal
- Final Drying

The purpose of the Bulk Water Removal is to quickly remove water prior to passing the drying gas through the contactor. The purpose of the Final Drying is to evaporate the remaining water from the contactor. Dry air, nitrogen, and carbon dioxide gas can be used to facilitate drying. Tables 8 and 9 provide a reference point for flow rates and drying times.

Vacuum is not recommended for drying the contactor. Tests have shown residual water after several hours of vacuum operation.

### A. Bulk Water Removal

To reduce the drying time, it is recommended to first remove the bulk water by flowing room temperature gas into the top shellside and lumenside ports. See the *Bulk Water Removal* schematic on page 10. Use clean, dry filtered (0.2 micron) gas at flow rate shown in Table 8. Keep the lower lumen and shellside ports open.

Discontinue the gas flow after the water discharge rates decreases to a few drips. Close the bottom shellside port when finished.

**Table 8: Bulk Water Removal Conditions**

Liqui-Cel Membrane Contactor Size	Gas Flow Rate scfm*
MiniModules and 2 x 6	0.5 scfm (0.84 m <sup>3</sup> /hr)
2.5 x 8	1 scfm (1.7 m <sup>3</sup> /hr)
4 x 28 and 6 x 28	10 scfm (17 m <sup>3</sup> /hr)
10 x 28 and 14 x 28	70 scfm (120 m <sup>3</sup> /hr)

\*Maximum gas pressure = 10 psig (0.7 kg/cm<sup>2</sup>)

### B. Final Drying

The final drying step involves flowing a clean, dry, filtered (0.2 micron) gas into the top shellside port. Using a warm gas will reduce drying time. We recommend using Nitrogen as the gas in the final drying step, as hot air can shorten the membrane life.

Table 9 can be used as a guide for the Final Drying step.

**Table 9: Final Drying Conditions**

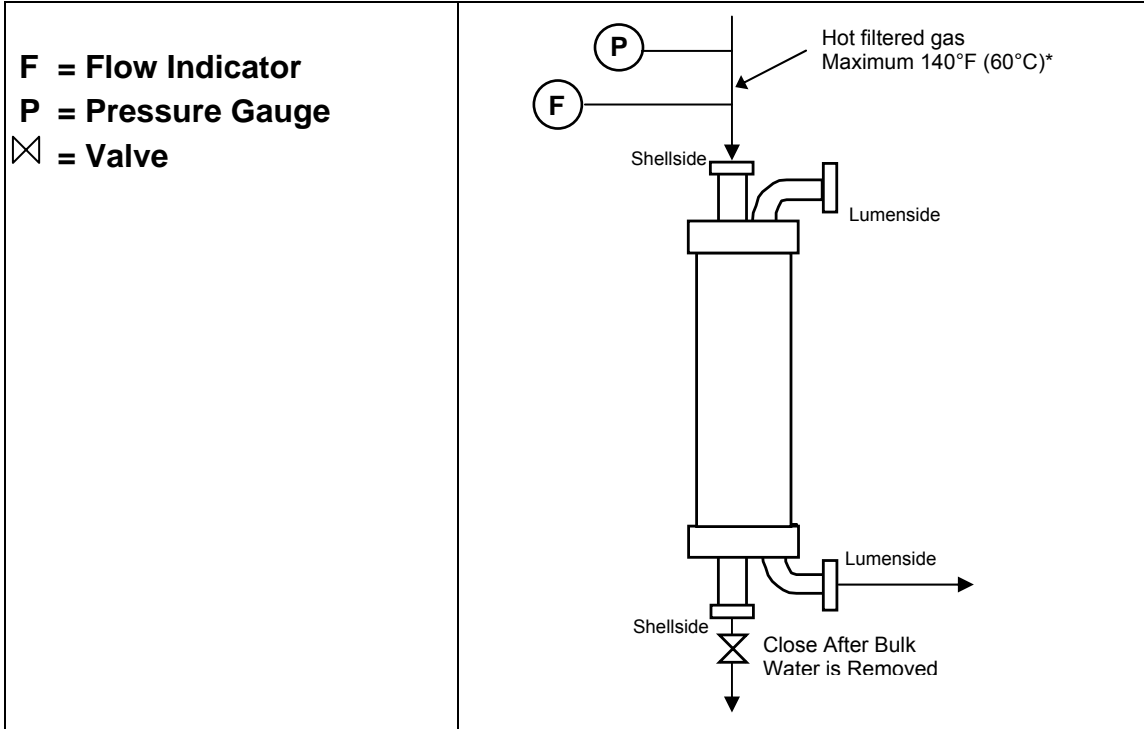
Liqui-Cel Membrane Contactor Size	Gas Flow Rate*	Estimated Drying Time**
2 x 6	0.5 scfm (0.84 m <sup>3</sup> /hr)	1 hr @ 60°C (140°F)
2.5 x 8	1 scfm (1.7 m <sup>3</sup> /hr)	1 hr @ 60°C (140°F)
4 x 28	10 scfm (17 m <sup>3</sup> /hr)	4 hr @ 60°C (140°F)
6 x 28	25 scfm (40 m <sup>3</sup> /hr)	8 hr @ 60°C (140°F)
10 x 28	70 scfm (120 m <sup>3</sup> /hr)	16 hr @ 60°C (140°F)
14 x 28	80 scfm (130 m <sup>3</sup> /hr)	24 hr @ 60°C (140°F)

\*Maximum gas pressure = 10 psig (0.7 kg/cm<sup>2</sup>)

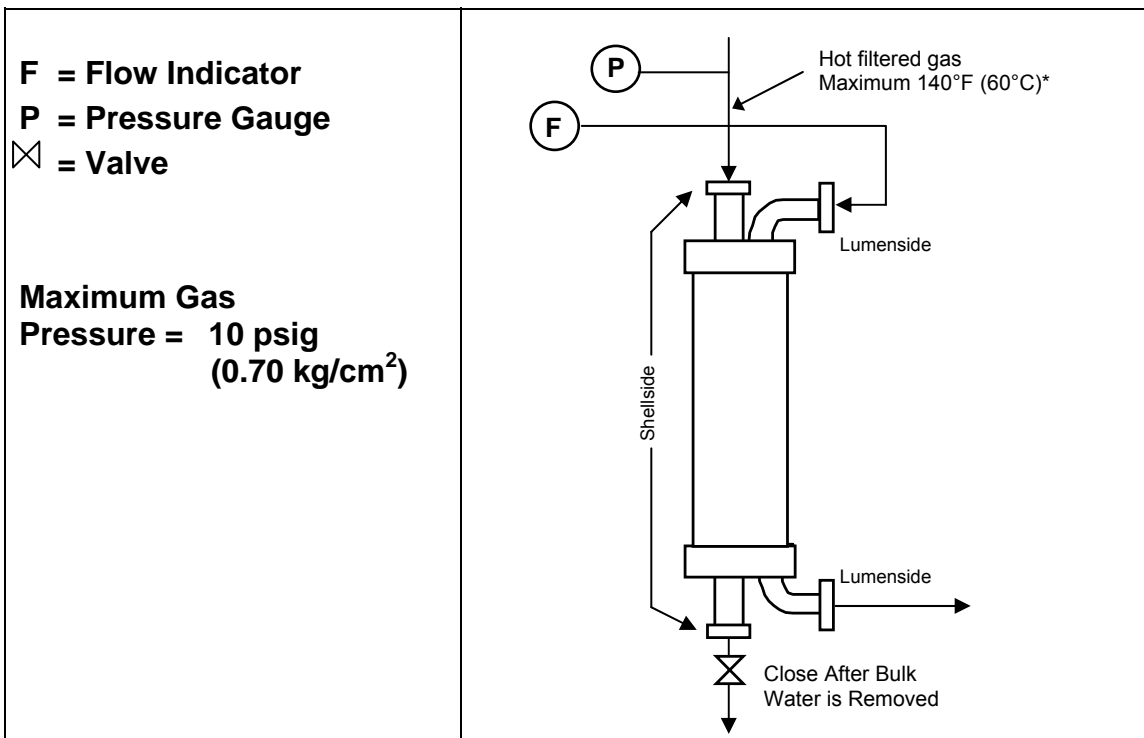
\*\*If using air in the final drying step, do not exceed 30°C (86°F)

**Drying Schematics**

**Bulk Water Removal/Initial Drying Step**



**Final Drying**



\*If using air in the final drying step, do not exceed 30°C (86°F)

## 10.0 MEMBRANE CONTACTOR INTEGRITY TEST

There are three conditions, which will cause the contactor to leak.

- Membrane wet-out
- A fiber break
- O-ring / seal failure

Membrane wet-out can occur from solutions containing surfactants or proteins, such as beer, juice, wine, fermentation broth or other organic solutions. This is a reversible condition once the contactor is cleaned. The integrity test can be used to verify that the hydrophobic property of the membrane has been restored. This test involves pressurizing the shellside with water and measuring the drip rate leaving the lower lumenside port. The integrity test should be completed after cleaning.

**Table 10: Membrane Contactor Integrity Test**

Steps	
1.	Relieve lumenside pressure. Blow-out lumenside stream with nitrogen or oil-free air. Open the lower lumenside port connection so an observation can be made.
2.	Close the shellside outlet valve
3.	Fill the shellside with filtered (10-micron) water. Slowly apply 60 psig (4.2 kg/cm <sup>2</sup> ) pressure to the shellside.
4.	Measure the drip rate from the lumenside port for 1 hour.
5.	Release the shellside pressure by slowly opening the outlet valve. Drain the contactor.

If the contactor leaks at a higher rate than the value listed in Table 11, either the cleaning protocol needs to be repeated, a fiber is broken or an O-Ring is damaged. Contact your Membrana representative for further help.

**Table 11: Guidelines for Typical Amounts of Liquid Passing to the Lumenside**

	2 x 6 Contactor	2.5 x 8 Contactor	4 x 28 Contactor	10 x 28 Contactor	14 x 28 Contactor
Condensation	<0.5ml/hr @ 60 psig	<5ml/hr	< 1.2 ml/min.	<7 ml/min.	<11ml/min.

It is normal for water vapor to collect in the lumenside of the membrane. It can condense and flow out of the contactor. The condensate rate can be compared to a new contactor to establish a baseline. The rates vary slightly depending on the fiber types but table 11 provides a good guideline.

## **11.0 STORAGE AND HANDLING GUIDELINES**

---

The Liqui-Cel Membrane Contactor that you have purchased can be damaged through improper handling and storage. The following guidelines are intended to provide a framework for successful storage of these contactors. If you have any questions, please contact your Membrana representative.

### **Handling**

Proper handling of contactors is critical. Care must be taken not to hit or jar (shock) the contactor to minimize the possibility of internal damage or damage to plastic parts from the contactor being knocked over or dropped. All four (4) ports should be protected to prevent the introduction of contaminants into the contactor. It is recommended that the contactors be stored in a dry, heat-sealed plastic bag or shrink-wrap material [0.076 mm (0.003 in.) wall thickness] in their original box.

All plastic port extensions should be supported to prevent bending of extensions under excessive piping loads.

### **Temperature**

Store the contactors dry in their original boxes at temperatures not to exceed 49°C (120°F). Contactors stored at very low temperatures < 5°C (41°F) should be allowed to equilibrate to room temperature prior to introducing water.

### **Humidity**

It is recommended that contactors be stored at low to moderate humidity levels (< 60% relative humidity). Humidity will not affect the components of the contactor but exposure at high humidity levels may affect the integrity of any cardboard packaging.

### **Storage Position**

Store the contactors in the horizontal position. Ten-inch contactors with SS housings packaged in wooden crates and 14-inch contactors should not be stacked more than two crates/boxes high. Ten-inch contactors with FRP housings and six-inch contactors are packaged in foam reinforced cardboard boxes. For safety considerations, they should not be stacked more than 3 boxes high. Four-inch contactors are packed in cardboard boxes and can be stacked up to 7 boxes high.

### **Shelf Life**

Membrane samples from contactors stored for 4 years (room temperature, low to moderate humidity, heat-sealed bag but not stored in a box) have shown no changes in physical properties (hollow fiber tensile strength and elongation).

### **Exposure to Sunlight**

Contactors should not be stored where they are exposed to direct sunlight. Contactors should always be stored in sealed bags, or shrink wrap material, in the original box or other opaque box.

## 12.0 Contactor Decontamination for Return To MEMBRANA

In the event that a contactor needs to be returned to MEMBRANA for analysis, it **must** be cleaned and dried. A **Returned Material Authorization (RMA) form must be obtained** from MEMBRANA before a contactor is returned. Please follow the instructions below when returning a contactor.

**Call your MEMBRANA Representative at (704) 587-8888 to obtain an RMA Form. Complete the Form and return it by fax to (704) 587-8585, Attn: Liqui-Cel® Membrane Contactor Technical Service.**

- I. If Non-Hazardous materials (water, air, nitrogen, oxygen, and carbon dioxide) were used, clean and dry the contactor, and place it in a clean leak-proof plastic bag.
- II. Write the RGA number on the outside of the shipping box.
- III. **If Hazardous Materials** were used in the contactor, follow the cleaning procedure in section 6.0. Provide a Material Safety Data Sheets (MSDS) of any chemical(s) introduced into the contactor to your product representative. Even though these chemicals need to be flushed from the contactor prior to shipment, the MSDS is required information to safeguard our personnel when handling the returned contactor. Place the contactor in a clean leak-proof plastic bag. Write the RGA number on the outside of the shipping box.

**If non-human (or other non-primate) blood or blood products were used in the contactor, follow your established normal cleaning protocol. In addition, flush the contactor with water until the rinsed water is completely clear. Continue rinsing for 30 more minutes to ensure complete removal of any blood product.**

***Prior to returning the contactor to MEMBRANA, it must be sterilized. The following sanitizing protocol is recommended: (5.25% available chlorine) diluted 1:500 with filtered water (final concentration = ~100 ppm available chlorine). Adjust the pH >10 using caustic prior to adding the hypochlorite solution.***

Recommended contact time and temperature with the contactor is 30 minutes at 70°F - 100°F (21°C - 38°C). The active chlorine level should be maintained at 100 ppm during the duration of the cleaning cycle. The entire cartridge needs to be contacted with this solution to kill bacteria or viruses. Therefore, both the shell and tube side flow paths need to be decontaminated.

Dry the contactor as per section 8.0 and place the contactor in a leak-proof plastic bag. Write the RGA number on the outside of the shipping box.

**It is important to Fax a copy of the RMA form to MEMBRANA prior to shipping. Fax to: (704) 587-8585, Attn: Liqui-Cel® Membrane Contactor Technical Service.**





**Membrana - Charlotte**  
A Division of Celgard, LLC  
13800 South Lakes Drive  
Charlotte, North Carolina  
28273  
USA  
Phone: 704 587 8888  
Fax: 704 587 8585

**Membrana GmbH**  
Oehder Strasse 28  
42289 Wuppertal  
Germany  
Phone: +49 202 6099 -658  
+49 6126 2260 -41  
Fax: +49 202 6099 -750

**Japan Office**  
Shinjuku Mitsui Bldg., 27th  
Floor  
1-1, Nishishinjuku 2-Chome  
Shinjuku-ku, Tokyo 163-0427  
Japan  
Phone: 81 3 5324 3361  
Fax: 81 3 5324 3369



ISO 9001  
ISO 14001

This product is to be used only by persons familiar with its use. It must be maintained within the stated limitations. All sales are subject to Seller's terms and conditions. Purchaser assumes all responsibility for the suitability and fitness for use as well as for the protection of the environment and for health and safety involving this product. Seller reserves the right to modify this document without prior notice. Check with your representative to verify the latest update. To the best of our knowledge, the information contained herein is accurate. However, neither Seller nor any of its affiliates assumes any liability whatsoever for the accuracy or completeness of the information contained herein. Determination of the suitability of any material and infringement of any third party rights, including patent, trademark, or copyright rights, are the sole responsibility of the user. Users of any substance should satisfy themselves by independent investigation that the material can be used safely. We may have described certain hazards, but we cannot guarantee that these are the only hazards that exist. Nothing herein shall be construed as a recommendation or license to use any information that conflicts with any patent, trademark or copyright of Seller or others. Please read our Operating Manuals carefully before installing and using these modules.

THE INFORMATION CONTAINED HEREIN AND SELLER'S PRODUCTS ARE PROVIDED "AS IS" WITHOUT WARRANTY OF ANY KIND, EITHER EXPRESSED OR IMPLIED, INCLUDING, BUT NOT LIMITED TO, THE IMPLIED WARRANTIES OF MERCHANTABILITY, FITNESS FOR ANY PARTICULAR PURPOSE OR USE, OR NON-INFRINGEMENT OF INTELLECTUAL PROPERTY. IN NO EVENT SHALL SELLER BE LIABLE FOR ANY SPECIAL, INCIDENTAL, INDIRECT, OR CONSEQUENTIAL DAMAGES OF ANY KIND, OR ANY DAMAGES WHATSOEVER RESULTING FROM THE USE OF INFORMATION CONTAINED HEREIN AND SELLER'S PRODUCTS.

Liqui-Cel®, SuperPhobic®, MiniModule®, and MicroModule® are registered trademarks of Membrana-Charlotte, A Division of Celgard, LLC.

