1. Purpose

Ionomr's Aemion® AF3N product provides the same high performance as its AF3 predecessor but is easier to use due to its single step exchange process which can be carried out within the stack, allowing for dry build. Coupled with the membrane's low swelling, this is ideal for automated assembly lines. The AF3N membrane possesses identical chemistry to AF3, the difference is that the halide ions are exchanged for nitrate prior to supply, removing the requirement for customers to perform multiple exchanges before use.

2. Scope

The purpose of this document is to impart the recommended procedure for a 1-step ion-exchange from nitrate to hydroxide form using pre-exchanged Aemion® membranes.

3. Definitions

3.1 **AEM – anion exchange membranes**. A film of anion-conductive ionomer used to transport hydroxide ions (OH^-) through hydrated channels while acting as a barrier to gases and electrons between the electrolyzer's anode and cathode compartments.

3.2 **EIS – electrochemical impedance spectroscopy.** An analytical tool to characterize material properties and electrochemical processes.

3.3 **HFR – high frequency resistance.** A measure of total cell Ohmic resistance. In this document, HFR is reported in area-specific units (i.e., ASR or area specific resistance).

3.4 **OCV – open circuit voltage.** The potential difference between two terminals with no current flow.

4. Reference Documents

4.1 APN-AEM-1011 Aemion® AEM Water Electrolyzer Reference Design

4.2 APN-AEM-1015 Aemion® Exchange Membranes: Pre-treatment & Activation Instructions

4.3 APN-AEM-1023 Aemion® Disassembly Instructions for Post-Mortem Characterization

5. Aemion® AF3N Membrane Pre-treatment & Activation Procedure

5.1 GENERAL

Ionomr Anion Exchange Membranes (AEMs) are significantly tougher than their counterparts in industry, leading to thinner membranes, longer service life and reduced overall system costs. They have low ionic resistance, high electrical resistance, and strong chemical stability in solutions of both high and low pH, including alkaline solutions (KOH preferred) from 0.5 M to 2 M and up to 80 °C. Standard AF3 films come in halide form (I^- and Cl^-) and require a 2-step exchange, while AF3N films come in nitrate form (NO_3^-) and can be activated in 1 step.

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5.2 HANDLING, STORAGE AND SAFETY

Store, handle and process the membrane in a clean, dust-free environment. Only use new and sharp blades when cutting the membrane for best results. Gloves should be worn when handling the membrane. The membrane should be handled with care: do not puncture, crease or tear the membrane. All surfaces that come in contact with the membrane during handling, inspection, treatment, storage, and installation should be smooth and clean. Membranes must not be left out in ambient lab environments for long periods of time (e.g., overnight or more). The acceptable period of time will depend on ambient temperature and RH.

Long term storage in original humidity barrier packaging or analogous humidity barrier packaging between 21-25 °C and 50-60% RH with minimum exposure to heat and light is required. Membranes must be repackaged between uses. Original packaging materials are resealable using a heat sealer capable of 240 °C or 464 °F (e.g., Uline Impulse Sealer H-1252). Storage of membranes after use in an electrochemical cell is best done in the wet form in sealed containers using aqueous electrolytes (e.g., KNO_3, KCl, etc.). For information on postmortem membrane preparation please refer to APN-AEM-1023.

Chemicals should be handled according to the manufacturer's instructions – please refer to the data sheets supplied with the chemicals. Of particular note here are the strongly corrosive properties of potassium hydroxide, and the oxidizing nature of potassium nitrate.

5.3 PRE-TREATMENT

Membranes are delivered in dry nitrate (NO_3^-) form and need to be exchanged into the ionic form it will operate in while assembled in the cell. With the new offering of pre-exchanged AF3N membranes, a 1-step exchange can sufficiently remove nitrate ions, as long as the protocol highlighted below is meticulously followed.

DRY ASSEMBLY ACTIVATION STEP - Nitrate to Hydroxide Form in-situ

Protocol	Temperature (°C)	Electrolyte	Flow rate ($mL_{electrolyte}/min/cm^2_{AEM}$)	Min. time (hours)*
Dual feed	RT	1 M KOH	≥ 2	8
Dual feed	80			8
Dry cathode	RT			15
Dry cathode	80			9

*Min. time is the amount of time required to achieve 90% of the conductivity measured after 24 hours, under a specific protocol. See Figure 1 for HFR over time under different protocols.

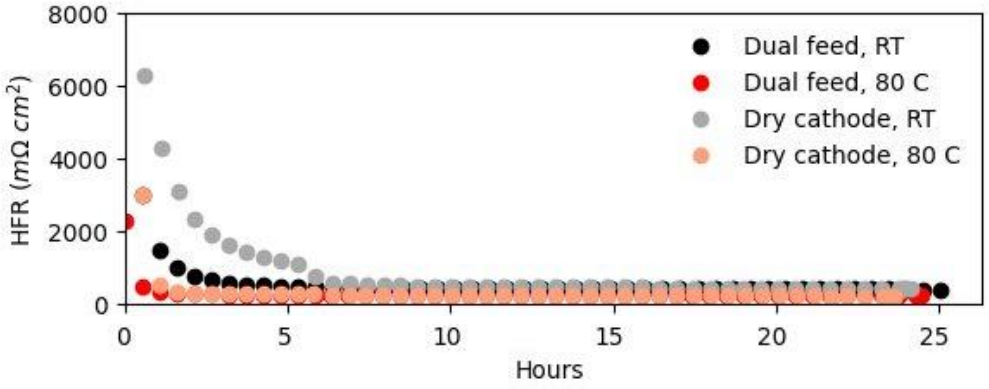


Figure 1. AF3N membrane activation tracked via HFR at OCV over time; in-situ activation using 1 M KOH. See Appendix A for details.

ACS grade KOH or equivalent treatment is necessary (< 2% carbonates, our typical assay is 0.5% carbonates). Atmospheric exposure of the KOH electrolyte solution results in gradual increases to solution carbonation and must be minimized. It is also necessary to ensure: a) low phosphates; b) low silicates; and c) low contents of other ions that can form multivalent anions in operational conditions. Operation for 24-72 hours may be necessary to achieve conditioned performance. If there are any concerns about storage, chemical stability, or pretreatment, please contact us for further information.

6. Membrane Handling

6.1 REMOVAL OF THE MEMBRANES FROM THE BACKING LAYER

Primary method

1. With clean gloved hands, hold the membrane on its backing layer.
2. Using a thumb or a finger, rub against the corner edge of the membrane to produce separation from the backing layer.
3. Once corner separation from the backing layer is achieved, carefully and gently, begin to pull the membrane from the backing layer whilst holding the backer down on a clean dry surface.
4. As the backing layer is released, support the membrane as it is removed from the backing layer, until all of the membrane has been removed.

Secondary method

1. With clean gloves, wet a portion of the membrane/backing layer edge with de-ionized water; this should aid in separation of the membrane from the backing layer. Repeat the steps in the primary method.
2. If the membrane does not separate upon initial wetting, spritz a small amount of water area close to the edge of the membrane and repeat the primary method.

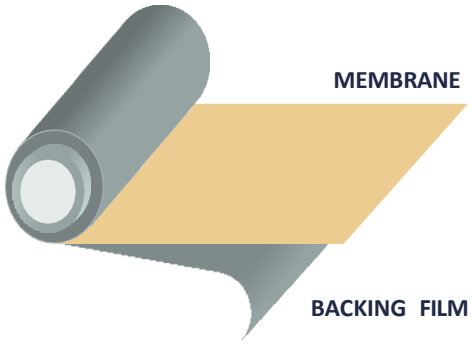
6.2 FOR COATING AEMION® MEMBRANES AFTER REMOVING FROM THE BACKING LAYER

Ensure that the membrane remains flat.

A powder coating masking tape (e.g., 3M™ Polyester Tape 8992, www.3mcanada.ca/3M/en_CA/p/d/b40070623/) to overlap the edges of the membrane prior to coating procedures to stabilize the membrane in place. This will help maintain the membrane positioning, and eliminate stress lines that may develop. Use caution when removing tape from membrane after the coating process as tears may occur. Cutting off taped area is an alternative.

Use caution to remove tape from membrane after the coating process.

ROLL UNWIND ORIENTATION
(BASE FILM FACING OUT)



6.3 FOR ASSEMBLY OF THE MEMBRANE INTO ELECTROLYZER AFTER REMOVING FROM THE BACKING LAYER

The membrane has a rough side (facing out), and a smooth side (against backing film). **It is recommended to assemble the membrane into the water electrolyzer with the smooth side facing the anode and the rough side facing the cathode.** Or as a general rule, the rough side is recommended to face the side which will experience higher pressure.

Note: this may not be true for all systems, and it is recommended to try the material in both orientations in your specific system.

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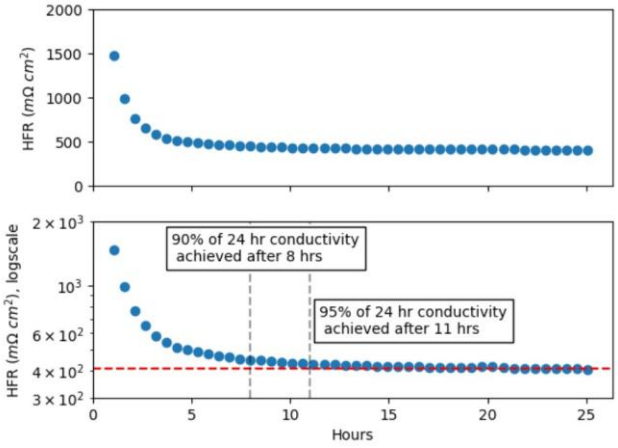
Appendix A: Membrane Activation Under Various Protocols

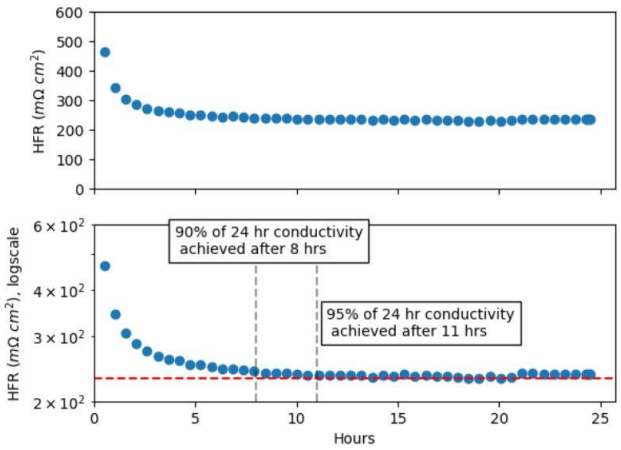
HFR measurements are dependent on contact resistances from cell hardware and, in this case, were obtained from EIS at OCV to ensure there are no current-driven effects. Because of this, the reported values are higher than one would expect under real electrolysis conditions.

Results show that heating the electrolyte for in-situ activation will yield the lowest HFR in the least amount of time due to increased electrolyte conductivity at higher temperatures. Similar activation times and resistances are observed for dual feed and dry cathode operation.

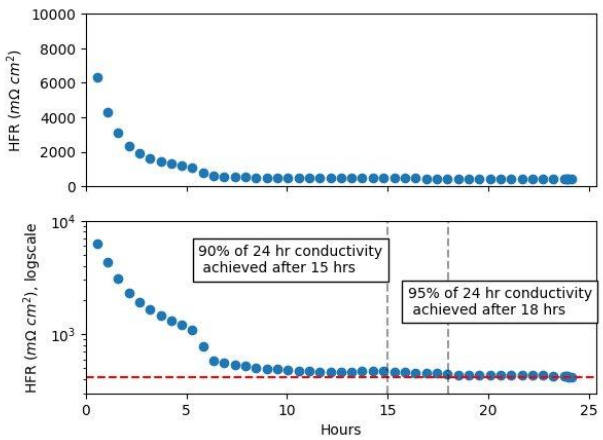
A: Dual feed at RT, ~400 mΩ · cm^2 after 24h.



B: Dual feed at 80 °C, ~200 mΩ · cm^2 after 24h.



C: Dry cathode at RT, ~400 mΩ · cm^2 after 24h.



D: Dry cathode at 80 °C, ~200 mΩ · cm^2 after 24h.

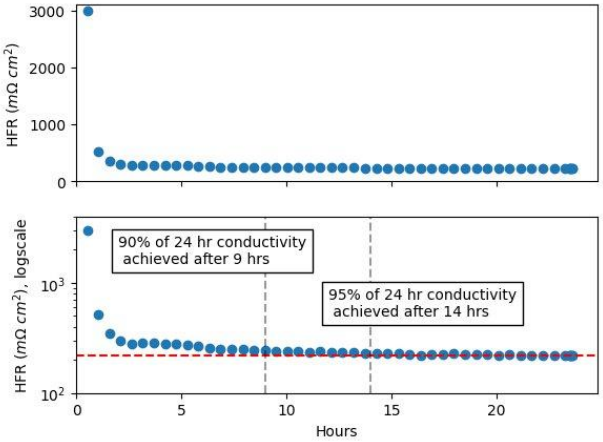


Figure A1. HFR at OCV over time with 1 M KOH under dual feed and dry cathode operation (not corrected for cell HFR – expected membrane HFR is < 200 mΩ · cm^2). Cells were assembled dry. Red dashed line indicates HFR after 24 hours.

Revision History:

Revision	Date	Description of Changes
A	Oct 2., 2025	Initial release
B	Mar. 5, 2026	Change to handling and storage section, added company address, added disclaimer statement