



# Nafion™ N115, N117, N1110

## Ion Exchange Materials

### Extrusion Cast Membranes

## Product Information

Nafion™ perfluorosulfonic acid (PFSA) membranes are non-reinforced films based on chemically stabilized PFSA/polytetrafluoroethylene (PTFE) copolymer in the acid (H<sup>+</sup>) form. The physical properties remain the same for the chemically stabilized membranes, which exhibit substantially lower fluoride ion release compared to the non-stabilized polymer—a sign of improved chemical durability. Nafion™ PFSA membranes are widely used for proton exchange membrane (PEM) fuel cells and water electrolyzers. The membrane performs as a separator and solid electrolyte in a variety of electrochemical cells that require the membrane to selectively transport cations across the cell junction. The polymer is chemically resistant and durable.

### Order and Packaging Information

Membrane dimensions are based on dry product conditioned at 23 °C (73°F) and 50% relative humidity (RH) before cutting. The membrane's water content will affect its dimensions, and the change may not be symmetrical in the length, width, and thickness directions. In addition, certain conditioning steps performed by the customer also may affect the dimensions. Customers may wish to review their membrane treatment steps and dimensional requirements with a Nafion™ technical representative before establishing membrane shipping dimensions.

### Standard dry product dimensions for individual pieces include:

**Width:** 0.30 m (min.) to 1.22 m (max.)

**Length:** 0.30 m (min.) to 1.22 m (max.)

The membrane delivery package for cut pieces will depend on the size and quantity of the membrane order. Smaller sized membranes are shipped flat, while longer lengths of individual pieces are shipped on a roll. The membranes are protected with a polyethylene wrap and inner packaging, and then placed in shipping containers.

### Standard dry product dimensions for roll goods include:

**Width:** 12-in (0.305-m) and 24-in (0.610-m) standard roll widths, and roll widths from 0.20-m (min.) up to 1.22-m (max.) on special order. Intermediate widths available in increments of 0.125-in

**Length:** 50-m standard roll length

There is a 100 m<sup>2</sup> minimum order requirement for non-standard roll widths and lengths. Membrane pieces or rolls can be cut to custom sizes, and special packaging provided at additional cost and/or delivery time. Please contact Nafion™ Customer Service for details.

**Table 1. Properties of Nafion™ PFSA Membrane**

Thickness and Basis Weight Properties <sup>1</sup>		
Membrane Type	Typical Thickness (μm)	Basis Weight (g/m <sup>2</sup> )
Nafion™ N115	127	250
Nafion™ N117	183	360
Nafion™ N1110	254	500
Physical and Other Properties <sup>2</sup>		
	Typical Value	Test Method
Physical Properties		
Tensile Modulus, MPa (kpsi)		
50% RH, 23 °C (73 °F)	249 (36)	ASTM D882
water soaked, 23 °C (73 °F)	114 (16)	ASTM D882
water soaked, 100 °C (212 °F)	64 (9.4)	ASTM D882
Tensile Strength, Max., MPa (kpsi)		
50% RH, 23 °C (73 °F)	43 (6.2) in MD, 32 (4.6) in TD	ASTM D882
water soaked, 23 °C (73 °F)	34 (4.9) in MD, 26 (3.8) in TD	ASTM D882
water soaked, 100 °C (212 °F)	25 (3.6) in MD, 24 (3.5) in TD	ASTM D882
Elongation at Break, %		
50% RH, 23 °C (73 °F)	225 in MD, 310 in TD	ASTM D882
water soaked, 23 °C (73 °F)	200 in MD, 275 in TD	ASTM D882
water soaked, 100 °C (212 °F)	180 in MD, 240 in TD	ASTM D882
Tear Resistance—Initial, g/mm		
50% RH, 23 °C (73 °F)	6000 in MD, TD	ASTM D1004
water soaked, 23 °C (73 °F)	3500 in MD, TD	ASTM D1004
water soaked, 100 °C (212 °F)	3000 in MD, TD	ASTM D1004
Tear Resistance <sup>3</sup> —Propagating, g/mm		
50% RH, 23 °C (73 °F)	>100 in MD, >150 in TD	ASTM D1922
water soaked, 23 °C (73 °F)	92 in MD, 104 in TD	ASTM D1922
water soaked, 100 °C (212 °F)	74 in MD, 85 in TD	ASTM D1922
Specific Gravity	1.98	—
Other Properties		
Conductivity, S/cm	0.10 min.	See footnote <sup>4</sup>
Available Acid Capacity, meq/g	0.90 min.	See footnote <sup>5</sup>
Total Acid Capacity, meq/g	0.95–1.01	See footnote <sup>5</sup>
Hydrolytic Properties <sup>2</sup>		
Water Content, % water <sup>6</sup>	5	ASTM D570
Water Uptake, % water <sup>7</sup>	38	ASTM D570
Thickness Change, % increase		
from 50% RH, 23 °C (73 °F) to water soaked, 23 °C (73 °F)	10	ASTM D756
from 50% RH, 23 °C (73 °F) to water soaked, 100 °C (212 °F)	14	ASTM D756
Linear Expansion, % increase <sup>8</sup>		
from 50% RH, 23 °C (73 °F) to water soaked, 23 °C (73 °F)	10	ASTM D756
from 50% RH, 23 °C (73 °F) to water soaked, 100 °C (212 °F)	15	ASTM D756

<sup>1</sup>Measurements taken with membrane conditioned to 23 °C (73 °F), 50% RH.

<sup>2</sup>Physical properties measured for Nafion™ N115. Where specified, MD—machine direction, TD—transverse direction. Conditioning state of membrane given. Measurements taken at 23 °C (73 °F), 50% RH.

<sup>3</sup>Tear resistance (g/mm) of dry membrane increases with thickness. Values given measured using 50 μm membrane.

<sup>4</sup>Conductivity measurement as described by Zawodzinski, et al., *J. Phys. Chem.*, 95 (15), 6040 (1991). Membrane conditioned in 100 °C (212 °F) water for 1 hr. Measurement cell submerged in 25 °C (77 °F) DI water during experiment. Membrane impedance (real) taken at zero imaginary impedance.

<sup>5</sup>A base titration procedure measures the equivalents of sulfonic acid in the polymer and uses the measurement to calculate the acid capacity or equivalent weight of the membrane.

<sup>6</sup>Water content of membrane conditioned to 23 °C (73 °F), 50% relative humidity (RH), compared to dry weight basis.

<sup>7</sup>Water uptake from dry membrane to water soaked at 100 °C (212 °F) for 1 hr (dry weight basis).

<sup>8</sup>Typical MD and TD values. MD expansion is slightly less than TD.

### Recommended Roll Storage Conditions

Unopened roll packages of Nafion™ PFSA membrane should be stored in the original shipping box, out of direct sunlight, and in a climate-controlled environment maintained at 10–30 °C (50–86 °F) and 30–70% relative humidity. Before opening the package, pre-condition the membrane roll to the processing area temperature for 24 hr.

Once opened and exposed to the environment, the membrane will equilibrate to the ambient relative humidity and change in dimensions accordingly. Membrane order dimensions are specified and measured at 23 °C (73 °F) and 50% relative humidity.

### Handling Practices

Ventilation should be provided for safe handling and processing of Nafion™ PFSA membrane. The amount of local exhaust necessary for processing Nafion™ PFSA membrane at elevated temperatures will depend on the combined factors of membrane quantity, temperature, and exposure time.

### Scrap Disposal

Preferred disposal options are (1) recycling and (2) landfill. Incinerate only if incinerator is capable of scrubbing out hydrogen fluoride and other acidic combustion products. Treatment, storage, transportation, and disposal must be in accordance with applicable federal, state/provincial, and local regulations.

### Safe Handling and Use of Nafion™ PFSA Membranes

The following information should be reviewed before handling and processing Nafion™ PFSA membranes:

- Material Safety Data Sheet for Nafion™ PFSA membranes N115, N117, and N1110
- Nafion™ “Safety in Handling and Use” technical bulletin, T-01
- “Guide to Safe Handling of Fluoropolymer Resins”, Fourth Edition, November 2005, Published by the Fluoropolymers Division of the Society of the Plastics Industry, Inc.

The data listed here fall within the normal range of product properties, but they should not be used to establish specification limits nor used alone as the basis of design. This information is based on technical data that Chemours believes to be reliable. It is intended for use by persons having technical skill and at their own discretion and risk. This information is given with the understanding that those using it will satisfy themselves that their particular conditions of use present no health or safety hazards. Because conditions of product use are outside our control, Chemours makes no warranties, express or implied, and assumes no obligation or liability in connection with any use of this information or for results obtained in reliance thereon. The disclosure of the information is not a license to operate under or a recommendation to infringe any patent of Chemours or others.

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For more information about Nafion™, contact:

The Chemours Company FC, LLC  
Global Customer Service for IXM  
22828 NC Highway 87 W  
Fayetteville, NC 28306, USA

Telephone USA: (800) 283-2493  
Fax: (302) 861-3736  
Email: [customerservice.nafion@chemours.com](mailto:customerservice.nafion@chemours.com)  
Web: [chemours.com/Nafion](http://chemours.com/Nafion)

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