Reverse osmosis is used to concentrate sap by pushing sap under pressure through a semi-permeable membrane. The membrane will remove ultra-pure water (permeate) and make a more concentrated sap (concentrate).

The membrane is the key element of your osmosis system, it allows sugar and water separation. Its structure is spiral wound, and its surface is porous. Bacteria proliferation and accumulation (fungal growth) can foul the membrane and cause permanent damage; it is important to keep the membrane well cleaned. Good maintenance will also ensure quality maple syrup production for many years.

The Econox is a reliable and efficient system that allows low cost and quality production. Exposing the membrane to iron or other minerals can compromise its life and performance. Cleaning and rinsing shall always be performed with unchlorinated demineralized water or with permeate water.

Membrane performance will decrease by time and can be measured by recording daily or weekly flow. It is important to use the temperature correction factor while calculating flow performance.

H2O Innovation is offering a membrane deep cleaning industrial service. You can take advantage of this low-cost service at the end of the season by shipping your membrane to H2O Innovation.

Note: Econox warranty is only valid with maintenance documented proof. H2O Innovation recommends keeping an updated logbook. You will find a logbook example at the end of this manual. USE only H2O certified products to preserve the life of your equipment. The use of non-certified products will void the warranty.
INTRODUCTION

The Econox is a compact and easy to operate reverse osmosis system. The system is designed to add more membranes, if desired, to concentrate a larger volume of sap. For a single membrane system, you can concentrate sap up to 10 Brix°, Brix concentration is dependent on the number of membranes on your Econox.

Install the Econox on a flat level surface. Allow for plenty of free space around your system to facilitate its operation and maintenance. Any changes to your equipment without prior approval of H2O Innovation may affect its performance and / or cause breakage.

When starting the Econox at the beginning of season calculate the pure water permeability (PWP) of your membranes. This will allow, you during the season, to quickly determine when it is necessary to clean your membranes. Go to the “PWP” section of this manual to see calculations examples.
ECONOX COMPONENTS

CONTROL VALVES

V1 = Concentration control valve
V2 = Pressure control valve
V3 = Concentration / cleaning and rinsing valve
V4 = Concentrate by-pass control valve
V5 = Permeate by-pass control valve
V6 = Drain valve
V7 = Wash tank valve
MEMBRANE INSTALLATION

Figure A. Unscrew the PVC union ring (permeate outlet).
Figure B. Unscrew the two (2) screws and washers retaining the cover in place.
Figure C. Using pliers or by hand, squeeze together the two tabs of the retaining seal to remove it from the membrane vessel.
Figure D. When there is no membrane in the vessel, push slightly the cover to tilt it and facilitate its removal.

EXPLODED VIEW OF A VESSEL END CAP

Figure A

Figure B

Figure C

Figure D

Figure D'
NOTE: When there is no membrane in the vessel, you will have to push slightly the cover to tilt it and facilitate its removal.

Insert the membrane in the membrane housing.

Install the U-Cup in the groove at the end of the membrane. The U-Shape of the ring should be facing the outside of the housing. Lubricate the U-Cup and the seal cap with water safe synthetic grease. Then firmly push the membrane into the housing while turning to seat it.

It’s important to ensure o-rings are well positioned. To facilitate handling, we highly recommend greasing the o-rings. This will allow easier insertion of the lid into the vessel and membrane.

- 1 o-ring is located on the cover;
- 3 o-ring are located on the membrane connector.

Replace the cover, the retaining seal, then the 2 screws.
START-UP

To start the Econox, place selector switch to the “START” position. This will start the booster pump. Hold the selector switch in this position until the pressure pump starts. Once the pump is running, release the switch. It will go back by itself to the “ON” position. The “ON” position is the normal operating mode of the system. A delay of a few seconds will occur before the recirculating pump starts.

**Maximum operating pressure = 600 psi**  
**Optimal operating pressure = 300-350 psi**

When the membrane is new and/or in a metabisulfite solution, it is important to rinse it thoroughly before its use. Use at least 300 gallons permeate per membrane (600 for a organic maple farm).

SHUTDOWN

To turn off the Econox, set the selector switch to the “OFF” position this will simultaneously stop the pumps. The Econox has protective devices that instantly stop the system in case of a problem. There is an alarm and warning lights for all the following elements:

- High water temperature (40°C-110°F)
- Low pressure at the inlet of the pressure pump +/- 15 psi
- Motor fault

GENERAL CHARACTERISTICS

Power supply 240 volts, 60 Hz, single phase

Dimensions

- Height: 72” (183 cm)
- Width: 27” (69 cm)
- Depth: 30 ” (76 cm)

Plumbing connections

- Sap inlet: 1 ½” PVC
- Permeate outlet: 1” PVC type A quick connect
- Concentrate outlet: 1” PVC type D quick connect
- Drain: 1 ½” PVC
PUMPS

FEED PUMP: Stainless steel pump, 1 HP or 2 HP motor, 60 Hz, 3500 rpm, 230 volts, single-phase

PRESSURE PUMP: 5 HP or 7.5 HP, 60 Hz, 3500 rpm, 230 volts, single-phase

RECIRCULATING PUMP: 1 HP, 60 Hz, 3500 rpm, 230V, single-phase

REQUIRED TANKS

PERMEATE TANK: To collect pure water (permeate) that your system will remove from sap. This water will be used to rinse the Econox;

SAP TANK: To accumulate enough sap to feed the Econox;

CONCENTRATE TANK: To accumulate enough concentrated sap to feed the evaporator.
OPERATING CYCLE

IMPORTANT: TO AVOID CONTAMINATION – Before concentration, ensure the membrane is clean, has been rinsed and that all rinse water has been sent to the drain.

INITIAL RINSE
Before starting the system, to avoid an overload of the system, put the concentration / cleaning and rinsing valve (V3) at an angle about 45° THEN completely open the concentration control valve (V1) and the pressure control valve (V2). Start the system then readjust permeate and concentrate flow according to the table values on page 15.

RINSING - Valve Positionning
V3 = CLEANING AND RINISING = (Concentration / cleaning and rinsing valve)
V4 = TOWARDS THE WASHING TANK = (Concentrate by-pass control valve)
V5 = TOWARDS THE WASHING TANK = (Permeate by-pass control valve)
V6 = OPEN = (Drain valve)
V7 = CLOSED = (Wash tank valve)
  • Rinse membranes with permeate 15 minutes.
  • Perform a pure water permeability test (PWP) and do its initial calculation.

CONCENTRATION
1. Close the drain valve (V6) and the wash tank valve (V7) as shown below;

2. Open the maple sap tank supply valve;
3. Position the concentrate by-pass control valve (V4) and the permeate by-pass control valve (V5) to their respective tank. Look at the pictures below;

4. Put the concentration / cleaning and rinsing valve (V3) in concentration mode as shown on the pictures below.
5. Direct the concentrate towards the maple sap tank until you reach the desired Brix degree. The feed valve of the maple sap tank must be open, and the feed valve of the concentrate maple sap tank must be closed.

6. Start the Econox. Place the OFF/ON/START switch to the “START” position. This will start the booster pump. Hold the selector in this position until the pressure pump starts. Once the pump is running, release the switch. It will go back by itself to the “ON” position. The “ON” position is the normal operating mode. It will then take a few seconds before the recirculation pump starts.

7. Adjust the concentration control valve (V1) to reach, on the permeate and concentrate flowmeter, the values as shown in the table below.

This table is considering an inlet maple sap of 2 Brix°, 8°C (47°F). The concentrate sap will be of 15 Brix° (except for separators having a single membrane, the concentrate will be 10 Brix° maximum).

<table>
<thead>
<tr>
<th>System</th>
<th>Number of membranes →</th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
<th>6</th>
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<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
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<tr>
<td>Econox 600</td>
<td>Permeate</td>
<td>6.5</td>
<td>10</td>
<td></td>
<td></td>
<td></td>
<td></td>
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<tr>
<td></td>
<td>Concentrate</td>
<td>1.5</td>
<td>1.5</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Brix outlet</td>
<td>10</td>
<td>15</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Econox 1200</td>
<td>Permeate</td>
<td>6.5</td>
<td>10</td>
<td>17.5</td>
<td>19</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Concentrate</td>
<td>1.5</td>
<td>1.5</td>
<td>2.5</td>
<td>3</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Brix outlet</td>
<td>10</td>
<td>15</td>
<td>15</td>
<td>15</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Econox 2000</td>
<td>Permeate</td>
<td></td>
<td></td>
<td>22.5</td>
<td>26</td>
<td>29</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Concentrate</td>
<td>3.5</td>
<td>4</td>
<td>4.5</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Brix outlet</td>
<td>15</td>
<td>15</td>
<td>15</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

*Those values are approximate. This table is indicative only.

Your Econox performance will depend on the sap inlet temperature, sap quality, membrane clogging, etc.
8. Adjust the pressure control valve (V2) as needed. This valve will need adjustments during the day, it is directly associated with the membrane fouling rate. The pressure will then need to be increased to maintain the Brix° of the concentrate.

9. After a minute of operation, take a concentrate sample to verify its sugar content.

10. When the concentrate has the desired Brix degree, open the feed valve of the concentrate tank and close the feed valve of the sap tank.

11. 1 hour before the end of the concentration cycle, fill the wash tank with permeate to its overflow. Position the permeate bypass control valve (V5) as shown on the picture on the right.

**NOTE:** To prevent clogging and bacterial growth, membranes should never remain in sugar. If the Econox is stopped more than 30 minutes, perform a rinse.
DESUGARING

Before performing a rinse, the first thing to do is a desugaring to capture all the sugar that is trapped in the membrane. For that, isolate your maple sap tank and feed the Econox with permeate instead of sap.

- Open the permeate tank valve to feed the Econox.
- Isolate the maple sap tank by closing its valve.

DESUGARING - Valve Positioning

V1 = leave as in concentration mode
V2 = leave as in concentration mode
V3 = 45°POSITION = (Concentration / cleaning and rinsing valve)
V4 = TOWARDS THE CONCENTRATE TANK = (Concentrate by-pass control valve)
V5 = TOWARDS THE WASHING TANK = (Permeate by-pass control valve)
V6 = CLOSED = (Drain valve)
V7 = CLOSED = (Wash tank valve)

*When your concentrate no longer contains sugar, position the valve in rinsing mode. Sugar push will take a few minutes, it will depend of the membranes number and the sugar amount you want to capture.
RINSING - Valve Positioning

V1 = leave as in concentration mode
V2 = leave as in concentration mode
V3 = CLEANING AND RINSING = (Concentration / cleaning and rinsing valve)
V4 = TOWARDS THE WASHING TANK = (Concentrate by-pass control valve)
V5 = TOWARDS THE WASHING TANK = (Permeate by-pass control valve)
V6 = OPEN = (Drain valve)
V7 = CLOSED = (Wash tank valve)

- Rinse membranes with permeate 15 minutes.
- Perform a pure water permeability test (PWP) and do its calculation. When the PWP reaches **15%** you have to wash the membrane. When it is more than **20%** it will be difficult to wash the membranes properly.

WASH

IMPORTANT:

Confirm PWP every 6 hours to ensure the membrane loss efficiency is under 15%.

**NEVER DO** an OxySan wash if you have not performed an acid wash (Opticlean) first. **Never** heat up over **77°F** (25°C)

ALWAYS leave the 20” 5 micron filter(s) in place when washing. Filters are protecting membranes from pressure overload.

USE only H2O certified products to preserve the life of your equipment. The use of non-certified products will void the warranty.
SOAP WASH

When doing a soap wash, pH must be between 11 and 12. Do not exceed the following soap quantities as this may damage your membranes.

- Ensure you have enough permeate to properly remove left over soap. Consider at least 300 gallons permeate per membrane (600 for an organic maple farm).
- Wash tank must be full to the overflow.
- Add per membrane 1 cup of Bio-Membrane OR ½ cup of Ultra-Bio-Membrane in the wash tank.
- Position the concentrate by-pass control valve \(V_4\) and the permeate by-pass control valve \(V_5\) towards the wash tank.
- Close the drain valve \(V_6\).
- Open the wash tank valve \(V_7\).
- Start the system.
- Turn the concentration / cleaning and rinsing valve \(V_3\) in “cleaning and rinsing mode”. Open it completely or until you reach 35psi on the after pre-filter pressure gauge.
- Let it run until the temperature reaches 104°F (40°C). The unit will stop automatically once it reaches this temperature (this will take around 20 minutes).
- Open the drain valve \(V_6\).

Do a complete rinse cycle to remove left over soap. Use at least 300 gallons permeate per membrane or 600 for an organic maple farm.

ACID WASH

When doing an acid wash, pH must be between 2 and 3. It is recommended to do an acid wash (Opticlean A) 2 or 3 times per season or when the flowmeter turns brown/orange. Use 1 cup of Opticlean A per membrane.

1. Do a complete rinse.
2. Do a soap wash.
3. Redo a complete rinse.
4. Do an acid wash. Procedure and manipulations are the same as for a soap wash.
5. Redo a complete rinse.

NEVER DO an Oxysan wash if you have not performed an acid wash first (Opticlean). Never let it heat up over 77°F (25°C).
DAILY STORAGE

Rinse your membrane. Compare your PWP with the initial PWP. Do a wash if needed. Let the unit sit in permeate until next morning.

If you are expecting to shut down the unit more than three days, you should put 1 cup per membrane of sodium metabisulfite powder in the wash tank full of permeate.

Let circulate for 5 minutes and let this solution sit in the Econox until next use. This bactericide solution is good for 3-4 weeks.

**Warning:** Never heat a metabisulfite solution in the Econox. Always rinse thoroughly before concentrating maple sap.

**Important:** You need to drain your Econox at the end of each day if there is a risk of freezing. If your maple farm is heated, there is no need to drain the unit.

**Note:** Econox warranty is only valid with maintenance documented proof. H2O Innovation recommend keeping an updated logbook including your membranes PWP. You will find a logbook example at the end of this manual.
5 MICRON FILTER MAINTENANCE

It is highly recommended to change the 5 micron filter(s) at the season beginning. Before each concentration cycle check the filter(s) AND check frequently when the system is running.

Filter frequency of changes
- After washing, if the pressure differential between the inlet and outlet pressure gauge is over 20 psi, it’s time to change your filter.

Replacement procedure
- Shut down the system and close the feed valve;
- Open the drain valves to bring the system back to atmospheric pressure;
- Unscrew the 5 microns housing (it should be unscrewed by hand);
- Remove the cartridge and replace with a new one;
  Retighten the filter housing by hand, ensure the O-Ring is well seated.

PRE-FILTER MAINTENANCE

Cleaning procedure, if needed, when you see dirt or when the mesh filter housing becomes opaque.
- Shut down the system and close the supply valve;
- Open the drain valves to bring the system back to atmospheric pressure;
- Unscrew the clear filter housing (it should be unscrewed by hand);
- Remove the filter, sediments and clean the filter housing;
- Retighten the clear filter housing by hand, ensure the O-Ring is well seated.
END-SEASON WASH AND STORAGE

H2O Innovation is offering a membrane deep cleaning industrial service. You can take advantage of this low-cost service at the end of the season by shipping your membrane to H2O Innovation. It is important to thoroughly wash the system and its membranes.

**Always** turn off the main power breaker to ensure no one will restart the Econox.

**END-SEASON COMPLETE WASH**

Follow the steps as described below for the end-season complete wash.

1. Complete rinse;
2. Soap wash;
3. Acid wash – OpticleanA;
4. Complete rinse;

If the PWP has dropped more than 10%, follow the next steps:
5. Oxysan wash / let it soak 24h, *do not exceed 25°C/77°F*;
6. Complete rinse;
7. Soap wash;
8. Complete rinse;
DRAINAGE FOR STORAGE

Always thoroughly rinse your Econox to ensure moving parts will not seize during the storage period.

- Empty the membrane vessel. Open the drain valve at the bottom of the vessel.
- Open the drain valve under the recirculation pump.
- Remove the feed hose from the high-pressure pump and push the check valve.
- Remove the drain plug located at the bottom of the feed pump.
- Empty all hoses and discard the 5 micron filter.

MEMBRANE STORING

The storage of your membrane is the most important part of storing your Econox. We recommend storing membranes in a PVC vessel, or in a sealed plastic bag. Four recommendations are to be followed according to membrane manufacturers:

- The membrane should never be exposed to freezing. The warranty does not cover a membrane that has been exposed to freezing;
- The membrane must be stored in a storage solution, in a cool place above the freezing point (about 7°C/45°F);
- The membrane should always remain moist. The membrane must be immersed in a solution that will prevent the growth of bacteria (use 1 gallon of storage solution in a sealed PVC vessel without water).

Note: Remove the membranes U-Cup. Do not let them sit in the storage solution. The storage solution attacks the plastic of the U-Cup drying them up and reducing their lifetime.
TROUBLESHOOTING

THE ECONOX DOES NOT START

• Circuit breaker is not in "ON" position, a circuit has been interrupted. Check your panel.
• Check the fuses.
• Check the pumps.
• The Econox is not plugged. Plug in.

THE SYSTEM DOES NOT STOP WHEN THERE IS NO SAP

• Check the pressure switch, readjust it or change it.

THE SYSTEM STARTS BUT PRESSURE DOES NOT INCREASE

• Concentration / cleaning and rinsing valve (V3) may be opened too much. Gradually close the valve.
• Ensure the Econox is fed with sap or permeate. Check the supply and tank valves.
• Ensure pipping is not freeze.
• No 5 micron prefilter in place. Dirt might have clogged the pressure pump valves. Send the pump to H2O for rebuilt.

SYSTEM STARTS BUT NO PRESSURE ON THE PRESSURE GAUGE

• Ensure the feed pump is started. Purge the lines to remove air.
• Pressure gauge might be dirty or defective. Clean it or change it as needed.

ECONOX DOES NOT REMAIN "ON" WHEN THE SELECTOR IS AT "ON"

• Obstructed 5 micron prefilter. Change the 5 micron prefilter.
• Insufficient level of sap or permeate. Refill sap and/or permeate tank.
• Pressure is not adjusted properly.
THE ECONOX DOES NOT MAINTAIN ITS PRESSURE

- Clogged prefilter, clean the prefilter.
- Concentration / cleaning and rinsing valve (V3) is not adjusted properly. Readjust the valve.

THERE IS A LEAK OF PERMEATE OR CONCENTRATE ON THE ECONOX

- Membrane plug is leaking. Check the Land retighten the clamps. Lubricate the U-cup, the o-rings, the permeate outlet and the sap inlet.
- Check the hose connections, ensure the fittings are tight. Ensure there is no broken, cracked or loose pipes.

CONCENTRATE RATE IS TOO LOW

- Check the U-cups for cracks and positioning. Replace if needed.
- Check the recirculation pump.
- Broken membrane. Replace it.
ECONOX IN IMAGES

Econox straight profile
Membrane housing
MEMBRANE INSTALLATION

Figure A. Unscrew the PVC union ring (permeate outlet).
Figure B. Unscrew the two (2) screws and washers retaining the cover in place.
Figure C. Using pliers or by hand, squeeze together the two tabs of the retaining seal to remove it from the membrane vessel.
Figure D. When there is no membrane in the vessel, push slightly the cover to tilt it and facilitate its removal.

EXPLODED VIEW OF A VESSEL END CAP

Figure A
Figure B
Figure C
Figure D
Figure D’
The pure water permeability (PWP) is used to check the current state of cleanliness of the membrane. PWP consists of measuring the membrane filtration rate when using pure water or filtrate. Membrane efficiency is obtained by comparing the membrane filtration rate when first used with its current filtration rate.

Procedure:
- Rinse the membrane using permeate
- Adjust the pressure to 150 psi*
- Record the permeate flow
- Record the water temperature
- Take the permeate value and divide it by the temperature correction factor at 13°C (55°F)

*To reach 150 psi, turn progressively the concentration / cleaning and rinsing valve (V3) in concentration mode. If you cannot reach 150 psi, close progressively the concentration control valve (V1). With a new membrane, you might not be able to reach 150 psi. It does not matter. The important step is to always do your PWP using the same pressure.

See the correction factor table on next page.

Example
Initial PWP = 7 gpm
The initial PWP is to be taken when the membranes are new, after 12 to 24 hours of use.

Today your readings are: 150 psi, 68°F and a permeate flow of 6 gpm.

PWP calculation
PWP = permeate flow / temperature correction factor
PWP = 6 gpm / 1,2 = 5 gpm (flow at 55°F)

Yield loss calculation:
\[(\text{PWP}/\text{PWP}_{\text{initial}}) \times 100 = \% \text{ efficiency}\]
\[(5 / 7) \times 100 = 71,4 \% \text{ efficiency}\]
Difficult

100 % - \% efficiency = \% yield loss
100 % - 71,4 % = \textit{28,6} \% yield loss

\textit{A wash is required because the loss is more than 20%. A was is required when the loss is more than 15%. When it is more than 20% it will be difficult to wash the membranes properly.}
## TEMPERATURE CORRECTION FACTOR TABLE

*PWP Reference temperature: 13°C / 55°F*

<table>
<thead>
<tr>
<th>Temperature °C / °F</th>
<th>Correction Factor</th>
<th>Temperature °C / °F</th>
<th>Correction Factor</th>
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<tbody>
<tr>
<td>0 / 32</td>
<td>0.672</td>
<td>13 / 55</td>
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<td>1 / 34</td>
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<td>17 / 63</td>
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<td>12 / 54</td>
<td>0.973</td>
<td>25 / 77</td>
<td>1.350</td>
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*When the PWP reaches 15% you have to wash the membrane. When the PWP is more than 20% it will be difficult to wash the membrane properly.*
## Logbook - Maintenance & Operation

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<th>Hours of operation</th>
<th>Outlet temperature °C / °F</th>
<th>Sap Brix °</th>
<th>Concentrate Brix °</th>
<th>Concentrate Flow GPM</th>
<th>Permeate Flow GPM</th>
<th>Corrected @ 55 °F</th>
<th>Membrane Pressure</th>
<th>Pre-Filter Pressure</th>
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