3M Science. Applied to Life.™

Start-up Procedures

for 3M™ Liqui-Cel™ MM 1×5.5, 1.7×5.5, 1.7×8.75 Series Membrane Contactors

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.

3M™ Liqui-Cel™ MM 1×5.5, 1.7×5.5, 1.7×8.75 Series Membrane Contactor are constructed of FDA Title 21 CFR § 174-186 compliant materials for wetted parts only at ambient temperatures.

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:

1. Note that for adding dissolved gases to water, the only mode of operation is sweep.
2. 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.
3. 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).

Correct Mounting Position and Port Identification

Start-up Procedures

A. General Start-up Instructions for the Liquid Phase

Note: Liquid flows on the lumenside. The liquid pressure should always be higher than the gas phase pressure inside the contactor.

1. Slowly introduce water to the system, making sure that the water inlet pressure and water flow rate never exceed the respective maximum operating limits.
2. Adjust the liquid flow rate and inlet pressure to the desired levels by adjusting the appropriate valves on the system.

B. General Start-up Instructions for the Sweep (strip) Gas and Vacuum Phase

Sweep (Strip) Gas Mode

Note: Sweep gas should be introduced at the top shell port.

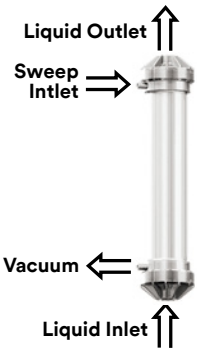
3. Set the gas delivery pressure entering the contactor at about 0.33 barg (< 5 psig) below the water pressure at the liquid outlet by adjusting the appropriate valve in the gas delivery system.
4. Introduce sweep gas into the contactor.
5. The required sweep supply rate depends on the target specification of dissolved gas concentration in the water leaving the contactor.

Product	Maximum Flow Rate	Maximum Pressure
1×5.5	500 ml/min	4.1 barg @ 25°C (68 psig @ 77°F)
1.7×5.5	2500 ml/min	
1.7×8.75	3000 ml/min	

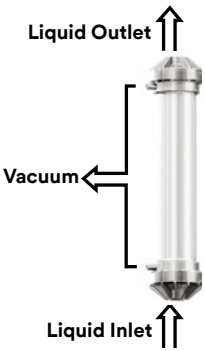
- Gas entering the contactor should be filtered at 0.2 micron absolute at 99.9% removal (beta 1000) for high-purity applications. Filtration at 1 micron absolute at 99.9% removal (beta 1000) may be sufficient for industrial applications.
- Upon initial start-up, flush all pipes to drain prior to introducing liquid into the membrane contactors.
- The vacuum pump and/or sweep gas should be on at all time unless the membrane contactors are completely drained.
- Liquid flows on the lumenside in Liqui-Cel MM 1×5.5, 1.7×5.5, 1.7×8.75 series membrane contactors.

Correct Mounting Position and Port Identification

Sweep with Vacuum (Combo Mode)



Vacuum Mode



Sweep (Strip) Gas with Vacuum (Combo) Mode

1. Set the gas pressure entering the contactor at ≤1 psig (0.07 barg) by adjusting the appropriate valve on the gas delivery system.
2. Set the recommended total sweep flow rate by adjusting the appropriate valve. See sweep guidelines for typical sweep gas flow rate ranges in the table below.
3. Introduce sweep gas to contactor.
4. Apply vacuum as described in the vacuum section.

Vacuum-Only Mode

5. Start vacuum pump following vacuum pump manufacturer's instructions.
6. Apply vacuum to the contactor by opening appropriate valve. You may pull vacuum from both shellside ports or block off the top port and pull vacuum from the bottom port only.
7. Adjust gas pressure on the vacuum side to the desired level at the vacuum port.

Product	Sweep Guidelines for Sweep Mode	Sweep Guidelines for Combo Mode
1×5.5	0.05 – 0.5 scfm (0.085 – 0.85 m³/hr)	0.01 – 0.1 scfm (0.016 – 0.16 m³/hr)
1.7×5.5	0.1 – 1.0 scfm (0.17 – 1.70 m³/hr)	0.02 – 0.2 scfm (0.034 – 0.34 m³/hr)
1.7×8.75	0.2 – 1.5 scfm (0.34 – 2.55 m³/hr)	0.04 – 0.3 scfm (0.068 – 0.51 m³/hr)

Product	Vacuum Guideline for Vacuum Mode
1×5.5	30 - 150 mm Hg absolute pressure
1.7×5.5	
1.7×8.75	

SAFETY INFORMATION:

Explanation of Signal Word Consequences	
⚠ **WARNING**	Indicates a hazardous situation which, if not avoided, could result in serious injury or death.
NOTICE	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:

- To prevent buildup of pressure inside the membrane contactor, do not block or valve off all gas/vacuum ports during operation or downtime.
- Do not exceed maximum operating pressure or temperature limits. Cleaning should be conducted at the minimal temperature and pressure required to clean the contactor, never exceeding the maximum operating pressure and temperature limits of the contactor.
- 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.

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.

NOTICE

- 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.
- To avoid contamination of the process fluid, gloves are recommended when handling the membrane contactors.
- 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 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.
- 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^2) 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.

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 3M's control and uniquely within user's 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 customer's 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.

Warranty, Limited Remedy, and Disclaimer: Unless a different warranty is specifically stated on the applicable 3M product packaging or product literature (in which case such warranty governs), 3M warrants that each 3M product meets the applicable 3M product specification at the time 3M ships the product. 3M MAKES NO OTHER WARRANTIES OR CONDITIONS, EXPRESS OR IMPLIED, INCLUDING, BUT NOT LIMITED TO, ANY IMPLIED WARRANTY OR CONDITION OF MERCHANTABILITY, FITNESS FOR A PARTICULAR PURPOSE, OR ARISING OUT OF A COURSE OF DEALING, CUSTOM, OR USAGE OF TRADE. If a 3M product does not conform to this warranty, then the sole and exclusive remedy is, at 3M's option, replacement of the 3M product or refund of the purchase price.

Limitation of Liability: Except for the limited remedy stated above, and except to the extent prohibited by law, 3M will not be liable for any loss or damage arising from or related to the 3M product, whether direct, indirect, special, incidental, or consequential (including, but not limited to, lost profits or business opportunity), regardless of the legal or equitable theory asserted, including, but not limited to, warranty, contract, negligence, or strict liability.

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Rev 03/2021

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