Duratherm* EXL Series

FACT SHEET

Industrial High Temperature Elements

Description and Use

The Duratherm EXL Series includes RO and NF membrane elements. These Series are specifically designed to maximize the benefits of hot water sanitization for industries relying on chemical-free sanitization for product quality and/or industry compliance standards.

The separation system sanitization protocol is performed via periodic exposure to temperature as high as 90°C (194°F) at minimum feed pressure to kill microorganisms by denaturation and coagulation of the proteins chains.

The Duratherm EXL elements are also suitable for separation systems at temperature up to 70°C (158°F).

All element constructions include polysulfone ATD & central tube and a patented Durasan* cage outer wrap.

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	Thin-film membrane (TFM*)

Model	Maximum crossflow gpm (m^3/hr)	Recommended crossflow	Salt rejection
Duratherm EXL RO2540HR	8 (1.8)		Figure 2
Duratherm EXL RO8040HR	100 (22.7)	Figure 7	Figure 2
Duratherm EXL NF2540HR	8 (1.8)		Figure 3, 4 & 5
Duratherm EXL NF4040HR	40 (9.1)	Figure 6	Figure 3, 4 & 5
Duratherm EXL NF4040	40 (9.1)	Figure 6	Figure 3, 4 & 5
Duratherm EXL NF8040HR	100 (22.7)	Figure 7	Figure 3, 4 & 5
Duratherm EXL NF8040	100 (22.7)	Figure 7	Figure 3, 4 & 5
Duratherm EXL UF2 8040	NA	NA	2,500 MWCO

Model	Spacer mil (mm)	Active area ft^2 (m^2)	Part number
Duratherm EXL RO2540HR	50 (1.27)	18 (1.7)	1228306
Duratherm EXL RO8040HR	50 (1.27)	275 (25.5)	1228840
Duratherm EXL NF2540HR	50 (1.27)	18 (1.7)	1206922
Duratherm EXL NF4040HR	50 (1.27)	65 (6.0)	1206950
Duratherm EXL NF4040	50 (1.27)	65 (6.0)	1207032
Duratherm EXL NF8040HR	50 (1.27)	280 (26.0)	1206982
Duratherm EXL NF8040	50 (1.27)	280 (26.0)	1207045
Duratherm EXL UF2 8040	50 (1.27)	280 (26.0)	3002290

Table 2: Maximum Pressure Drops

Range	0°C-50°C psig (kPa)	51°C-70°C psig (kPa)
Over an element	15 (103)	7 (48)
Per housing	60 (414)	30 (207)

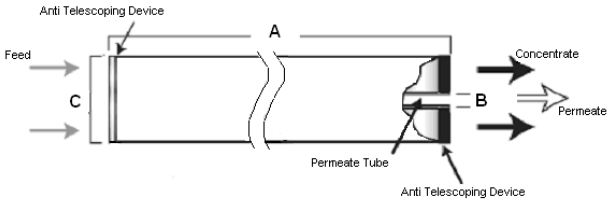

Figure 1A: Element Dimensions Diagram – Female

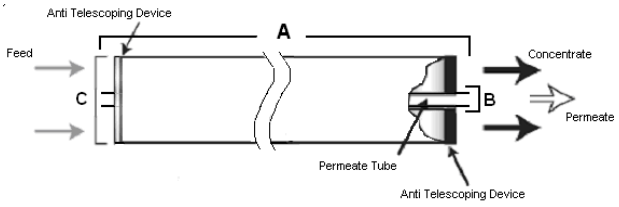

Figure 1B: Element Dimensions Diagram – Male

Table 3: Dimensions and Weight

Model[2]	Dimensions, inches (cm)			Boxed Weight lbs (kg)
	A	B[1]	C[3]	
XX 2540	40.0 (101.6)	0.75 (1.91)	2.43 (6.17)	4 (1.8)
XX 4040	40.0 (101.6)	0.625 (1.59)	3.9 (9.9)	9 (4.1)
XX 8040	40.0 (101.6)	1.125 (2.86)	7.9 (20.1)	29 (13.2)

[1]Internal diameter.
[2]These elements are dried then bagged before shipping.
[3]The element diameter (dimension C) is designed for optimum performance in Veolia pressure vessels. Others pressure vessel dimension and tolerance may result in excessive bypass and loss of capacity.

Table 4: Operating and CIP Parameters

Do not exceed 20 GFD (33 LMH) or 2,000 Wagner units under any circumstance.

Typical Operating Pressure	Figures 9 & 10	
Maximum Operating Pressure	1,200 psi (8,273 kPa) 600 psi (4,137 kPa) 400 psi (2,758 kPa) Hot Water Sanitizing	32 – 77°F (0 – 25°C) 78 – 122°F (26 – 50°C) 123 – 158°F (51 – 70°C) 158 – 194°F (70 – 90°C)
Maximum Temperature	Continuous Operation: 158°F (70°C) Clean-In-Place (CIP): 122°F (50°C) Hot Water Sanitizing: 194°F (90°C)	
pH range	Continuous Operation: 3 – 9 clean-In- Place (CIP): 2 – 10.5	
Chlorine Tolerance	500 ppm hours dechlorination recommended	
Feedwater	NTU < 1 SDI < 5	

Hot Water Sanitization Recommendations

Prior to first use, new elements must be flushed with clean water[1] to remove any residual chemicals for at least an hour, at a transmembrane pressure of not more than 45 psi (3 bar). The system must be started and in operation for minimum 24 hours prior to hot water sanitization.

If the new elements are to be hot water sanitized before first use, the system must be flushed at low transmembrane pressure (up to 45 psi (3 bar)), for minimum 24 hours prior to sanitization.

Transmembrane pressure during hot water sanitization should also be maintained as low as possible, not exceeding 45 psi (3 bar), while ensuring some permeate flow for effective sanitization on the permeate side.

The cross flow to the system should be monitored and adjusted so that the pressure drop is not more than 2 psi per element or 10 psi per housing.

The following procedure should be followed step by step for the hot water sanitization of Duratherm elements.

1. The elements that have been in operation should be cleaned with approved Clean In Place (CIP) procedure to remove any mineral scales or organic foulants, and then be thoroughly flushed for at least an hour before sanitization.
2. Increase the temperature in the system from room temperature to target sanitization temperature[2] (up to 90°C/194°F) at a rate not higher than 5°C/9°F per minute. Maintain the target temperature for 30 to 60 minutes.
3. Cool the system to room temperature at a rate not higher than 5°C/9°F per minute.

[1]RO permeate is strongly preferred when available. Feedwater which does not foul or form scale on membrane can also be used but only after appropriate filtration. Note that the solubility of some inorganics, for example calcium carbonate and at least above 45°C calcium sulfate, decreases with increasing temperature.

[2]The effectiveness of heat sanitizing is a function of temperature and time. Duratherm elements can withstand 90°C hot water sustained for over 60 minutes, but there is no gain by maintaining the high temperature for longer time than needed to deactivate the microbes that will be deactivated at the chosen temperature.

Loss of permeate flow after repeated 90ºc (194ºf) 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:

- The rate of temperature increase and decrease.
- The presence of other species like organics, ionic and metallic compounds that could locally decrease or increase the temperature at the surface of the membrane.
- The feed flow rate and specifically the heat transfer rate to the membrane surface.
- The thickness and geometry of the feed spacer used.

At optimum conditions measured in controlled environment with deionized water, between 30% and 50% of the original permeate flow rate was lost before the element performance had stabilized after repeated heat treatments (over 90% of this flow reduction occurred during the first heat treatment). With the loss of permeate flow rate, the salt rejection increases. The rate of cooling and heating was not more than 5°C (9ºF) 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.

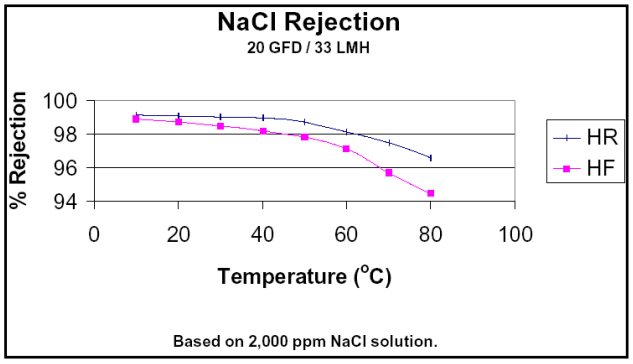

Figure 2: Typical NaCl Rejection dependence on Temperature of Duratherm EXL RO Element

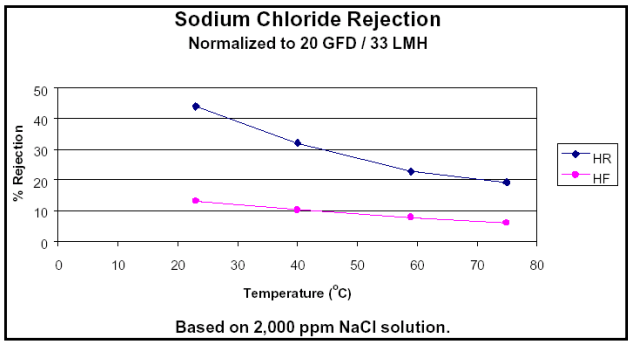

Figure 3: Typical NaCl Rejection dependence on Temperature of Duratherm EXL NF Element

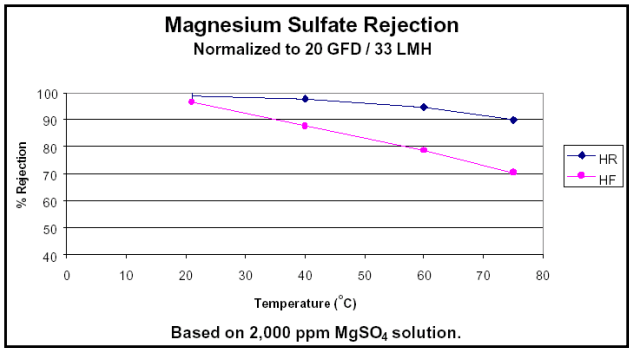

Figure 4: Typical $MgSO_4$ Rejection dependence on Temperature of Duratherm EXL NF Elements

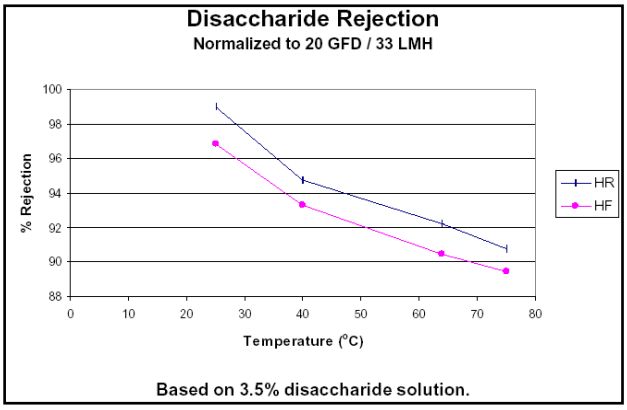

Figure 5: Typical Disaccharide Rejection dependence on Temperature of Duratherm EXL NF Elements

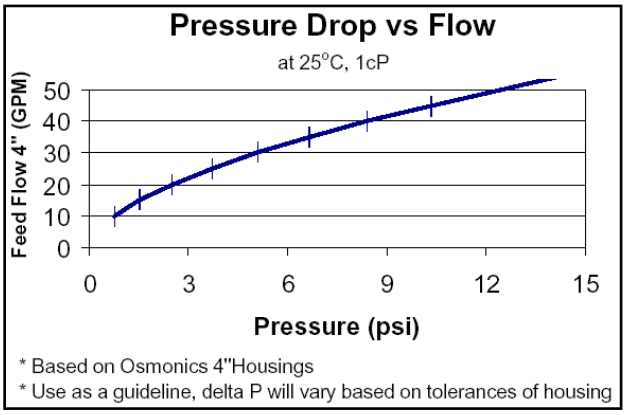

Figure 6: Pressure Drop for 4" Element

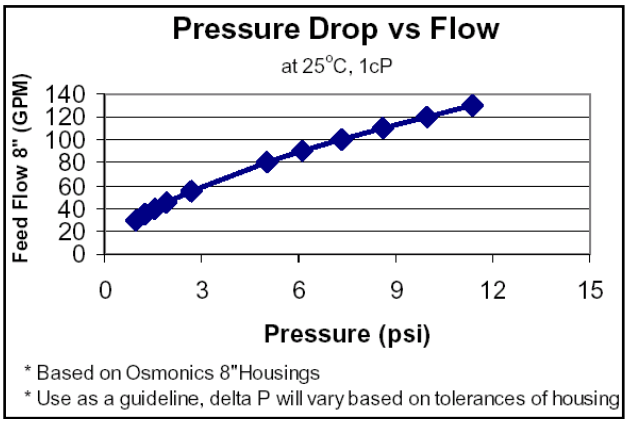

Figure 7: Pressure Drop for 8" Element

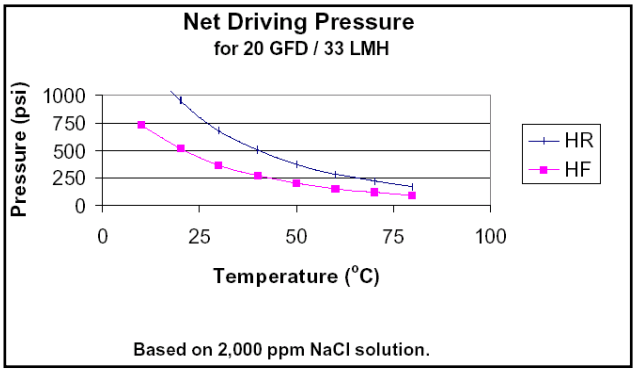

Figure 8: Net Driving Pressure for Duratherm EXL RO Element

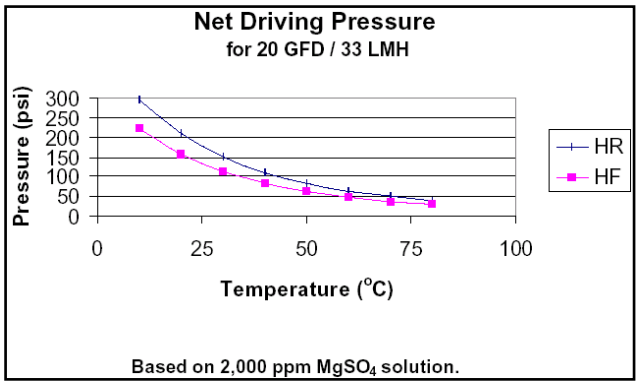

Figure 9: Net Driving Pressure for Duratherm EXL NF Element

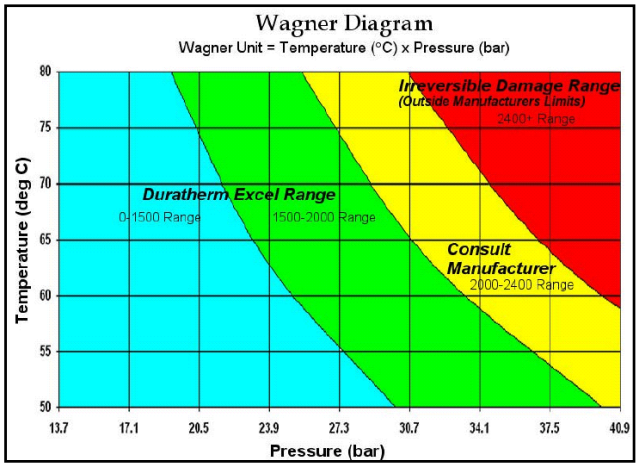

Figure 10