



# DOW FILMTEC™ Membranes

## System Design: Membrane System Design Guidelines

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### Membrane System Design Guidelines

The factor which has the greatest influence on a membrane system design is the fouling tendency of the feed water. Membrane fouling is caused by dissolved organics, bacteria, particles and colloidal material which are present in the feed water and are concentrated at the membrane surface. The Silt Density Index (SDI) value of the pretreated feed water is often used as a surrogate measure of the fouling material present. The concentration of the fouling materials at the membrane surface increases with increasing permeate flux (the permeate flow rate per unit membrane area) and increasing FILMTEC™ element recovery (the ratio of permeate flow rate to feed flow rate for a single element). A system with high permeate flux rates is, therefore, likely to experience higher fouling rates and require more frequent chemical cleaning.

A membrane system should be designed such that each element of the system operates within a recommended range of operating conditions to minimize the fouling rate and to exclude mechanical damage. These element operating conditions are limited by the maximum recovery, the maximum permeate flow rate, the minimum concentrate flow rate and the maximum feed flow rate per element: the higher the fouling tendency of the feed water, the more conservative the limits of these parameters. The proposed limits are recommended guidelines based on many years of experience with FILMTEC membranes.

The average flux of the entire system, i.e. the system permeate flow rate related to the total active membrane area of the system, is a characteristic number of a design. The system flux is a useful number to quickly estimate the required number of elements for a new project. Systems operating on high quality feed waters are typically designed at high flux values whereas systems operating on poor quality feed waters are designed at low flux values. However, even within the same feed water category, systems are designed with higher or lower flux values, depending on the focus being either on minimizing the capital expenses or minimizing the long-term operational expenses. The ranges of flux values given in the tables below are typical numbers for the majority of systems, but they are not meant to be limits.

A continuous RO/NF process designed according to the system design guidelines and with a well-designed and operated pretreatment system will show stable performance with no more than about four cleanings per year in standard applications. Exceeding the recommended limits may result in more frequent cleanings, reduced capacity, increased feed pressure and reduced membrane life. A moderate violation of the limits for a short time may be acceptable as long as the physical limits—the maximum pressure drop and the maximum feed pressure—are not exceeded. On the other hand, a conservative approach is to anticipate a higher fouling tendency and to design the system according to the stricter limits in order to enjoy a trouble-free system operation and an increased membrane life.

## Membrane System Design Guidelines for 8-Inch FILMTEC™ Elements

The following tables show the recommended guidelines for designing RO systems with 8-inch FILMTEC™ elements according to feed water type.

**Table 3.4 Design guidelines for 8-inch FILMTEC elements in water treatment applications**

Feed source	RO Permeate	Well Water	Surface Water			Wastewater (Filtered Municipal Effluent or Industrial Effluent)			Seawater		
			Surface Water with Dow Ultrafiltration	Generic membrane filtration or advanced conventional pretreatment	Generic conventional pretreatment	Dow Ultrafiltration	Generic membrane filtration (MBR/MF/UF)	Conventional pretreatment	Well or Open Intake with Dow Ultrafiltration	Open Intake with generic membrane filtration or advanced conventional pretreatment	Open intake with generic conventional pretreatment
Feed silt density index (%/min)	SDI < 1	SDI < 3	SDI < 2.5	SDI < 3	SDI < 5	SDI < 2.5	SDI < 3	SDI < 5	SDI < 2.5	SDI < 3	SDI < 5
Maximum element recovery %	30	19	19	17	15	14	13	12	15	14	13
Active Membrane Area	Maximum permeate flow rate, gpd or maximum permeate flux, gfd										
365 ft <sup>2</sup> elements	10,200	8,500	8,500	7,200	6,600	6,300	5,900	5,200	— Not Recommended —		
370 ft <sup>2</sup> elements	10,200	8,500	8,500	7,200	6,600	6,300	5,900	5,200	7,800	7,400	7,000
380 ft <sup>2</sup> elements	10,700	8,900	8,900	7,500	6,900	6,500	6,000	5,300	7,900	7,600	7,200
390 ft <sup>2</sup> elements	10,920	9,200	— Not Recommended —			— Not Recommended —			— Not Recommended —		
400 ft <sup>2</sup> elements	11,200	9,300	9,300	7,900	7,300	6,800	6,400	5,700	8,400	8,000	7,600
440 ft <sup>2</sup> elements	12,300	10,300	10,300	8,700	8,000	7,600	7,100	6,300	9,200	8,800	8,360
<b>Maximum element flux (gfd)</b>	<b>28</b>	<b>22.7</b>	<b>22.7</b>	<b>20</b>	<b>18</b>	<b>17</b>	<b>16</b>	<b>14</b>	<b>21</b>	<b>20</b>	<b>19</b>
<i>Design Flux range</i>	<b>21-25</b>	<b>16-20</b>	<b>16-20</b>	<b>13-17</b>	<b>12-16</b>	<b>11-15</b>	<b>10-14</b>	<b>8-12</b>	<b>9-11</b>	<b>8-10</b>	<b>7-10</b>
Element type	Minimum concentrate flow rate <sup>2</sup> , gpm (m <sup>3</sup> /h)										
BW elements (365 ft <sup>2</sup> )	10 (2.3)	13 (3.0)	13 (3.0)	13 (3.0)	15 (3.4)	16 (3.6)	16 (3.6)	18 (4.1)	— Not Recommended —		
BW elements (400 ft <sup>2</sup> and 440 ft <sup>2</sup> )	10 (2.3)	13 (3.0)	13 (3.0)	13 (3.0)	15 (3.4)	18 (4.1)	18 (4.1)	20 (4.6)	— Not Recommended —		
NF elements	10 (2.3)	13 (3.0)	13 (3.0)	13 (3.0)	15 (3.4)	18 (4.1)	18 (4.1)	18 (4.1)	— Not Recommended —		
Full-fit elements	25 (5.7)	25 (5.7)	— Not Recommended —			— Not Recommended —			— Not Recommended —		
SW elements	10 (2.3)	— NR —	— Not Recommended —			— Not Recommended —			13 (3.0)	14 (3.2)	15 (3.4)
Element type Active area ft <sup>2</sup> (m <sup>2</sup> )	Maximum feed flow rate <sup>2</sup> , gpm (m <sup>3</sup> /h)										
BW elements 365 (33.9)	65 (15)	65 (15)	65 (15)	63 (14)	58 (13)	52 (12)	52 (12)	52 (12)	— Not Recommended —		
BW/NF elements 400 (37.2)	75 (17)	75 (17)	75 (17)	73 (17)	67 (15)	61(14)	61(14)	61(14)	— Not Recommended —		
BW elements 440 (40.9)	75 (17)	75 (17)	75 (17)	73 (17)	67 (15)	61(14)	61(14)	61(14)	— Not Recommended —		
Full-fit elements 390 (36.2)	85 (19)	75 (17)	— Not Recommended —			— Not Recommended —			— Not Recommended —		
SW elements 370 (34.4)	65 (15)	— NR —	— Not Recommended —			— Not Recommended —			63 (14)	60 (13.5)	56 (13)
SW elements 380 (35.3)	72 (16)	— NR —	— Not Recommended —			— Not Recommended —			70 (16)	66 (15)	62 (14)
SW elements 400 (37.2)	72 (16)	— NR —	— Not Recommended —			— Not Recommended —			70 (16)	66 (15)	62 (14)

For more information about DOW FILMTEC™ membranes, including all scientific data and supporting reference materials, call the Dow Water and Process Solutions business: North America: 1-800-447-4369; Pacific: +60 3 7958 3392; Latin America: (+55) 11-5188-9222; Japan: +813 5460 2100; Europe: (+32) 3-450-2240; China: +86 21 2301 1000. Or visit our website at [dowwaterandprocess.com](http://dowwaterandprocess.com).

NOTICE: The use of this product in and of itself does not necessarily guarantee the removal of cysts and pathogens from water. Effective cyst and pathogen reduction is dependent on the complete system design and on the operation and maintenance of the system.

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