



# Start-up Procedures

for 3M™ Liqui-Cel™ EXF and SP Series Membrane Contactors  
2.5×8, 4×13, 4×28, 6×28, 8×20, 8×40, 8×80, 10×28, 14×28, 14×40

## **Prior to any start-up procedure, proper installation is required.**

Please read and follow all safety information, warnings and instructions in this manual. Failure to follow all product warnings and instructions could cause serious injury and property damage. Retain these instructions for future reference.

## **Intended Use and Product Selection:**

3M™ Liqui-Cel™ Membrane Contactors are intended to remove dissolved gasses and bubbles from compatible liquids or to add gasses to a liquid stream. Liqui-Cel products are for use in industrial separation applications of industrial fluids only, in accordance with the applicable product instructions and specifications. Certain limited Liqui-Cel products are also intended for use in Food and Beverage (F&B) applications. Refer to the specific Liqui-Cel product's performance data sheet to determine whether it includes a F&B designation and can be used for such applications.

3M Liqui-Cel Membrane Contactors may further be used in the production of water for various pharmaceutical products upstream of the final water sterilization step.

Since there are many factors that can affect a product's use, the customer and user remains responsible for determining whether the 3M product is suitable and appropriate for the user's specific application, including user conducting an appropriate risk assessment and evaluating the 3M product in user's application.

## **Restrictions on Use:**

3M advises against the use of these 3M products in any application other than the stated intended use(s), since other applications have not been evaluated by 3M and may result in an unsafe or unintended condition. Do not use in any manner whereby the 3M product, or any extractable or leachable from the 3M product, may become part of or remains in a medical device, drug, cosmetic, or food or drink additive or supplement; or in applications involving life-sustaining medical applications or prolonged contact with internal bodily fluids or tissues. If you are considering using this 3M product for a restricted use, you must first contact 3M with information about your proposed application to request prior written authorization for supply.

If your process may result in dangerous concentrations of explosive, flammable, toxic or oxidizing liquids or gases in the membrane contactor or the system, contact 3M prior to use.

**Steps:**

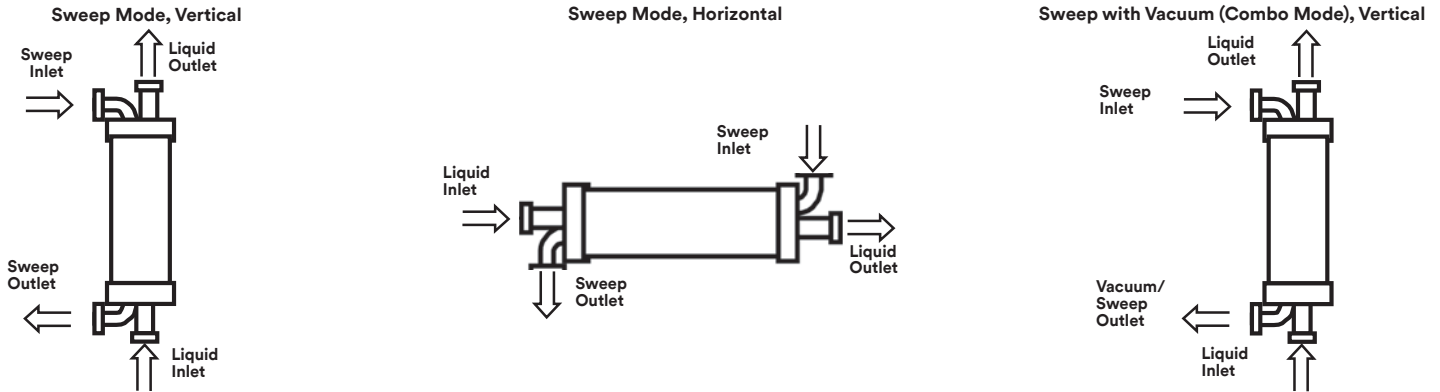
- Note that for adding dissolved gases to water, the only mode of operation is sweep.
- Mount contactor vertically or horizontally. If mounted vertically the drain port should be at the bottom end of the module. If mounted horizontally the drain port should be pointed downwards.
- Refer to start-up procedures below for connections and mode of operation.

**Notes:**

- The liquid pressure should always be higher than the gas pressure inside the contactor.
- Liquids entering the membrane contactor should be prefiltered at 5 micron absolute at 99.9% removal (beta 1000).
- Gas entering the contactor should be filtered at 0.2 micron absolute at 99.9% removal (beta 1000) for high-purity applications. Filtration at 1 micron absolute at 99.9% removal (beta 1000) may be sufficient for industrial applications.
- Upon initial start-up, flush all pipes to drain prior to introducing liquid into the membrane contactors.
- The vacuum pump and/or sweep gas should be on at all times unless the membrane contactors are completely drained.
- Liquid flows on the shell side in 3M™ Liqui-Cel™ EXF and SP Series Membrane Contactors.

**Mounting Position, Port Identification and Operating Modes**

Note: See the Operating Guide in the Tech Support Section at 3M.com/Liqui-Cel if you need additional piping and instrumentation information.



Before you begin start-up identify the mode of operation and mount contactor in desired orientation.

**A. General start-up instructions for the liquid phase**

Note: Both gas/vacuum ports should not be closed during operation. These ports provide a safety vent in the contactors so that pressure does not build up.

Slowly introduce water to the system, making sure that the water inlet pressure and water flow rate through the contactor never exceed the maximum operating limits listed below. If using a SP Series Membrane Contactor device, the liquid must flow on the shell side. (Labeled as Liquid Inlet above).

**Maximum flows:** 2.5x8: 0.7 m<sup>3</sup>/hr (3 gpm); 4x13: 3.4 m<sup>3</sup>/hr (15 gpm); 4x28: 6.8 m<sup>3</sup>/hr (30 gpm); 6x28: 11 m<sup>3</sup>/hr (50 gpm); 8x20 PVC or SS: 11 m<sup>3</sup>/hr (50 gpm); 8x40: 28 m<sup>3</sup>/hr (125 gpm); 8x80: 28 m<sup>3</sup>/hr (125 gpm); 10x28 FRP or SS: 57 m<sup>3</sup>/hr (250 gpm); 10x28 IND: 48 m<sup>3</sup>/hr (210 gpm); 14x28: 91 m<sup>3</sup>/hr (400 gpm); 14x40: 125 m<sup>3</sup>/hr (550 gpm).

- Adjust water flow rate and inlet pressure to desired levels by adjusting appropriate system valves.

**B. Start-Up Instructions for strip gas and vacuum phase**

Note: Vacuum, when used in combo, should always be pulled from the lowest gas port to facilitate draining and ensure performance.

**Sweep Gas Mode**

- Regulate gas supply pressure to membrane contactor at ≤10 psig (0.7 barg) by adjusting the appropriate system valves.
- Set the recommended total sweep flow rate by adjusting the appropriate system valves. See the sweep guidelines for typical sweep gas flow rate ranges.

- Introduce sweep gas into each contactor.

Note: If using compressed air, make sure it is oil free and air temp <35°C.

**Sweep Gas with Vacuum (Combo) Mode**

- Regulate gas supply pressure to membrane contactor at ≤1 psig (0.07 barg) by adjusting the appropriate system valves.
- Set the recommended total sweep flow rate by adjusting the appropriate system valves. See sweep guidelines for typical sweep gas flow rate ranges in the table below.
- Introduce sweep gas into each contactor.
- Apply vacuum as described in the vacuum section below.

Note: If using compressed air, make sure it is oil free and air temp <35°C.

Note: If the lumens are filled with condensed water vapor, contactor performance can be restored by flowing pressurized sweep gas at ≤30 psig for 5 minutes. Gas pressure in the membrane contactor should always be lower than liquid pressure.

**Blower in suction mode with atmospheric air as sweep gas for CO<sub>2</sub> removal**  
(for 4x13, 4x28, 6x28, 8x20 PVC, 10x28 and 14x28 products).

Refer to Air Sweep Guidelines for Sweep-Only Mode in table below for typical air flow rates.

- Start blower using suction mode operation.
- Open isolation valve (if applicable).
- Close relief valve.

**Vacuum Only Mode**

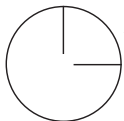
- Start vacuum pump following vacuum pump manufacturer's instructions.
- Apply vacuum to the contactor by opening appropriate valve.
- Adjust absolute gas pressure on the vacuum side to the desired level at the vacuum port on the contactor.

	Air Sweep Guidelines for Sweep-Only Mode	Air Sweep Guidelines for Combo Mode	N <sub>2</sub> Sweep Guidelines for Combo Mode
2.5x8	0.25 – 1.5 scfm (0.4 – 2.4 Nm <sup>3</sup> /hr)	0.05 – 0.25 scfm (0.08 – 0.4 Nm <sup>3</sup> /hr)	0.02 – 0.1 scfm (0.03 – 0.2 Nm <sup>3</sup> /hr)
4x13	1 – 6 scfm (1.6 – 9.5 Nm <sup>3</sup> /hr)	0.2 – 1 scfm (0.3 – 1.6 Nm <sup>3</sup> /hr)	0.1 – 0.5 scfm (0.16 – 0.8 Nm <sup>3</sup> /hr)
4x28	1 – 10 scfm (1.6 – 15.8 Nm <sup>3</sup> /hr)	0.2 – 2 scfm (0.3 – 3 Nm <sup>3</sup> /hr)	0.1 – 1 scfm (0.16 – 1.6 Nm <sup>3</sup> /hr)
6x28	2 – 12 scfm (3.2 – 19 Nm <sup>3</sup> /hr)	0.4 – 2 scfm (0.7 – 3.0 Nm <sup>3</sup> /hr)	0.2 – 1 scfm (0.3 – 1.6 Nm <sup>3</sup> /hr)
8x20 PVC	3 – 18 scfm (4.7 – 28.5 Nm <sup>3</sup> /hr)	0.5 – 5 scfm (0.8 – 8 Nm <sup>3</sup> /hr)	0.2 – 1 scfm (0.3 – 1.6 Nm <sup>3</sup> /hr)
8x20 SS	Not Recommended		0.2 – 1 scfm (0.3 – 1.6 Nm <sup>3</sup> /hr)
8x40	5 – 20 scfm (7.9 – 31.7 Nm <sup>3</sup> /hr)	1 – 5 scfm (1.6 – 8 Nm <sup>3</sup> /hr)	0.4 – 1 scfm (0.6 – 1.6 Nm <sup>3</sup> /hr)
8x80	Not Recommended		0.5 – 1 scfm (0.8 – 1.6 Nm <sup>3</sup> /hr)
10x28	5 – 30 scfm (7.9 – 47.5 Nm <sup>3</sup> /hr)	2 – 10 scfm (3.2 – 16 Nm <sup>3</sup> /hr)	0.4 – 1 scfm (0.6 – 1.6 Nm <sup>3</sup> /hr)
14x28	10 – 60 scfm (15.8 – 95 Nm <sup>3</sup> /hr)	3 – 15 scfm (4.7 – 24 Nm <sup>3</sup> /hr)	0.5 – 1 scfm (0.8 – 1.6 Nm <sup>3</sup> /hr)
14x40	Not Recommended		0.5 – 1 scfm (0.8 – 1.6 Nm <sup>3</sup> /hr)

\* Note that the gas side/vacuum pressure limits may be less than this. See Operating Guide for other pressure restrictions in the European Communities (EU).

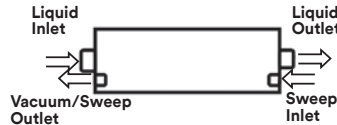
2.5×8 with NPT, 8×20, 8×40 and 8×80-inch membrane contactors have different connections than those shown in the Mounting Position, Port Identification and Operating Mode diagrams. See below for liquid and sweep gas/vacuum port identification for these products.

Liquid Connection

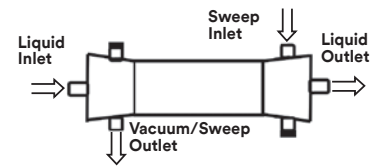


2.5×8

Vacuum/Sweep Gas Connection



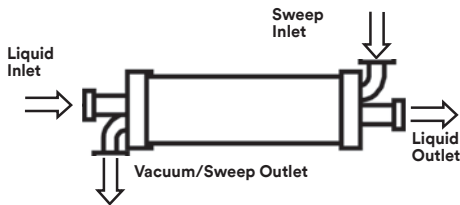
8×20



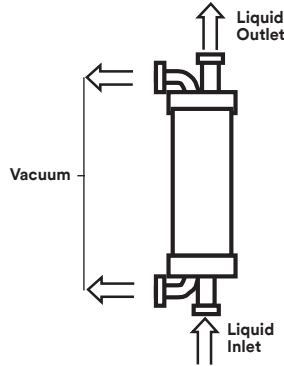
(Two vacuum/sweep ports are capped.)

8×40 and 8×80

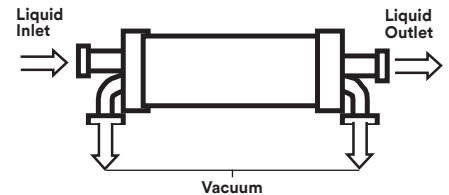
Sweep with Vacuum (Combo Mode), Horizontal



Vacuum Mode, Vertical



Vacuum Mode, Horizontal



## SAFETY INFORMATION

### Explanation of Signal Word Consequences

<b>⚠ WARNING</b>	Indicates a hazardous situation which, if not avoided, could result in serious injury or death.
<b>⚠ CAUTION</b>	Indicates a hazardous situation which, if not avoided, could result in minor or moderate injury.
<b>NOTICE</b>	Indicates a situation which, if not avoided, could result in product or system damage.

Read entire product manual. Failure to follow all product instructions and warnings could cause personal injury and/or property damage.

**⚠ WARNING – To reduce the risks associated with liquid bursting or gas explosion and/or exposure to chemicals and membrane contactor damage:**

- Do not introduce gas alone into the membrane contactor without liquid in the shell side except when following 3M storage guidelines.
- Do not exceed maximum operating pressure or temperature limits.
- Implement workplace safety risk controls according to local applicable laws and regulations.
- Always use appropriate personal protective equipment (PPE) when installing, servicing, operating, cleaning or disposing of the membrane contactor.
- All plumbing should be done in accordance with local regulations and code.
- To prevent buildup of pressure inside the membrane contactor, do not block or valve off all gas/vacuum ports during operation or downtime.
- Ensure chemically compatible materials of construction are used within system.
- Always make sure to verify proper connections within the membrane contactor system.
- Never modify or alter the membrane contactor. Only 3M or parties authorized in writing may make changes/repairs to the equipment.
- Inspect membrane contactor prior to cleaning or installation. Only use replacement parts supplied by 3M for this product.
- Inspect the membrane contactor to ensure no leaking, cracking, or other signs of damage on membrane contactor, gaskets and tubing or piping.

**To reduce the risks associated with asphyxiation [or other health hazards], accidental gas explosion, or environmental contamination:**

- Ensure proper system ventilation and discharge of any gases being used in or generated during membrane contactor operation, cleaning and drying, (including sweep gas, vacuum pump or blower discharge,) according to all applicable building codes and regulations.

**To reduce the risks associated with fire and explosion:**

- Do not introduce explosive, flammable, toxic or oxidizing liquids or gases in dangerous concentrations into the membrane contactor or the system.
- Over-pressurization of liquid and gas should be prevented by the installation of proper pressure relief valves/safety systems.

**To reduce the risks associated with impact, lifting or moving:**

- Do not attempt to move the system while it contains liquid.
- Do not attempt to move system while in operation.
- Use appropriately rated lifting equipment for lifting or moving. Review the product datasheet or operating guide for weights.
- Always ensure the system is stable, level, and properly secured. Be sure the system cannot tip, roll, fall, slide or make any movement that may cause injury, damage to the unit, or damage to other system components.
- If needed, use shims to level the system.

## CAUTION

To reduce the risks associated with hot surfaces and hot exhaust gases:

- Do not touch the membrane contactor or liquid lines during operation or cleaning and drying. Surfaces may be hot.
- Avoid close proximity to blower exhaust.

To reduce the risks associated with environmental contamination:

- Exhaust gas should be vented in a safe manner and according to local regulations.

To reduce the risks associated with damaging the membrane contactor:

- Ensure membrane contactor is properly aligned with piping, and flanges are adequately tightened during use and after cleaning. Always conduct system checks in accordance with installation instructions and facility policies prior to operation.
- Ensure proper draining and flushing of membrane contactor before maintenance, service, or shipping of membrane contactors.

**NOTICE – To reduce membrane contactor or system damage:**

- Care must be taken not to drop, hit or impact the membrane contactor.
- If the membrane contactor is used with air sweep, then the temperature should not exceed 35°C (95°F). For membrane contactors used with vacuum only this statement does not apply.
- For all membrane contactors, lumen side pressure should never exceed shell side pressure during cleaning and operation. Always refer to operating and cleaning guidelines for the use application.
- To avoid contamination of the process fluid, gloves are recommended when handling the membrane contactors.
- All plastic port extensions should be supported to prevent bending of extensions under excessive piping loads.
- 3M™ Liqui-Cel™ Membrane Contactors should be stored dry and in a sealed plastic bag or shrink wrap material to help prevent the introduction of contaminants into the membrane contactor.
- 3M Liqui-Cel Membrane Contactors should be stored in their original box, or other opaque box, and should not be installed where they are exposed to direct sunlight.
- Store 3M Liqui-Cel Membrane Contactors dry at temperatures < 50°C (122°F), but preferably at lower temperature such as <35°C (95°F), to not risk reduced lifetime. Membrane contactors should always be stored above freezing temperatures, and if stored at low temperature, they should be allowed to equilibrate to room temperature before use.
- Do not use thread sealant to connect fittings to membrane contactor.
- Use care if using a metal fitting to connect to a plastic connector on the membrane contactor.
- Do not allow membrane contactors containing microporous hollow fiber membranes to come into contact with surfactants, oil, or organic solvents, such as pure alcohols, glycol, acetone, etc., to reduce the risk of membrane wet out. SP-series membrane contactors containing polyolefin membrane are not subject to this restriction.
- To protect the membrane contactors, prefiltration equipment should be inspected and maintained in accordance to 3M Liqui-Cel Membrane Contactors Inlet Water & Sweep Gas Operating Guidelines, in the Technical Resources section at 3M.com/Liqui-Cel.
- Suspended solids, biological contaminants, or the precipitation of soluble or insoluble salts on the membrane surface may lead to membrane plugging.
- Filtered, de-chlorinated, and deionized water is recommended for mixing cleaning solutions. If a pH shift occurs water containing sparingly soluble compounds of Ca, Mg, Fe, Al, and silica (SiO<sub>2</sub>) etc. could precipitate from the solution and block or damage the membrane. Ensure that your water is free of these compounds.
- Cumulative exposure of the membrane to oxidants, such as ozone, chlorine, hydrogen peroxide, peracetic acid, etc., should be restricted to reduce the risk of membrane oxidation.
- Avoid water hammer (sudden pressure spikes) in system.

## ATTENTION:

### Disposal

At end of life, dispose of the membrane contactor or cartridges in accordance with all applicable local and government regulations.

### Hazards from Chemicals

The chemicals that User selects to use in connection with the membrane can present their own hazards. User should follow all safety information and related requirements provided by the chemical supplier and applicable regulations, as well as conduct User's own workplace safety, hazard and application assessment. This document cannot and does not address all safety and/or safe handling requirements that different chemicals could present. User is responsible for ensuring that chemicals are only used by persons familiar with their use and hazards (for example, personnel who have received hazardous material training), and who have the appropriate protective equipment as specified in their organization's safety program and the chemical's safety datasheet (SDS). User 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 such chemicals.

**Product Selection and Use:** Many factors beyond 3Ms control and uniquely within users knowledge and control can affect the use and performance of a 3M product in a particular application. As a result, customer is solely responsible for evaluating the product and determining whether it is appropriate and suitable for customers application, including conducting a workplace hazard assessment and reviewing all applicable regulations and standards (e.g., OSHA, ANSI, etc.). Failure to properly evaluate, select, and use a 3M product and appropriate safety products, or to meet all applicable safety regulations, may result in injury, sickness, death, and/or harm to property.

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