



X - SPIRAL

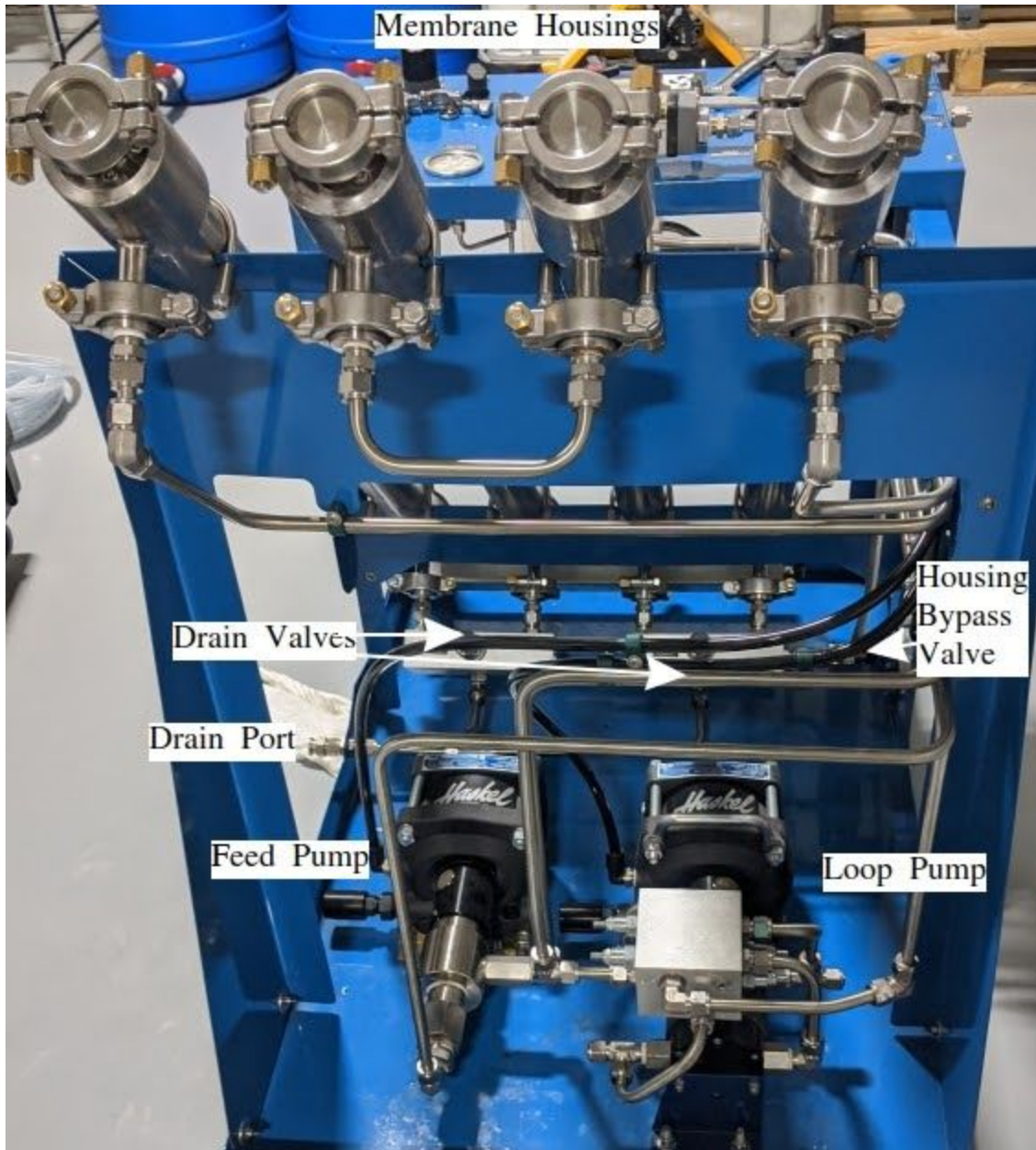
X-Spiral 2.5 Pneumatic Operating Manual



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Parts Glossary



Feed Pump: Feeds solution into the system.

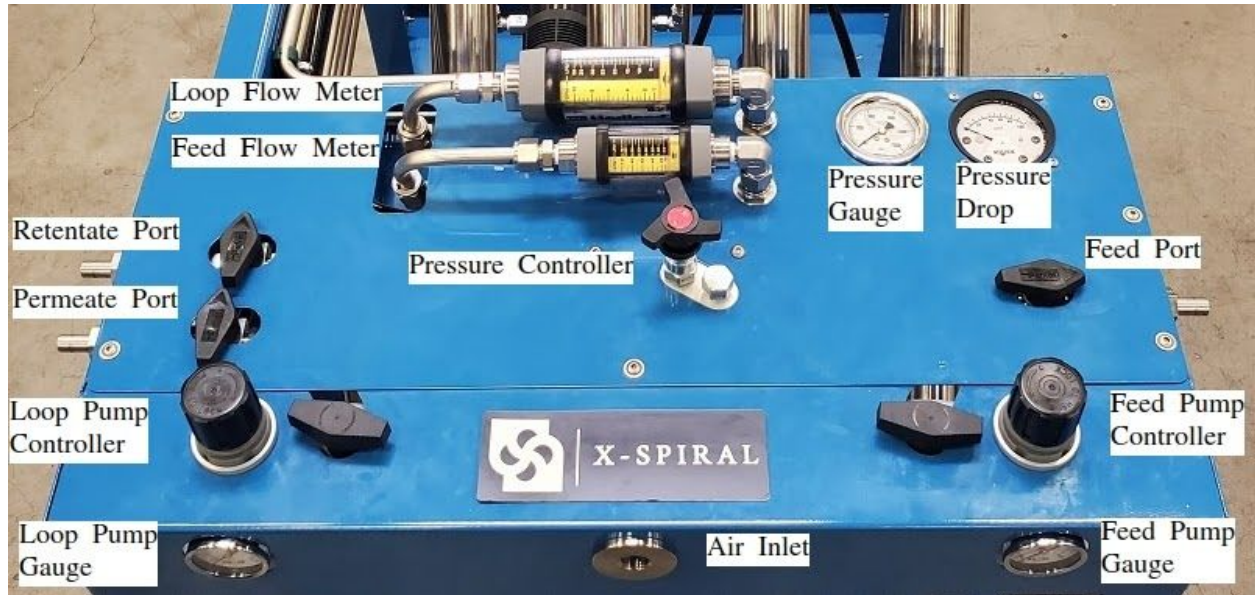
Loop Pump: Recirculates solution in system over the membranes.

Drain Port: Drains fluid from system as part of cleaning SOP. Drain Valves: Two drain valves, one set draining housings 1 and 2, the other set draining housings 3 and 4.

Housing Bypass Valve: Allows you to run only the first membrane housing, in order to easily try out new membranes without needing four of them.

Housings: Housings hold 2540 size membranes; adapters are included to convert various geometry membranes into the right end cap style.

Control Glossary



Air Inlet: Connects to the air compressor via ½" air line.

Feed Port: An on-off switch opens and closes the feed port

Feed Pump Controller: Increases and decreases the air pressure to the feed pump. Clockwise will increase the pressure, counterclockwise will decrease it. The feed pump controls the rate of solution being fed to the system, and has a role in determining the system pressure.

Feed Pump Gauge: Reads the air pressure being provided to the feed pump.

Loop Pump Controller: Increases and decreases the air pressure to the loop pump. Clockwise will increase the pressure, counterclockwise will decrease it. The loop pump controls the crossflow speed over the membranes.

Loop Pump Gauge: Reads the air pressure being provided to the loop pump.

Retentate Port: An on-off switch opens and closes the retentate port.

Permeate Port: An on-off switch opens and closes the permeate port.

Loop Flow Meter: Reads the crossflow over the membranes -- flow is taken as the median point in it's oscillations.

Feed Flow Meter: Reads the rate of solution being fed into the system-- flow is taken as the median point in it's oscillations.

Pressure Controller: An adjustable pressure relief valve that controls the maximum pressure of the system. Combined with the feed pump it determines the system pressure. Turning clockwise raises the pressure limit, counterclockwise lowers it.

Pressure Gauge: Reads the system pressure

Pressure Drop Gauge: Reads the pressure drop from the front to the back of the membrane series. Not necessary for user operation unless testing a new membrane type.

Startup Procedure

1. Undo the clamps on the tops of the four housings and remove them.
2. Notice that the membranes have an o-ring on one end, but no o-ring on the other.
3. Looking from the front, the membranes must be loaded into the unit with their o-rings facing in the following order (left to right): up, down, up, down.
4. There are two types of adapter, a tubular adapter and a plug. The plug must be inserted in the end of the membrane facing the top of the housing; the tube must be inserted in the end facing the bottom.
5. Lubricate the adapters and o-rings with some glycerin, then insert the membranes into the housings with the directional order given above.
6. Once the membranes are inserted completely, put the end caps of the housings back on, and reattach all clamps.
7. Now that the housings are closed, the membranes should be washed with clean ethanol with the following procedure:
8. Open all the on/off valves, and make sure the pressure control valve is fully open.
9. Place the permeate, retentate, and feed lines into one vessel of ~ 5 gallons of clean ethanol.
10. Turn the feed pump controller to 1 gallon per minute, and run until air is no longer coming out of the retentate port. At this point the system is fully primed.
11. Now turn the loop pump up to its' maximum speed. The loop flow meter should read a median value of around 7 gallons per minute.
12. Continue this rinsing process for 30 minutes. Then, turn the pumps back off and close the on/off valves. The system is now primed and ready for actual operation.

Operating Procedure

1. Place the retentate line and the feed line into your feed vessel. Place the permeate line into your recovered alcohol vessel.
2. Open all the on/off valves on the system.
3. Start to increase the feed pump pressure by turning the feed pump controller clockwise. Feed solution will begin to enter the system. Monitor the feed rate, and stop when the feed is coming in at ~1 gpm.
4. Begin to rotate the pressure control valve clockwise. The system pressure will rise, and the feed pump will begin to slow. Increase the feed pump pressure until it is pumping at ~ 1 gpm again.
5. Alternate turning the pressure control valve and the feed pump pressure until you have reached your desired run pressure while still maintaining the ~1 gpm flow rate. For desolvation with standard membranes, the recommended pressure is 600 psi.
6. At this point, turn the loop pump pressure control until the loop pump has achieved the recommended crossflow rate as seen on the loop flow meter. For standard membranes, this is 7 gpm.
7. The system will now be recirculating out of the retentate port back into the feed vessel, and clean solvent will be coming out of the permeate port into the recovered alcohol vessel.
8. The system is now at a steady state, and can be run until solvent has been removed from the feed solution to the desired level.
9. As the feed becomes more concentrated, you will notice the permeation rate decreasing. When the feed reaches 30% oil concentration, the rate will have reduced to 1/2 or less of the initial rate, and at this point will begin declining rapidly. When this happens, the batch should be ended and moved on to a finishing evaporation stage.
10. You may now load another batch immediately, or, if you are done for the day, move on to the shutdown procedure.

Shutdown Procedure

1. Note: failure to follow this procedure as written will result in premature fouling of the membranes.
2. Rotate the pump pressure controls and system pressure control fully counterclockwise. The pumps should no longer be running, and the system pressure should be zero.
3. Open the drain valves, and remove the tri-clamp caps on the top ends of the housings. Drain fluid out of the system into a pan. The system holds ~1.5 gallon.
4. Once the fluid is completely drained, close the drain valves and reattach the caps.
5. Place the feed line into a vessel of 5 gallons of fresh alcohol. Place the retentate and permeate lines into an empty vessel.
6. Start running the feed pump at 1 gpm. Leave the system pressure controller completely open and do not build pressure.
7. Air will come out of the retentate port. Run until all the air has been removed and oily retentate is coming out.
8. At this point, turn the loop pump up to 7 gpm, and lower the feed pump rate until retentate is only slowly coming out of the system, ~0.1 gpm.
9. Run until the retentate stream is coming out as clean solvent, around 30 minutes.
10. At this point, rotate the pump pressure controls fully counterclockwise and close all the on/off valves. The membranes are now in clean solvent and can be stored indefinitely until you desire to run the next back.

Membrane Hygiene Notes

In order to get maximum lifespan on the membranes, certain practices must be maintained. All fluid fed to the membrane must be filtered down to at least 5 micron. If more particulate is allowed in, a loss of selectivity will be observed, with cannabinoids entering the permeate stream.

Membranes must always be left on clean solvent when the system is turned off. It is necessary to follow the cleaning procedure whenever the system will be left unused for more than an hour. If this procedure is not followed, a slowing of speed will be observed over time as oil particles have a chance to settle into the membrane surface.

Membranes should always be run at their recommended crossflow. If run at a lower crossflow, a temporary increase in solvent purity may be observed, but the membranes will clog quickly.

A membrane autopsy program is available; if your membranes experience performance loss, they can be cleaned and sent back to the manufacturer to determine the cause of failure and help adjust your pre-processing procedures accordingly.