

# Duratherm\* HWS series

## hot water sanitization pure water elements

### description and use

The Duratherm\* HWS Series includes RO, NF, and UF membrane elements. This Series is specifically designed to maximize the benefits of hot water sanitization for industries relying on chemical free sanitization for product quality and/or industry compliance standard.

Separation system sanitization protocol is performed via periodic exposure to temperature as high as 195°F (90°C) at minimum feed pressure to kill microorganisms by denaturation and coagulation of the proteins chains.

The Duratherm HWS RO and HWS NF are suitable for separation systems purifying water at temperature up to 122°F (50°C) in low crossflow environment and no suspended solids.

This Series includes a variety of size 8", 4" and 2.5" diameters. All element constructions include Durasan\* Cage outer wrap, Polysulfone ATD and central tube.

### features and benefits

- Prevent bio-fouling development
- No disposal costs
- 100% wet testing Quality Assurance
- Durable construction
- Sanitization on the permeate side

### markets

- Food / Beverage
- BioPharm
- Electronics
- Chemical

**Table 1: Element Specification**

Membrane	A-Series, Thin-film membrane (TFM*) <sup>a,b</sup> D-Series, Thin-film membrane (TFM*) <sup>c</sup> P-Series, Polyethersulfone <sup>d</sup>
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a=HWS RO-HR, b=HWS RO, c=HWS NF, d=HWS UF

Model	Maximum Crossflow gpm (m3/h)	Average permeate flow gpd (m3/day)	Average salt rejection / MWCO
Duratherm HWS R02521 <sup>1,4</sup>	4 (0.9)	270 (1.0)	99.0%
Duratherm HWS R02540HR <sup>1,4</sup>	4 (0.9)	620 (2.3)	99.5%
Duratherm HWS R04040HR <sup>1,4</sup>	20 (4.5)	2,300 (8.7)	99.5%
Duratherm HWS R08040HR <sup>1,4</sup>	65 (14.8)	9,000 (34.1)	99.5%
Duratherm HWS R02540 <sup>2,4</sup>	4 (0.9)	760 (2.9)	99.0%
Duratherm HWS R04040 <sup>2,4</sup>	20 (4.5)	2,300 (8.7)	99.0%
Duratherm HWS R08040 <sup>2,4</sup>	65 (14.8)	9,000 (34.1)	99.0%
Duratherm HWS NF4040 <sup>3,4</sup>	20 (4.5)	2,100 (7.9)	96.0%
Duratherm HWS NF8040 <sup>3,4</sup>	65 (14.8)	9,000 (34.1)	96.0%
Duratherm HWS UF8040	65 (14.8)	--	10,000 Da

<sup>1</sup> Testing conditions: 2,000ppm NaCl solution at 225psig (1,550kPa) operating pressure, 77°F, pH7.5 and 15% recovery before any hot water sanitization.

<sup>2</sup> Testing conditions: 500ppm NaCl solution at 115psig (790kPa) operating pressure, 77°F, pH7.5 and 15% recovery before any hot water sanitization.

<sup>3</sup> Testing conditions: 2,000ppm MgSO4 solution at 110psig (760kPa) operating pressure, 77°F, pH7.5 and 15% recovery before any hot water sanitization

<sup>4</sup> Average salt rejections after 24 hours of operation.

Individual flow rate may vary +/-20%.

Final permeate flow rate is subject to variations in the heat treatments. In most cases, the permeate flow rate after heat treatments will stabilize below nominal flow rate before heat treatment at:

- 25% for the Duratherm HWS RO HR
- 30-50% for the Duratherm HWS RO, NF and UF.

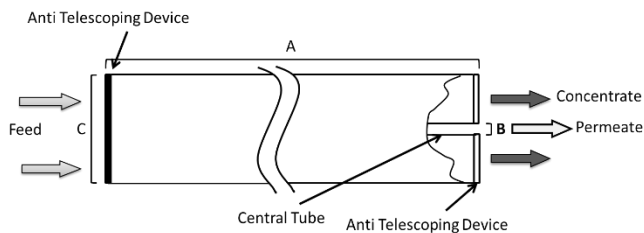
This is taken into consideration in Winflows Database 3.07 and later.

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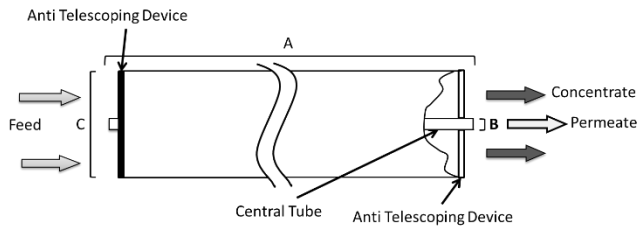
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Model	Active area ft <sup>2</sup> (m <sup>2</sup> )	Outer wrap	Part number
Duratherm HWS R02521	10 (1.0)	Cage	1229607
Duratherm HWS R02540HR	24 (2.2)	Cage	1263600
Duratherm HWS R04040HR	90 (8.4)	Cage	1263435
Duratherm HWS R08040HR	374 (34.8)	Cage	1263599
Duratherm HWS R02540	24 (2.2)	Cage	1228430
Duratherm HWS R04040	90 (8.4)	Cage	1228459
Duratherm HWS R08040	374 (34.8)	Cage	1228481
Duratherm HWS NF4040	90 (8.4)	Cage	1263437
Duratherm HWS NF8040	374 (34.8)	Cage	1262377
Duratherm HWS UF8040	348 (32.3)	Cage	1263602



**Figure 1a : Element Dimensions Diagram (Female) – 4040 & 8040**



**Figure 1b: Element Dimensions Diagram (Male) - 2540**

**Table 2: Dimensions and Weight**

Model <sup>1</sup>	Dimensions, inches (cm)			Boxed Weight lbs. (kg)
	A	B <sup>2</sup>	C <sup>3</sup>	
HWS 2521 Models	21.0 (533)	0.75 (1.90) OD	2.4 (6.1)	1.3 (0.6)
HWS 2540 Models	40.0 (101.6)	0.75 (1.90) OD	2.4 (6.1)	4 (1.8)
HWS 4040 Models	40.0 <sup>1</sup> (101.6)	0.625 (1.59)	3.9 (9.9)	9 (4.1)
HWS 8040 Models	40.0 (101.6)	1.125 (2.86)	7.9 (20.1)	29 (13.2)

<sup>1</sup>A includes the interconnector.

<sup>2</sup>Internal diameters unless specified OD (outside diameter).

<sup>3</sup>The element diameter (dimension C) is designed for optimum performance in SUEZ pressure vessels. Other pressure vessel dimension and tolerance may result in excessive bypass and loss of capacity

**Table 3: Temperatures**

**Do not exceed 20 GFD (34LMH) in any circumstances**

Model	Maximum operating temperature	Maximum cleaning temperature	Maximum sanitization temperature
Duratherm HWS RO HR	122°F (50°C)	122°F (50°C)	194°F (90°C)
Duratherm HWS RO	122°F (50°C)	122°F (50°C)	194°F (90°C)
Duratherm HWS NF	122°F (50°C)	113°F (40°C)	194°F (90°C)
Duratherm HWS UF	122°F (50°C)	122°F (50°C)	194°F (90°C)

**Table 4: Pressures and operating parameters**

Model	Max operating pressure 41–122°F (5–50°C)	Typical applied pressure	Rec. element recovery	Typical operating flux
Duratherm HWS RO HR	600psi (4,137kPa)	225psi (1,551kPa) <sup>a</sup>	<15%	10-18GFD (17-31LMH)
Duratherm HWS RO	600psi (4,137kPa)	225psi (1,551kPa) <sup>a</sup>	<15%	10-18GFD (17-31LMH)
Duratherm HWS NF	600psi (4,137kPa)	110psi (760kPa)	<15%	10-18GFD (17-31LMH)
Duratherm HWS UF	600psi (4,137kPa)	80psi (552kPa)	<15%	10-25GFD (17-40 LMH)

<sup>a</sup> Do not operate at T>50°C (Sanitizing only)

**Table 5: Operating and CIP parameters**

Model	pH range		Chlorine tolerance	Feed water
	Continuous Operation	Clean-in-Place (CIP)		
Duratherm HWS RO HR	4.0-11.0	2.0-11.5	500 ppm-hours <sup>1</sup>	NTU < 1 SDI < 5
Duratherm HWS RO	4.0-11.0	2.0-11.5	500 ppm-hours <sup>1</sup>	NTU < 1 SDI < 5
Duratherm HWS NF	3.0-9.0	2.0-10.5	500 ppm-hours <sup>1</sup>	NTU < 1 SDI < 5
Duratherm HWS UF	4.0-11.0	2.0-11.5	5,000+ ppm-days	NTU < 1 SDI < 5

<sup>1</sup> Dechlorination recommended

## hot water sanitization recommendations

For optimal performance, Duratherm HWS elements should always be cleaned using approved CIP procedures and flushed with fouling free water before the sanitization process. Feed pressure during sanitization should not exceed 40psi (275kPa) and the crossflow should not incur a pressure drop greater than 2psi (14kPa) per element. Heating rate to sanitizing temperature and cool down should not be faster than 5°C (9°F)/minute. Maximum sanitization temperature is 90°C (194°F).

## loss of permeate flow after repeated 90°C (194°F) sanitization cycles

It is almost impossible to exactly predict the percentage of permeate flow rate lost from the high temperature sanitations, which among other factors depends on:

- 1) Rate of temperature increase and decrease.
- 2) Presence of other species like organics, ionic and metallic compounds that could locally decrease or increase the temperature at the surface of the membrane.
- 3) Feed flow rate and specifically the heat transfer rate to the membrane surface.
- 4) The thickness and geometry of the feed spacer used.

At optimum conditions measured in controlled environment with deionized water, a loss of flow is observed before the element performance had stabilized after repeated heat treatments (over 90% of this flow reduction occurred during the first heat treatment). This loss of flow represents:

- maximum 25% for Duratherm HWS RO HR
- between 30% and 50% for Duratherm HWS RO, HWS NF, and HWS UF

With the loss of permeate flow rate, the salt rejection increases. The rate of cooling and heating was not more than 5°C (41°F) per minute, and the differential pressure drop per element did not exceed 2 psi.

Pilot testing based on the criteria noted above will give the best operating parameters for any specific application.

All the graphs below are RO Winflows simulations (Winflows 3.2.1 Database 3.07) which consider a 50% permeate flow loss for the HWS RO and 25% for HWS RO HR.

## salt rejection

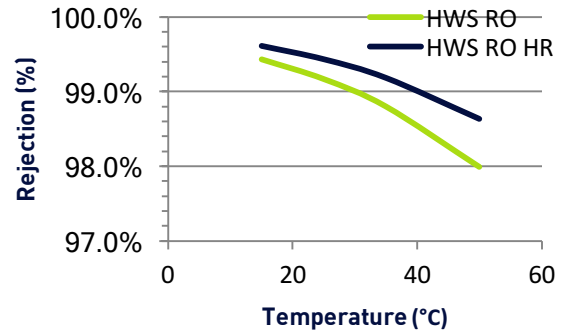


Figure 2: Simulated NaCl rejections with 2000 ppm NaCl at 15% recovery and 33 LMH

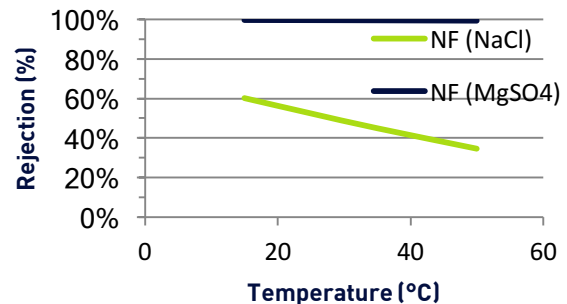


Figure 3: Simulated rejections for HWS NF with: 2000 ppm NaCl at 15% recovery and 33 LMH and 2000 ppm MgSO<sub>4</sub> at 15% recovery and 33 LMH